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

BETA MDCR and MDC Calculations			
Survey Speed:		MDCR =	
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	
Type/Serial #:	Ludlum 2929/176108
Probe/Serial #:	43-10-1/181905
Calibration Due Date:	April 30 2014

Source Information	Alpha	Beta
Initial Source Activity (A_o) (dpm)	17610	28510
Source ID	A2-743	A2-771
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		BETA	
Count #	Bkgrd Counts/minute	Srce Counts/minute	Bkgrd Counts/minute	Srce Counts/minute
1	0	13873	35	11178
2	0	13838	34	11281
3	0	13901	42	11589
4	0	14037	38	11390
5	1	13524	43	11375
6	0	13861	31	11500
7	0	13686	44	11529
8	0	13721	38	11184
9	0	13846	36	11114
10	2	13882	49	11316
11	0	13606	34	11240
12	0	13723	32	11038
13	0	13798	26	11066
14	0	13736	30	11060
15	0	13860	41	11361
16	2	13916	37	11218
17	0	13937	46	11079
18	0	13769	37	11349
19	0	13639	44	11150
20	0	13659	34	11105
SUM	5	275812	751	225122
Average	0.25	13790.60	37.55	11256.10

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

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
2π emission rate	17,608	28,509

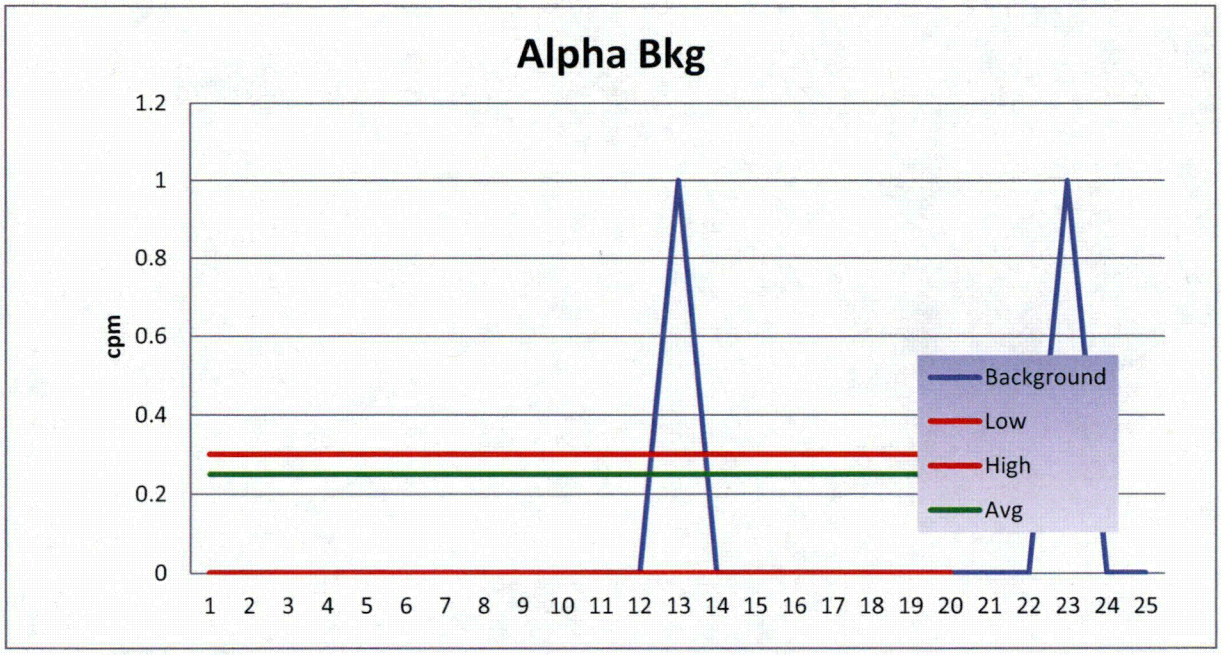
DATE	TIME	BKG CPM Alpha	Beta	SOURCE CPM Alpha	Beta	COMMENTS	Tech Initials
1/27/2014	7:00:00 AM	0	45	13758	11091		AM
1/28/2014	7:00:00 AM	0	36	13661	11354		AM
1/29/2014	7:00:00 AM	0	37	14501	11086		AM
1/30/2014	7:00:00 AM	0	42	13249	11495		AM
1/31/2014	7:00:00 AM	0	38	14659	11752		AM
2/3/2014	7:00:00 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

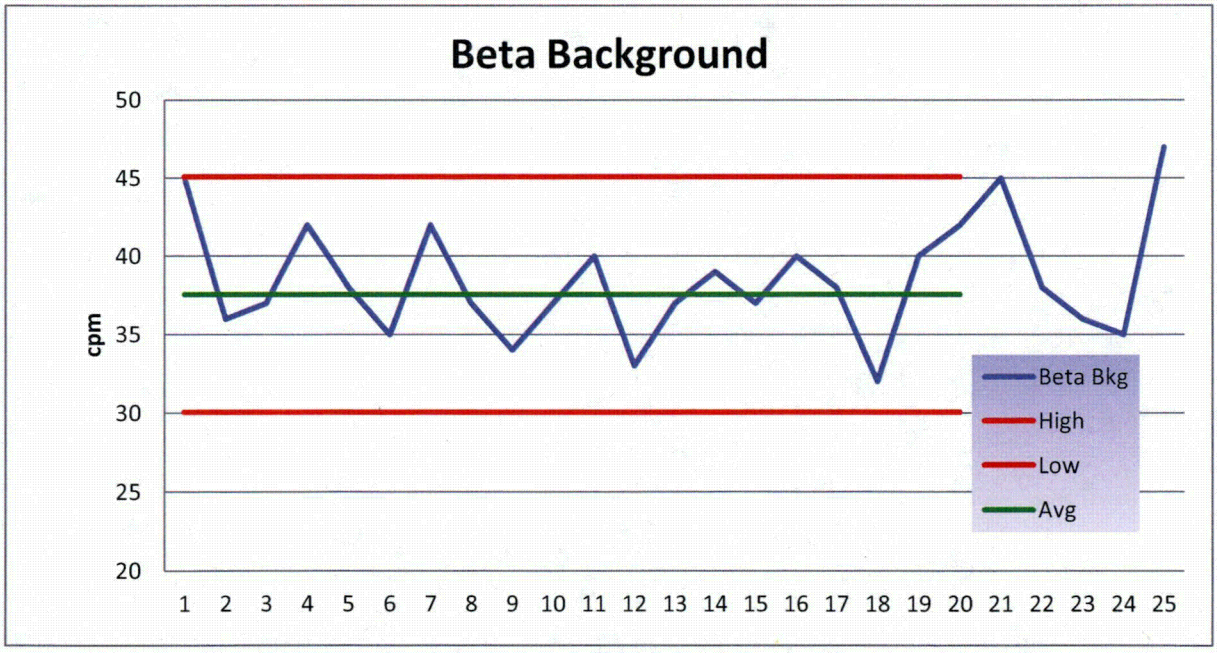
Mean from form RS-013.0-1 Background			Mean from form RS-013.0-1 Source		
	0	Alpha		13790.6	Alpha
	37.55	Beta		11213	Beta

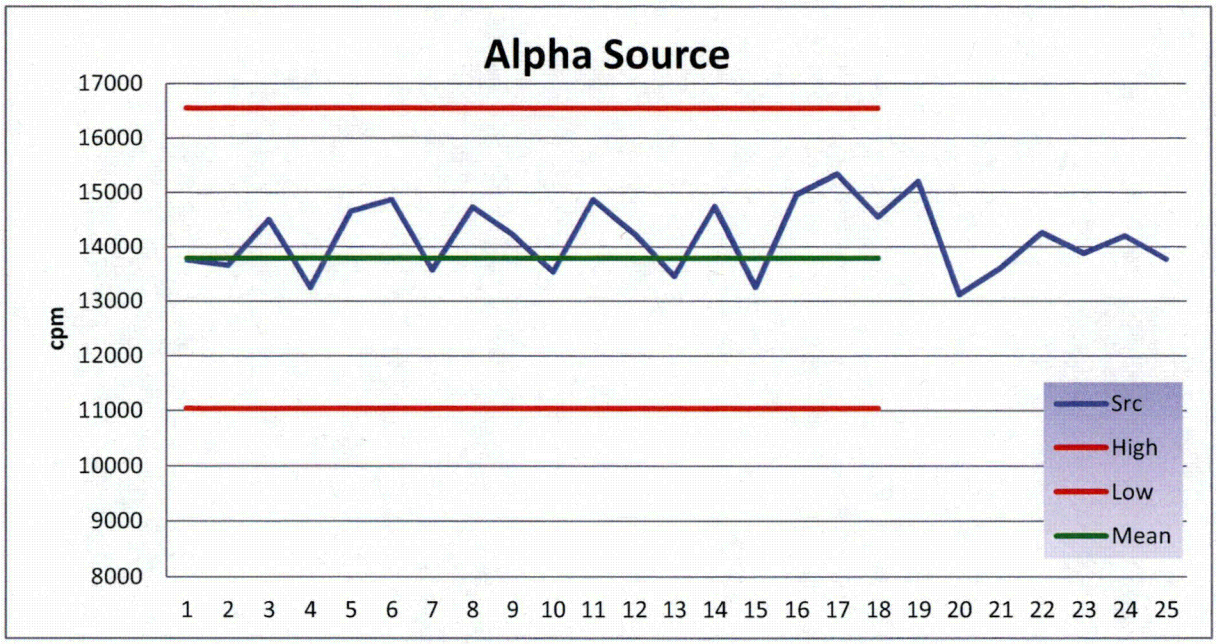
Background Acceptance Limits				
M-20%	0.2	M+20%	0.3	Alpha
M-20%	30	M+20%	45	Beta

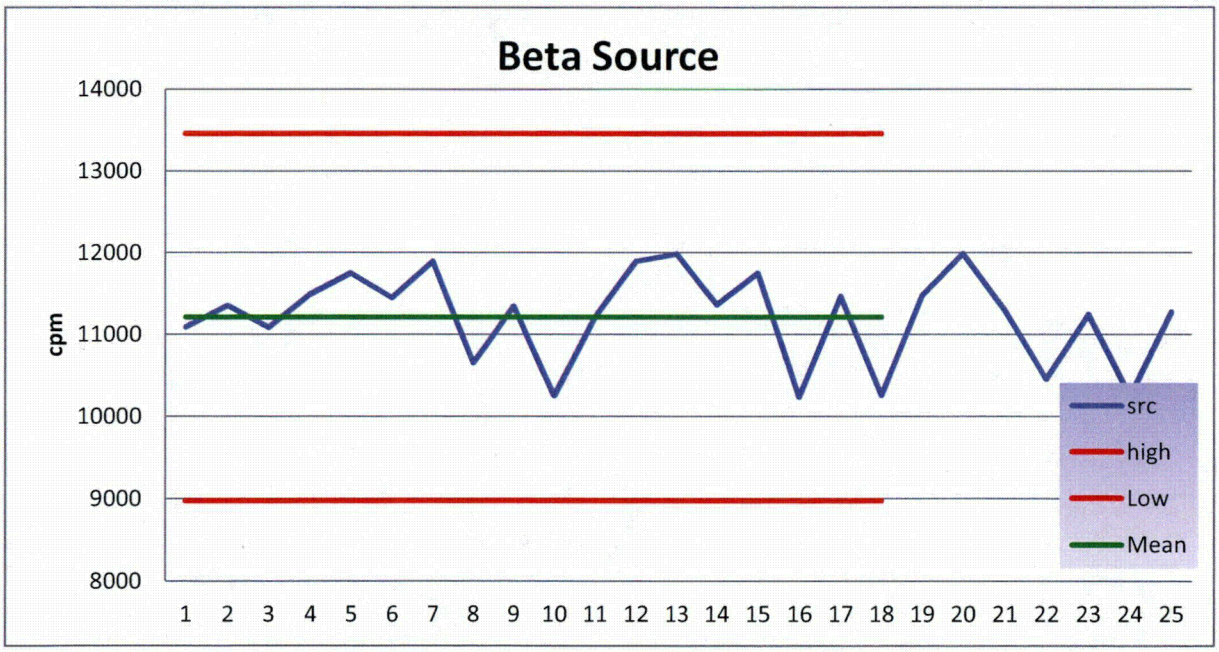
Source Acceptance Limits				
M-20%	11032	M+20%	16549	Alpha
M-20%	8970	M+20%	13456	Beta

Reviewed by: Date:


Alpha Bkg
cpm
1.2
1
0.8
0.6
0.4
0.2
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
Background
Low
High
Avg


Beta Background
cpm
50
45
40
35
30
25
20
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
Beta Bkg
High
Low
Avg


Alpha Source
17000
16000
15000
14000
13000
12000
11000
10000
9000
8000
cpm
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
Src
High
Low
Mean


Beta Source
14000
13000
12000
11000
10000
9000
8000
cpm
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
src
high
Low
Mean

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

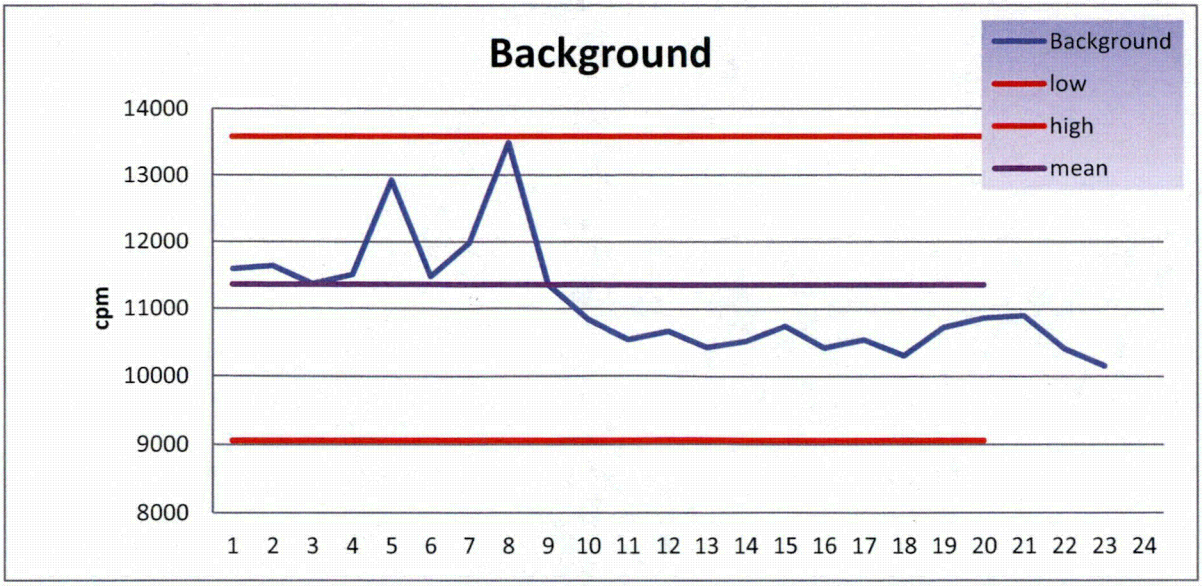
Mean from form RS-013.0-1 Background: 0 / 11376.45 gamma

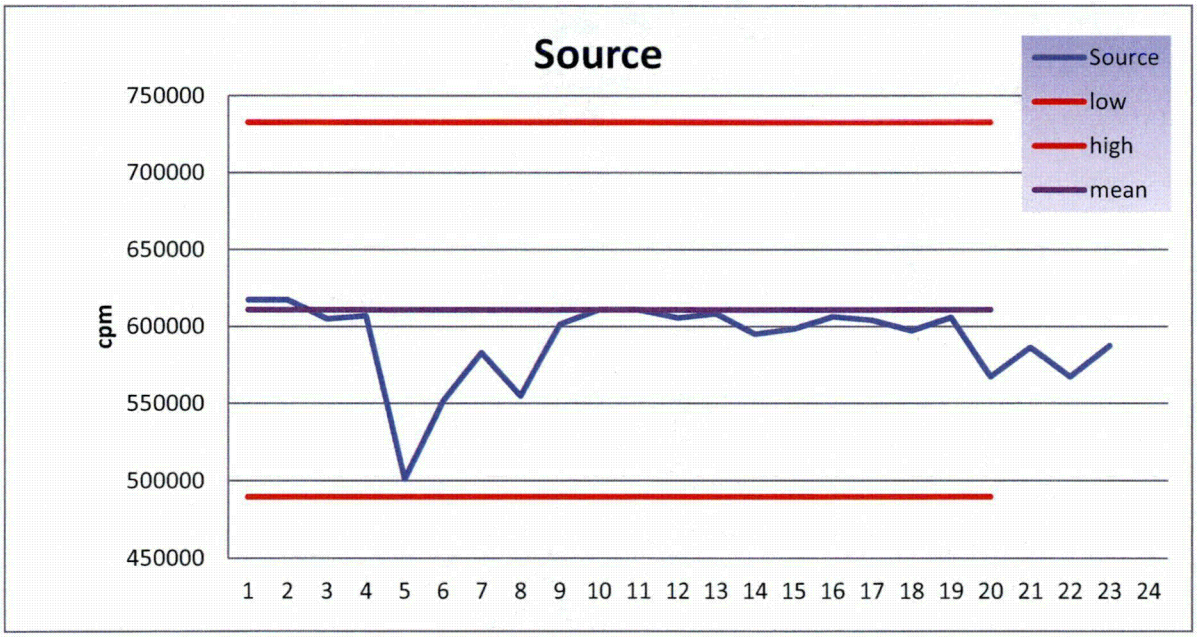
Mean from form RS-013.0-1 Source: 0 / 610840.8 gamma

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: _____


Background
Background
low
high
mean
14000
13000
12000
11000
10000
9000
8000
cpm
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24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Source
low
high
mean
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700000
650000
600000
550000
500000
450000
cpm
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24

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

Source Information		Gamma
Initial Source Activity (A_o) (dpm)		
Source ID		
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		BETA	
Count #	Bkgrd Counts/minute	Srce Counts/minute	Bkgrd Counts/minute	Srce Counts/minute
1	N/A	N/A	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	0	0
Average	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

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

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

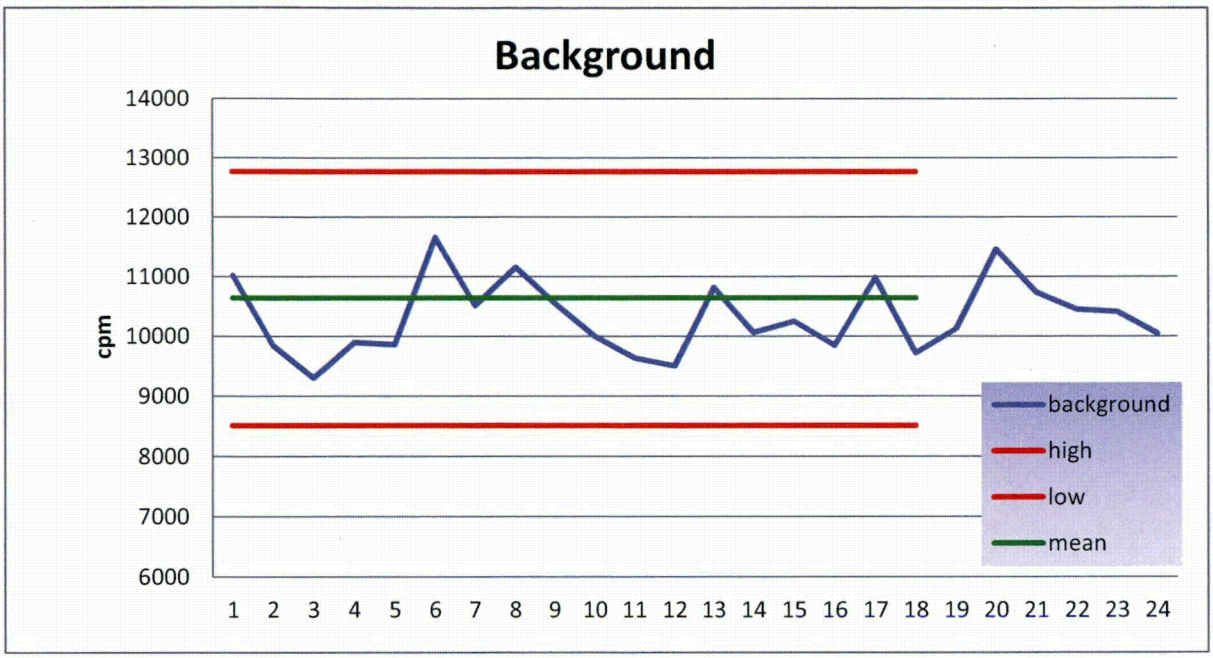
DATE	TIME	BACKGROUND CPM Gamma	SOURCE CPM Gamma	COMMENTS	Tech Initials
1/9/2014	7:00	11022	501249		ALR
1/13/2014	7:00	9849	410284		SRR
1/14/2014	7:00	9305	430872		SRR
1/15/2014	7:00	9895	445126		SRR
1/16/2014	7:00	9856	488558		SRR
1/17/2014	7:00	11658	500557		SRR
1/20/2014	7:00	10510	457286		SRR
1/21/2014	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

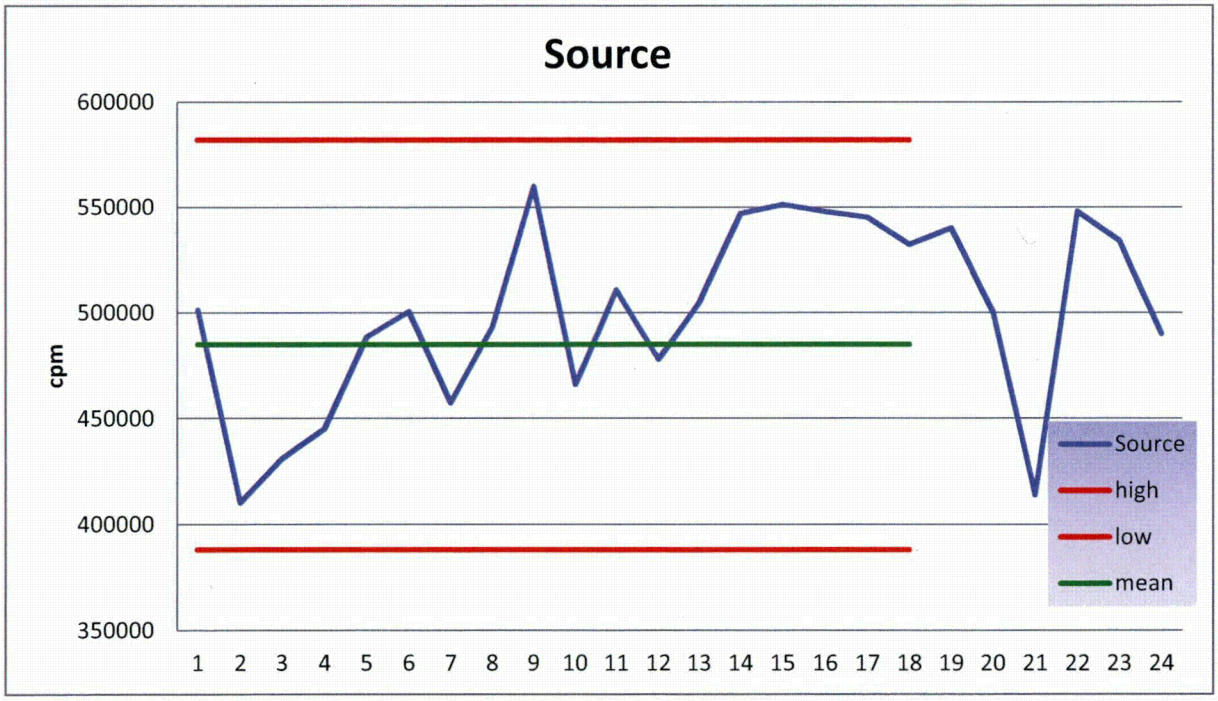
Mean from form RS-013.0-1 Background			Mean from form RS-013.0-1 Source		
0	Alpha		0	Alpha	
10638.5	Gamma		484908.9	Gamma	

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: _____


Background
cpm
14000
13000
12000
11000
10000
9000
8000
7000
6000
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
background
high
low
mean


Source
cpm
600000
550000
500000
450000
400000
350000
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Source
high
low
mean

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			

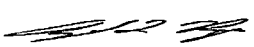
If data type is a background for a specific material, list the material type =

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

Source Information		Gamma
Initial Source Activity (A_o) (dpm)		
Source ID		
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		BETA	
Count #	Bkgrd Counts/minute	Srce Counts/minute	Bkgrd Counts/minute	Srce Counts/minute
1	N/A	N/A	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	0	0
Average	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

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

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:** 1/14-2/14

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
2/14/2014	7:00	9782	553688		AO
2/17/2014	7:00	9601	552718		AO
2/18/2014	7:00	9868	547461		AO
2/19/2014	7:00	9823	535964		AO
2/20/2014	7:00	9832	513391		AO
2/21/2014	7:00	9795	548275		AO
2/24/2014	7:00	9918	549958		AO
2/25/2014	7:00	10024	518410		AO
2/26/2014	7:00	9825	534070		AO
2/27/2014	7:00	9951	556236		AO
3/3/2014	7:00	9800	544719		AO

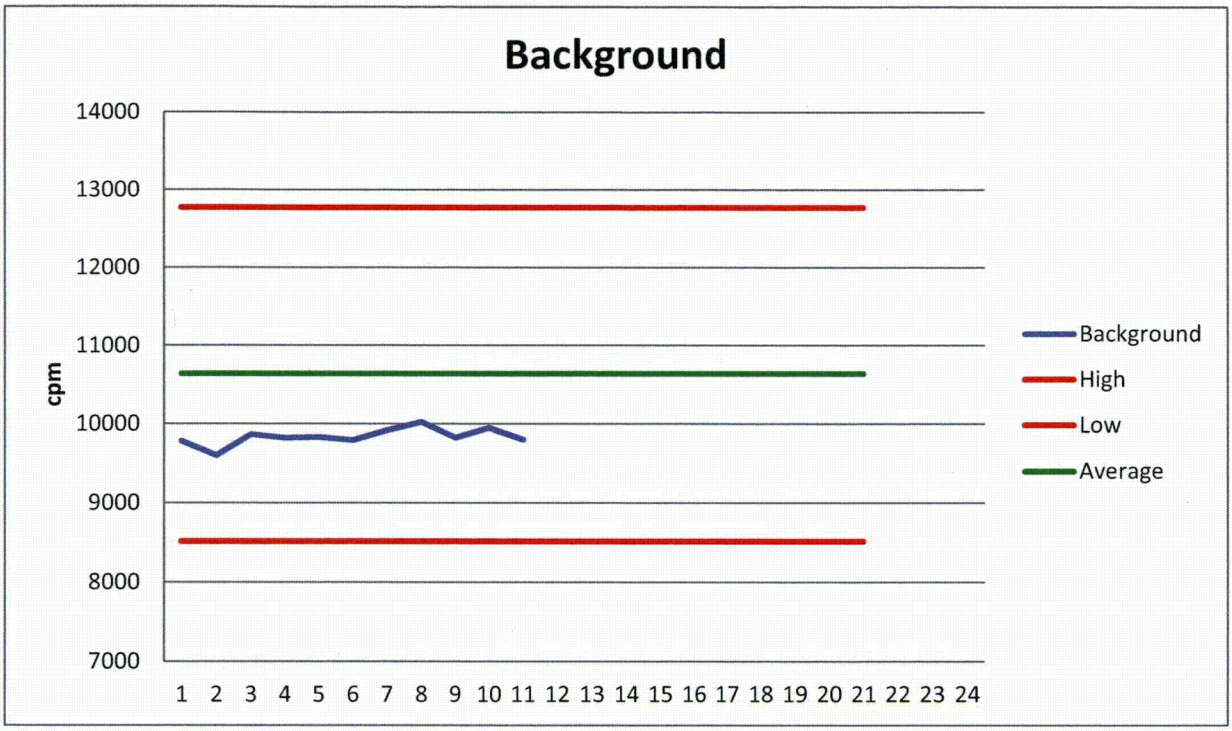
Mean from form RS-013.0-1 Background		
	0	Alpha
	10638.5	Gamma

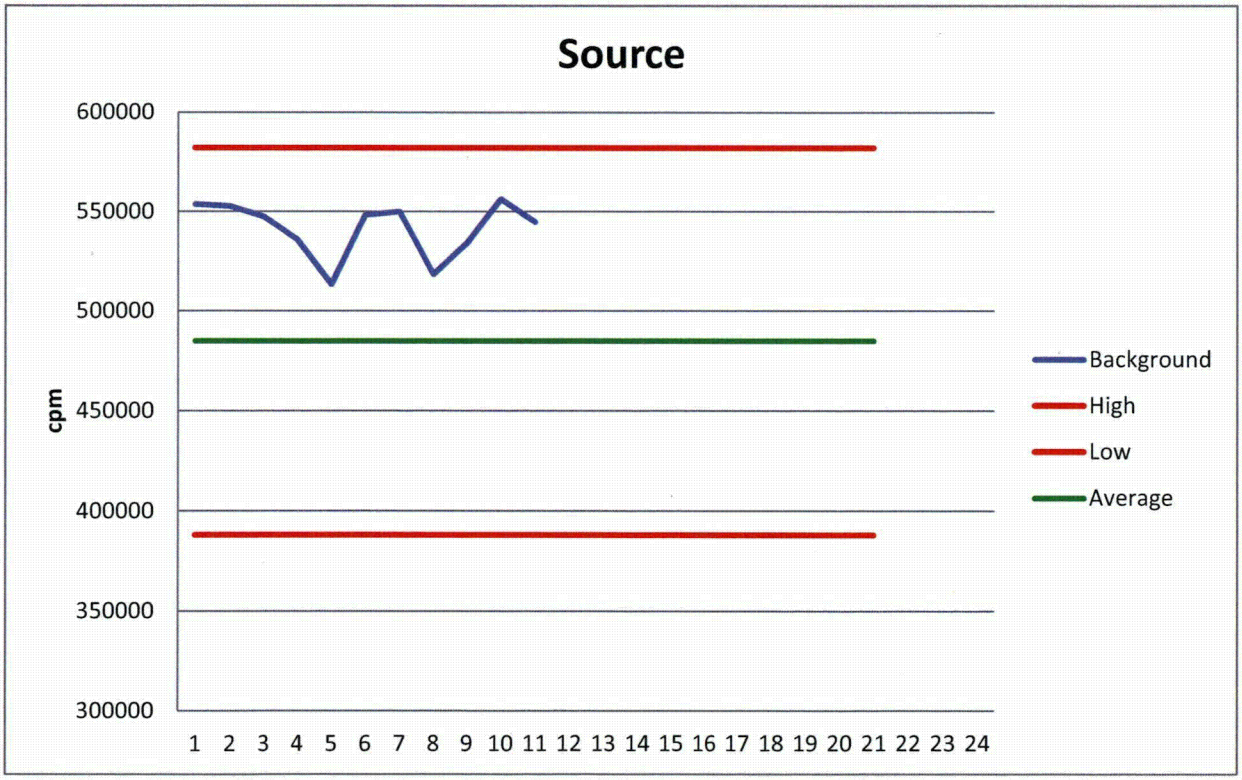
Mean from form RS-013.0-1 Source		
	0	Alpha
	484908.9	Gamma

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: _____


Background
14000
13000
12000
11000
10000
9000
8000
7000
cpm
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Background
High
Low
Average


Source
600000
550000
500000
450000
400000
350000
300000
cpm
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Background
High
Low
Average

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:

INSTRUMENT EFFICIENCY CALCULATION
Form RS-013.0-2

SITE: GKP **Date:** 12/17/13 **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		Beta
Initial Source Activity (A_o) (dpm)		
Source ID		
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		BETA	
Count #	Bkgrd Counts/minute	Srce Counts/minute	Bkgrd Counts/minute	Srce Counts/minute
1	N/A	N/A	N/A	N/A
2	N/A	N/A	N/A	N/A
3	N/A	N/A	N/A	N/A
4	N/A	N/A	N/A	N/A
5	N/A	N/A	N/A	N/A
6	N/A	N/A	N/A	N/A
7	N/A	N/A	N/A	N/A
8	N/A	N/A	N/A	N/A
9	N/A	N/A	N/A	N/A
10	N/A	N/A	N/A	N/A
11	N/A	N/A	N/A	N/A
12	N/A	N/A	N/A	N/A
13	N/A	N/A	N/A	N/A
14	N/A	N/A	N/A	N/A
15	N/A	N/A	N/A	N/A
16	N/A	N/A	N/A	N/A
17	N/A	N/A	N/A	N/A
18	N/A	N/A	N/A	N/A
19	N/A	N/A	N/A	N/A
20	N/A	N/A	N/A	N/A
SUM	0	0	0	0
Average	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

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

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

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

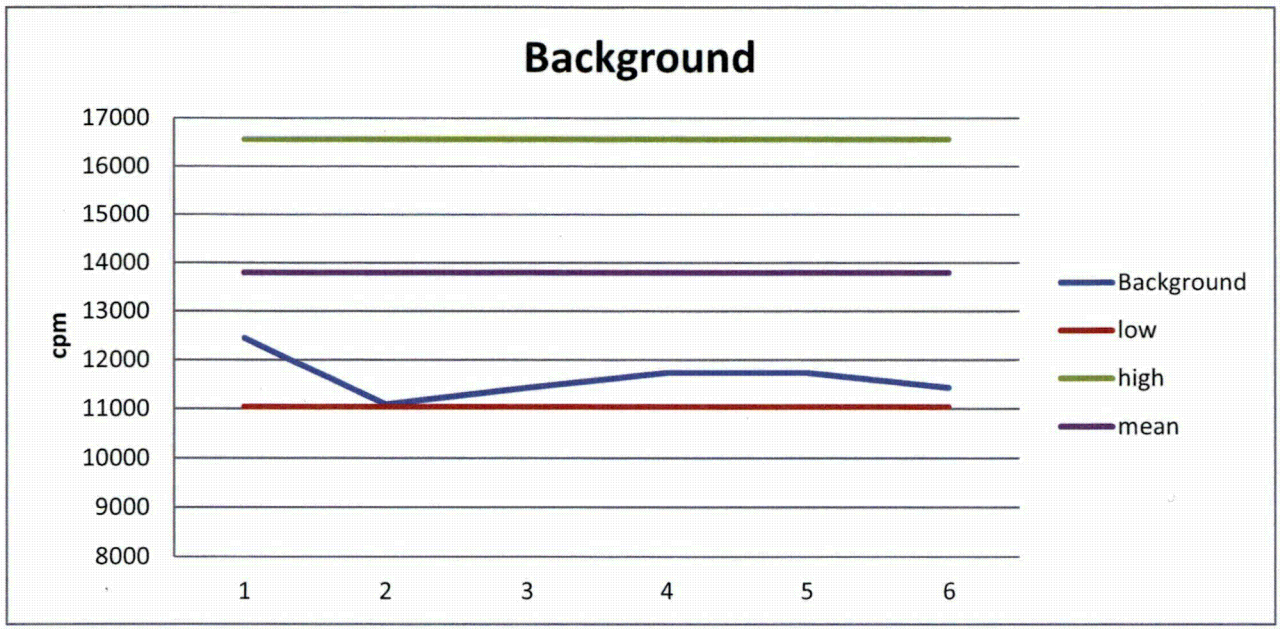
DATE	TIME	BACKGROUND CPM Gamma	SOURCE CPM Gamma	COMMENTS	Tech Initials
1/9/2014	7:00	12456	461778		ALR
1/13/2014	7:00	11095	450544		SRR
1/14/2014	7:00	11436	451638		SRR
1/15/2014	7:00	11739	402776		SRR
1/15/2014	7:00	11739	461732		SRR
1/16/2014	7:00	11432	488961		SRR
1/17/2014	7:00	Out of Service	Out of Service	Out of Service	SRR
1/20/2014	7:00	Out of Service	Out of Service	Out of Service	SRR
1/21/2014	7:00	Out of Service	Out of Service	Out of Service	SRR
1/23/2014	7:00	Out of Service	Out of Service	Out of Service	SRR
1/24/2014	7:00	Out of Service	Out of Service	Out of Service	SRR

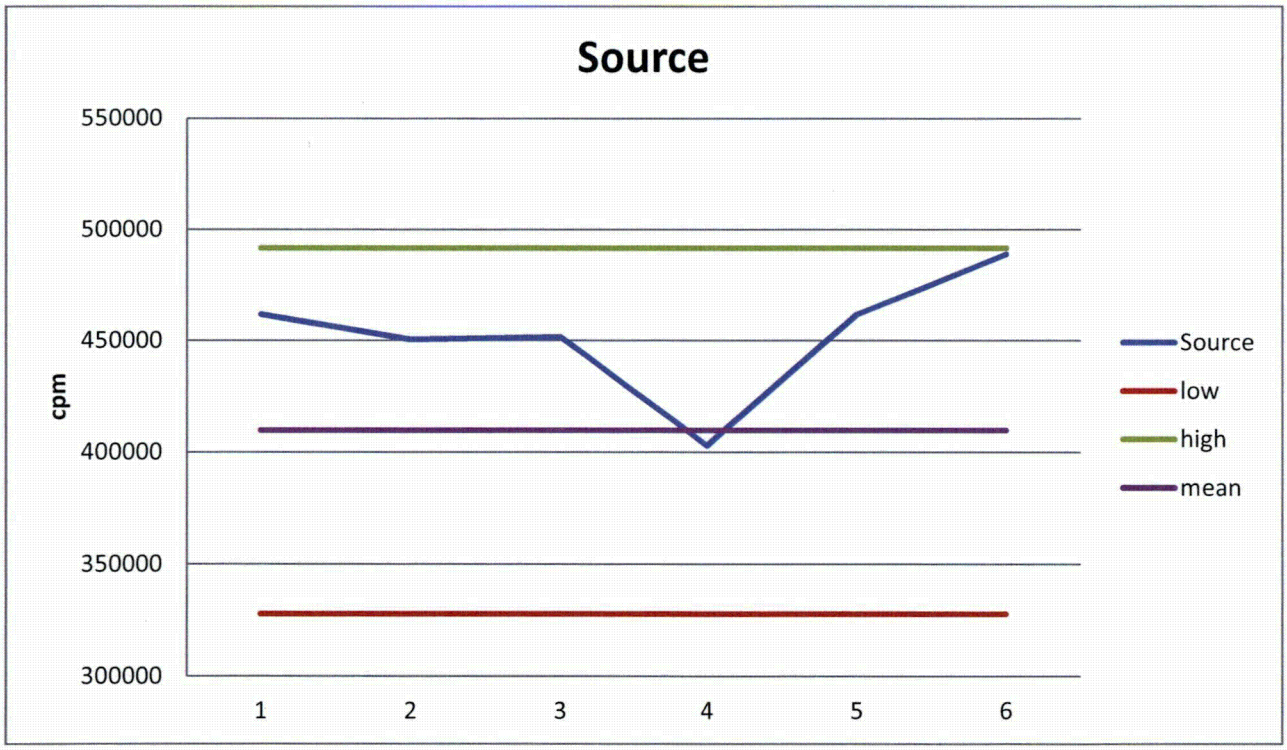
Mean from form RS-013.0-1 Background	0	Alpha	Mean from form RS-013.0-1 Source	0	Alpha
	13800.7	gamma		409704.9	gamma

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

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

Reviewed by: Date:


Background
17000
16000
15000
14000
13000
12000
11000
10000
9000
8000
cpm
1
2
3
4
5
6
Background
low
high
mean


Source
550000
500000
450000
400000
350000
300000
cpm
1
2
3
4
5
6
Source
low
high
mean

background			source		
low	high	mean	low	high	mean
11040.56	16561	13800.7	327763.9	491645.8	409704.9
11040.56	16561	13800.7	327763.9	491645.8	409704.9
11040.56	16561	13800.7	327763.9	491645.8	409704.9
11040.56	16561	13800.7	327763.9	491645.8	409704.9
11040.56	16561	13800.7	327763.9	491645.8	409704.9
11040.56	16561	13800.7	327763.9	491645.8	409704.9

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: _____

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 / 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		

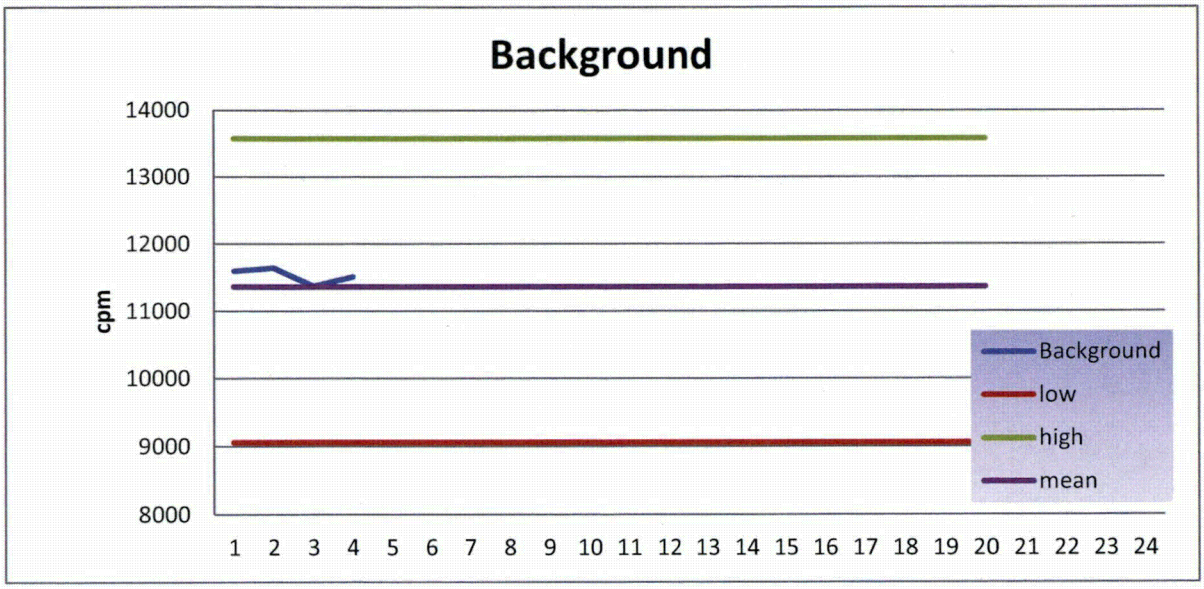
Mean from form RS-013.0-1 Background: 0 / 11391.05 gamma

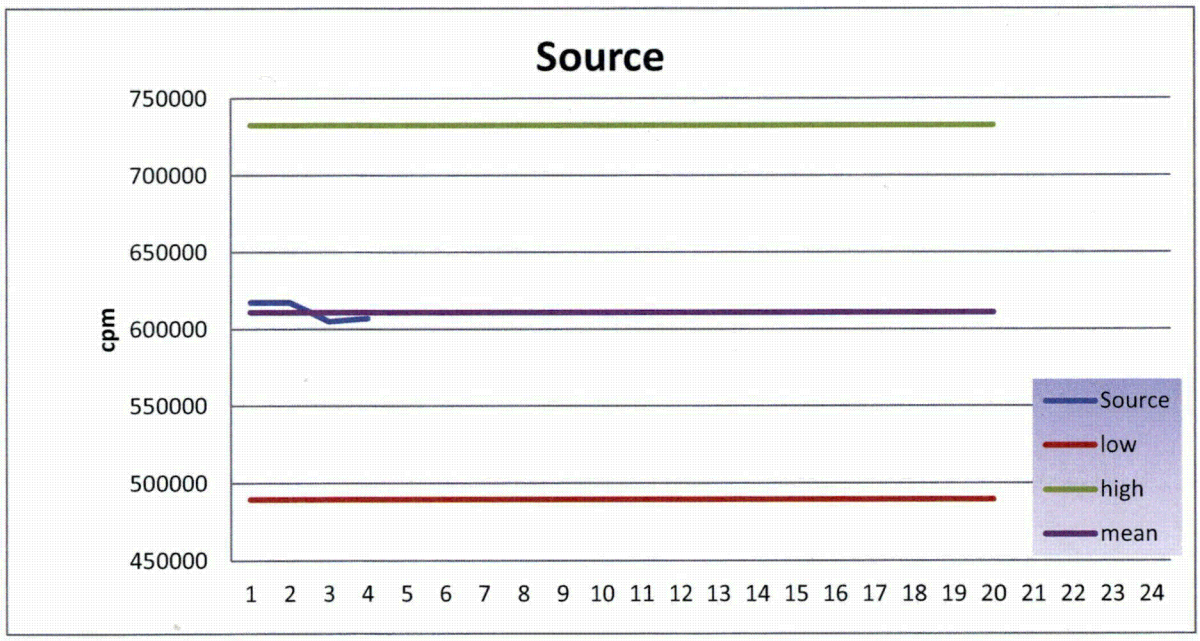
Mean from form RS-013.0-1 Source: 0 / 611960.3 gamma

Background Acceptance Limits				
M-20%	0	M+20%	0	Alpha
M-20%	9113	M+20%	13669	Beta

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

Reviewed by: _____ Date: _____


Background
14000
13000
12000
11000
10000
9000
8000
cpm
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Background
low
high
mean


Source
750000
700000
650000
600000
550000
500000
450000
cpm
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Source
low
high
mean

bkg			src		
low	high	mean	low	high	mean
9055.2	13577.28	11359.7	489317.3	732583.4	610801.8
9055.2	13577.28	11359.7	489317.3	732583.4	610801.8
9055.2	13577.28	11359.7	489317.3	732583.4	610801.8
9055.2	13577.28	11359.7	489317.3	732583.4	610801.8
9055.2	13577.28	11359.7	489317.3	732583.4	610801.8
9055.2	13577.28	11359.7	489317.3	732583.4	610801.8
9055.2	13577.28	11359.7	489317.3	732583.4	610801.8
9055.2	13577.28	11359.7	489317.3	732583.4	610801.8
9055.2	13577.28	11359.7	489317.3	732583.4	610801.8
9055.2	13577.28	11359.7	489317.3	732583.4	610801.8
9055.2	13577.28	11359.7	489317.3	732583.4	610801.8
9055.2	13577.28	11359.7	489317.3	732583.4	610801.8
9055.2	13577.28	11359.7	489317.3	732583.4	610801.8
9055.2	13577.28	11359.7	489317.3	732583.4	610801.8
9055.2	13577.28	11359.7	489317.3	732583.4	610801.8
9055.2	13577.28	11359.7	489317.3	732583.4	610801.8
9055.2	13577.28	11359.7	489317.3	732583.4	610801.8
9055.2	13577.28	11359.7	489317.3	732583.4	610801.8
9055.2	13577.28	11359.7	489317.3	732583.4	610801.8
9055.2	13577.28	11359.7	489317.3	732583.4	610801.8

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

Source Information		Gamma
Initial Source Activity (A_o) (dpm)		
Source ID		
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		BETA	
Count #	Bkgrd Counts/minute	Srce Counts/minute	Bkgrd Counts/minute	Srce Counts/minute
1	N/A	N/A	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	0	0
Average	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

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

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

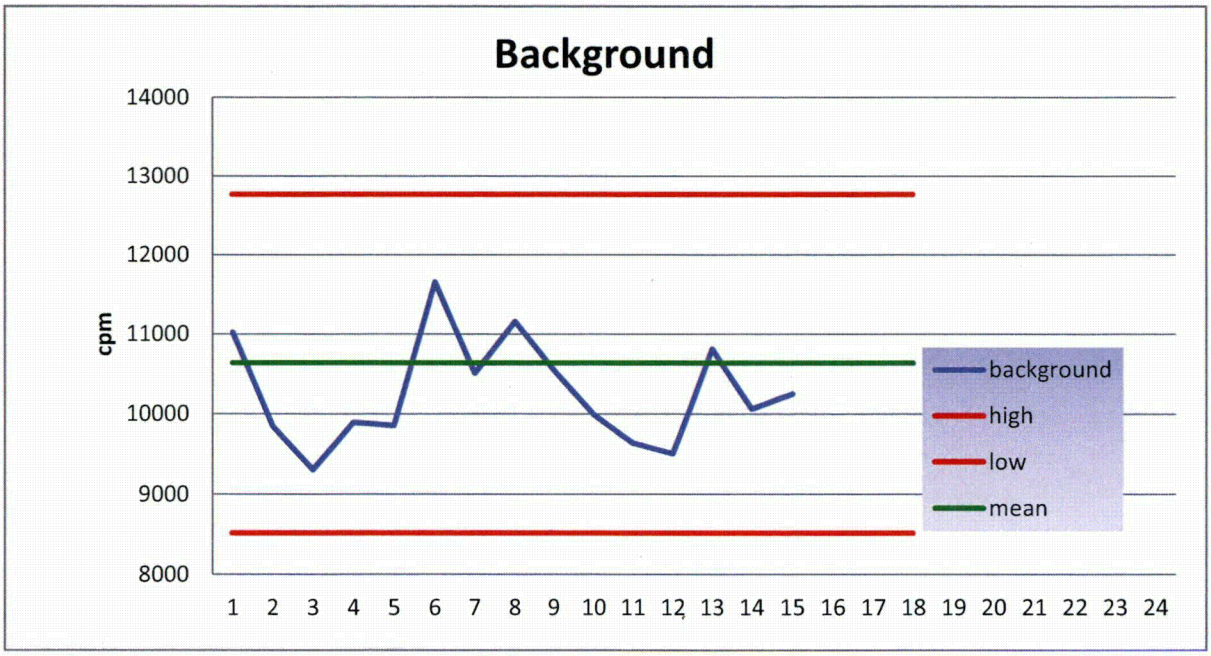
Mean from form RS-013.0-1 Background: 0 Alpha; 10638.5 Gamma

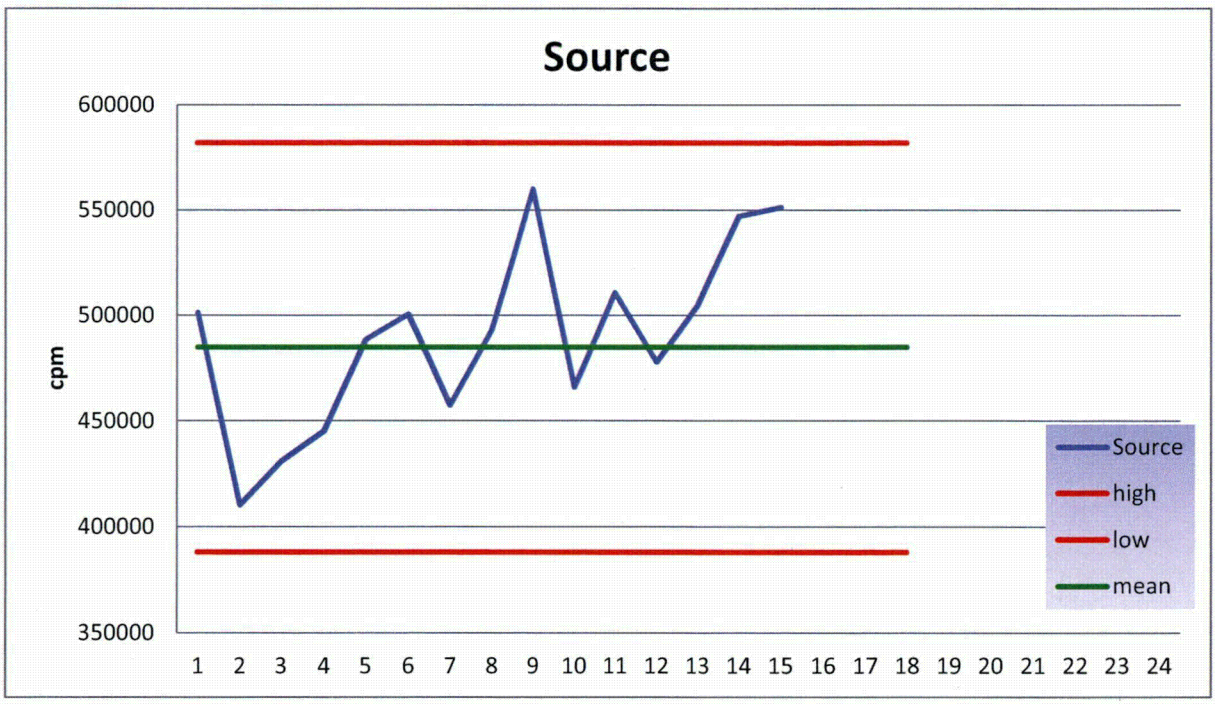
Mean from form RS-013.0-1 Source: 0 Alpha; 484908.9 Gamma

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:


Background
14000
13000
12000
11000
10000
9000
8000
cpm
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
background
high
low
mean


Source
600000
550000
500000
450000
400000
350000
cpm
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Source
high
low
mean

Background			Source		
High	Low	Mean	High	Low	Mean
12766	8511	10638.5	581890.6	387927.1	484908.9
12766	8511	10638.5	581890.6	387927.1	484908.9
12766	8511	10638.5	581890.6	387927.1	484908.9
12766	8511	10638.5	581890.6	387927.1	484908.9
12766	8511	10638.5	581890.6	387927.1	484908.9
12766	8511	10638.5	581890.6	387927.1	484908.9
12766	8511	10638.5	581890.6	387927.1	484908.9
12766	8511	10638.5	581890.6	387927.1	484908.9
12766	8511	10638.5	581890.6	387927.1	484908.9
12766	8511	10638.5	581890.6	387927.1	484908.9
12766	8511	10638.5	581890.6	387927.1	484908.9
12766	8511	10638.5	581890.6	387927.1	484908.9
12766	8511	10638.5	581890.6	387927.1	484908.9
12766	8511	10638.5	581890.6	387927.1	484908.9
12766	8511	10638.5	581890.6	387927.1	484908.9
12766	8511	10638.5	581890.6	387927.1	484908.9
12766	8511	10638.5	581890.6	387927.1	484908.9

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

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	
Type/Serial #:	Ludlum 2929/176108
Probe/Serial #:	43-10-1/181905
Calibration Due Date:	April 30 2014
Mode (count or dose)	Count
Data Type (Src, Bkg)	Source

Source Information	Alpha	Beta
Source Isotope	Th-230	Tc-99
Source ID	A2-743	A2-771

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

BETA			
MDCR and MDC Calculations			
Survey Speed:		MDCR =	
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	
Type/Serial #:	Ludlum 2929/176108
Probe/Serial #:	43-10-1/181905
Calibration Due Date:	April 30 2014

Source Information	Alpha	Beta
Initial Source Activity (A_o) (dpm)	17610	28510
Source ID	A2-743	A2-771
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		BETA	
Count #	Bkgrd Counts/minute	Srce Counts/minute	Bkgrd Counts/minute	Srce Counts/minute
1	0	13873	35	11178
2	0	13838	34	11281
3	0	13901	42	11589
4	0	14037	38	11390
5	1	13524	43	11375
6	0	13861	31	11500
7	0	13686	44	11529
8	0	13721	38	11184
9	0	13846	36	11114
10	2	13882	49	11316
11	0	13606	34	11240
12	0	13723	32	11038
13	0	13798	26	11066
14	0	13736	30	11060
15	0	13860	41	11361
16	2	13916	37	11218
17	0	13937	46	11079
18	0	13769	37	11349
19	0	13639	44	11150
20	0	13659	34	11105
SUM	5	275812	751	225122
Average	0.25	13790.60	37.55	11256.10

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

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
2π emission rate	17,608	28,509

DATE	TIME	BKG CPM Alpha	Beta	SOURCE CPM Alpha	Beta	COMMENTS	Tech Initials
1/27/2014	700	0	45	13758	11091		AM
1/28/2014	700	0	36	13661	11354		AM
1/29/2014	700	0	37	14501	11086		AM
1/30/2014	700	0	42	13249	11495		AM
1/31/2014	700	0	38	14659	11752		AM

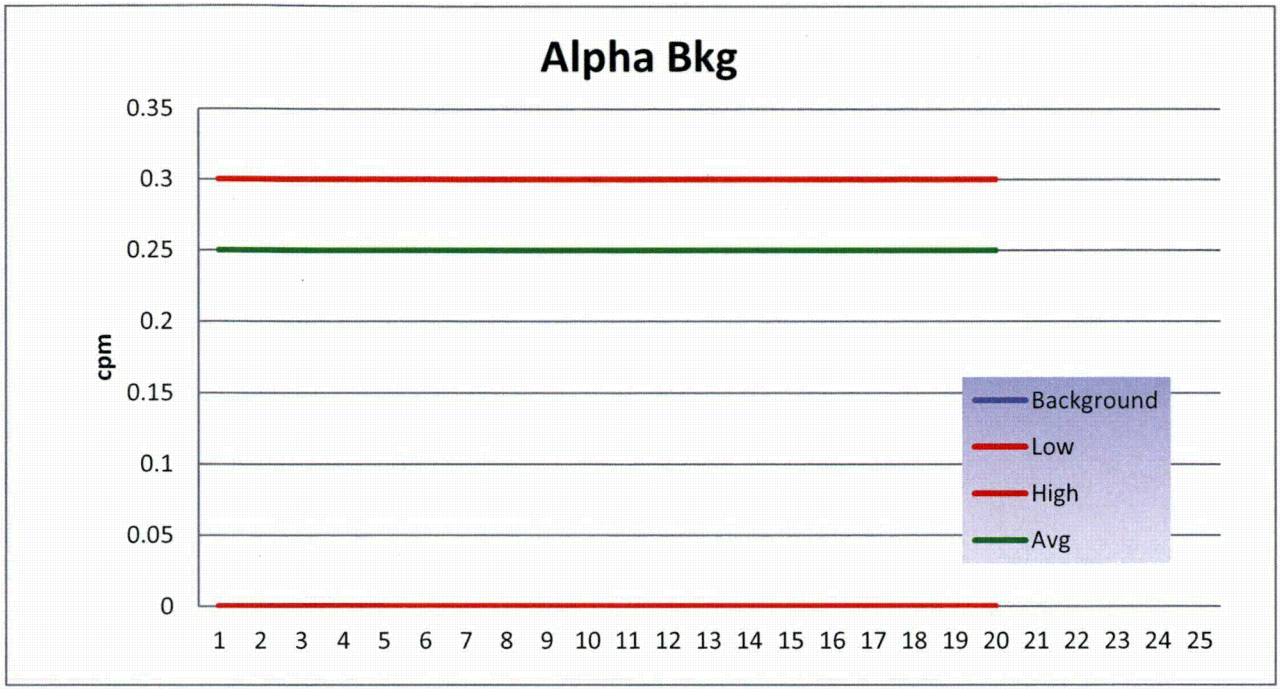
Mean from form RS-013.0-1 Background	0	Alpha	
	37.55	Beta	

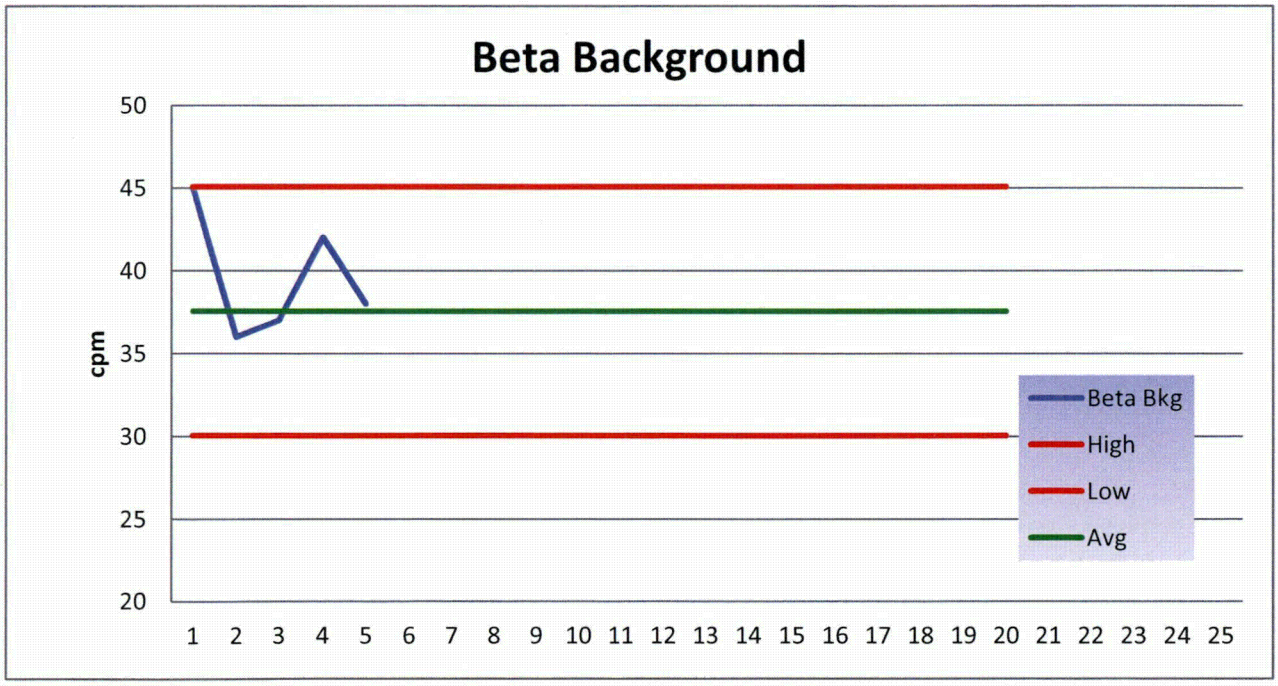
Mean from form RS-013.0-1 Source	13790.6	Alpha	
	11213	Beta	

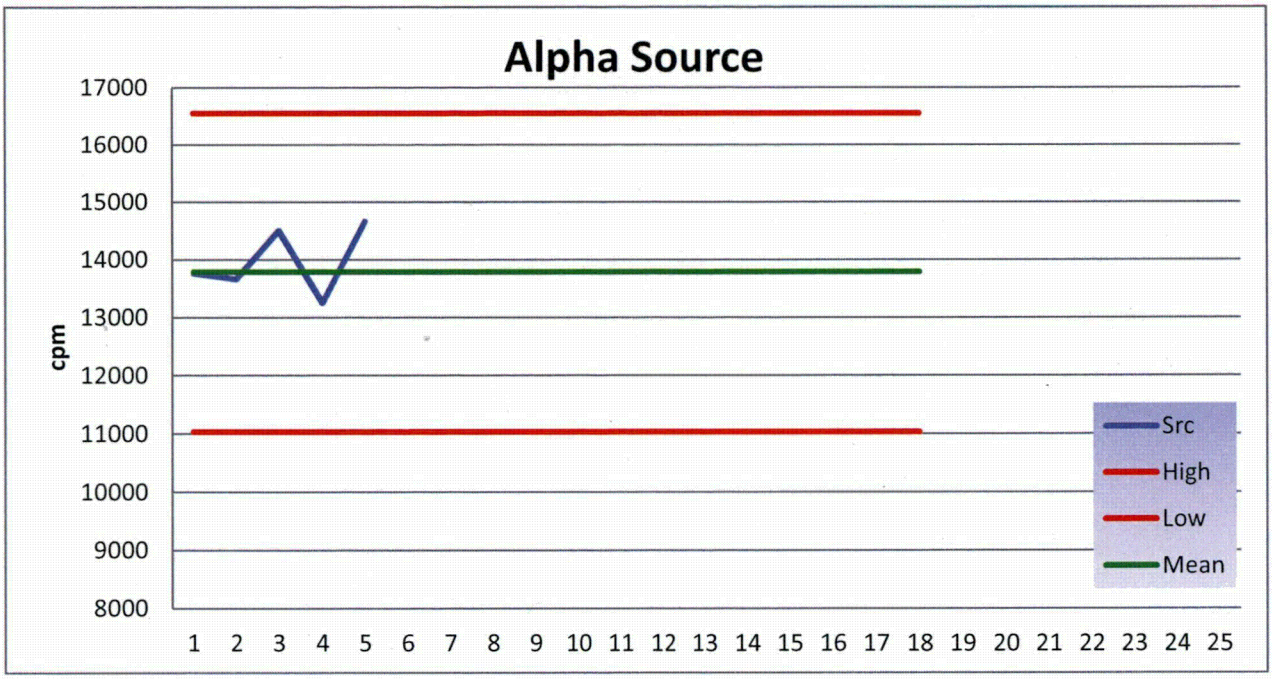
Background Acceptance Limits				
M-20%	0.2	M+20%	0.3	Alpha
M-20%	30	M+20%	45	Beta

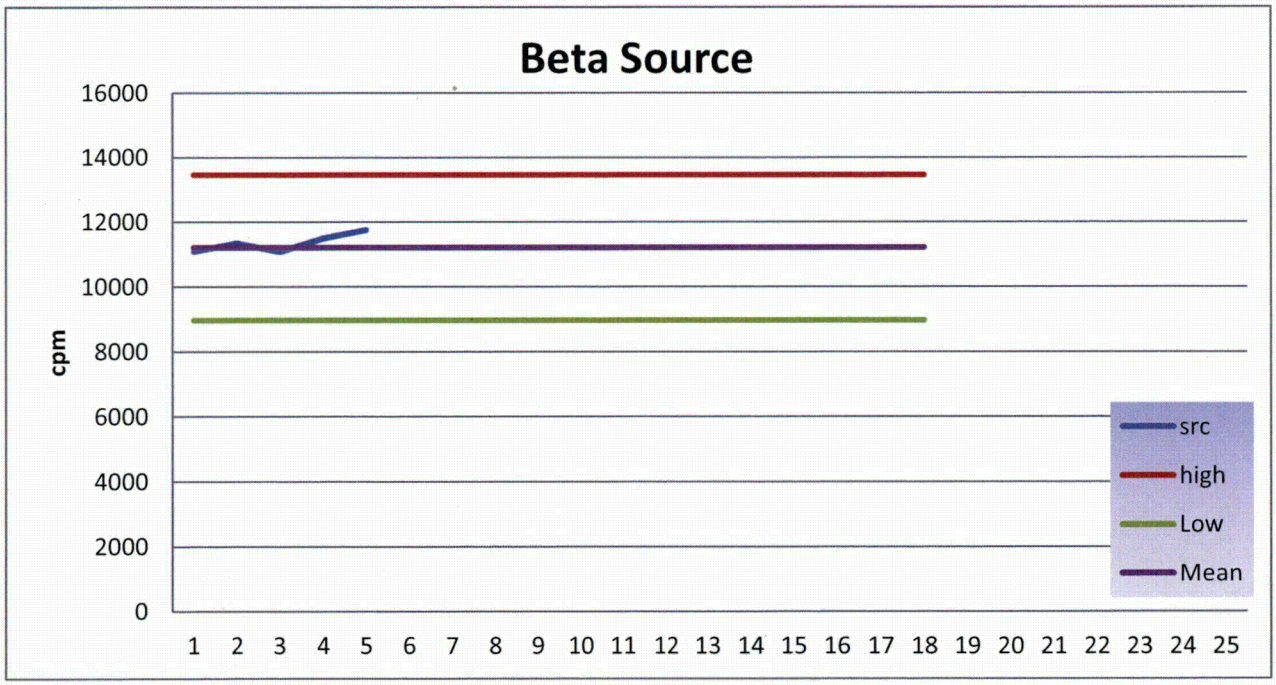
Source Acceptance Limits				
M-20%	11032	M+20%	16549	Alpha
M-20%	8970	M+20%	13456	Beta

Reviewed by: Date:


Alpha Bkg
cpm
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
Background
Low
High
Avg


Beta Background
cpm
50
45
40
35
30
25
20
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
Beta Bkg
High
Low
Avg


Alpha Source
cpm
17000
16000
15000
14000
13000
12000
11000
10000
9000
8000
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
Src
High
Low
Mean


Beta Source
cpm
16000
14000
12000
10000
8000
6000
4000
2000
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
src
high
Low
Mean

	bkg					
a				b		
	0	0.3	0.25	30.04	45.06	37.55
	0	0.3	0.25	30.04	45.06	37.55
	0	0.3	0.25	30.04	45.06	37.55
	0	0.3	0.25	30.04	45.06	37.55
	0	0.3	0.25	30.04	45.06	37.55
	0	0.3	0.25	30.04	45.06	37.55
	0	0.3	0.25	30.04	45.06	37.55
	0	0.3	0.25	30.04	45.06	37.55
	0	0.3	0.25	30.04	45.06	37.55
	0	0.3	0.25	30.04	45.06	37.55
	0	0.3	0.25	30.04	45.06	37.55
	0	0.3	0.25	30.04	45.06	37.55
	0	0.3	0.25	30.04	45.06	37.55
	0	0.3	0.25	30.04	45.06	37.55
	0	0.3	0.25	30.04	45.06	37.55
	0	0.3	0.25	30.04	45.06	37.55
	0	0.3	0.25	30.04	45.06	37.55
	0	0.3	0.25	30.04	45.06	37.55
	0	0.3	0.25	30.04	45.06	37.55
	0	0.3	0.25	30.04	45.06	37.55
	0	0.3	0.25	30.04	45.06	37.55

src

a			b		
11032.48	16548.72	13790.6	8970.4	13455.6	11213
11032.48	16548.72	13790.6	8970.4	13455.6	11213
11032.48	16548.72	13790.6	8970.4	13455.6	11213
11032.48	16548.72	13790.6	8970.4	13455.6	11213
11032.48	16548.72	13790.6	8970.4	13455.6	11213
11032.48	16548.72	13790.6	8970.4	13455.6	11213
11032.48	16548.72	13790.6	8970.4	13455.6	11213
11032.48	16548.72	13790.6	8970.4	13455.6	11213
11032.48	16548.72	13790.6	8970.4	13455.6	11213
11032.48	16548.72	13790.6	8970.4	13455.6	11213
11032.48	16548.72	13790.6	8970.4	13455.6	11213
11032.48	16548.72	13790.6	8970.4	13455.6	11213
11032.48	16548.72	13790.6	8970.4	13455.6	11213
11032.48	16548.72	13790.6	8970.4	13455.6	11213
11032.48	16548.72	13790.6	8970.4	13455.6	11213
11032.48	16548.72	13790.6	8970.4	13455.6	11213
11032.48	16548.72	13790.6	8970.4	13455.6	11213
11032.48	16548.72	13790.6	8970.4	13455.6	11213

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	
Type/Serial #:	Ludlum 2929/176108
Probe/Serial #:	43-10-1/181905
Calibration Due Date:	April 30 2014
Mode (count or dose)	Count
Data Type (Src, Bkg)	Source

Source Information	Alpha	Beta
Source Isotope	Th-230	Tc-99
Source ID	A2-743	A2-771

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

BETA			
MDCR and MDC Calculations			
Survey Speed:		MDCR =	
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	
Type/Serial #:	Ludlum 2929/176108
Probe/Serial #:	43-10-1/181905
Calibration Due Date:	April 30 2014

Source Information	Alpha	Beta
Initial Source Activity (A_o) (dpm)	17610	28510
Source ID	A2-743	A2-771
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		BETA	
Count #	Bkgrd Counts/minute	Srce Counts/minute	Bkgrd Counts/minute	Srce Counts/minute
1	0	13873	35	11178
2	0	13838	34	11281
3	0	13901	42	11589
4	0	14037	38	11390
5	1	13524	43	11375
6	0	13861	31	11500
7	0	13686	44	11529
8	0	13721	38	11184
9	0	13846	36	11114
10	2	13882	49	11316
11	0	13606	34	11240
12	0	13723	32	11038
13	0	13798	26	11066
14	0	13736	30	11060
15	0	13860	41	11361
16	2	13916	37	11218
17	0	13937	46	11079
18	0	13769	37	11349
19	0	13639	44	11150
20	0	13659	34	11105
SUM	5	275812	751	225122
Average	0.25	13790.60	37.55	11256.10

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

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
2π emission rate	17,608	28,509

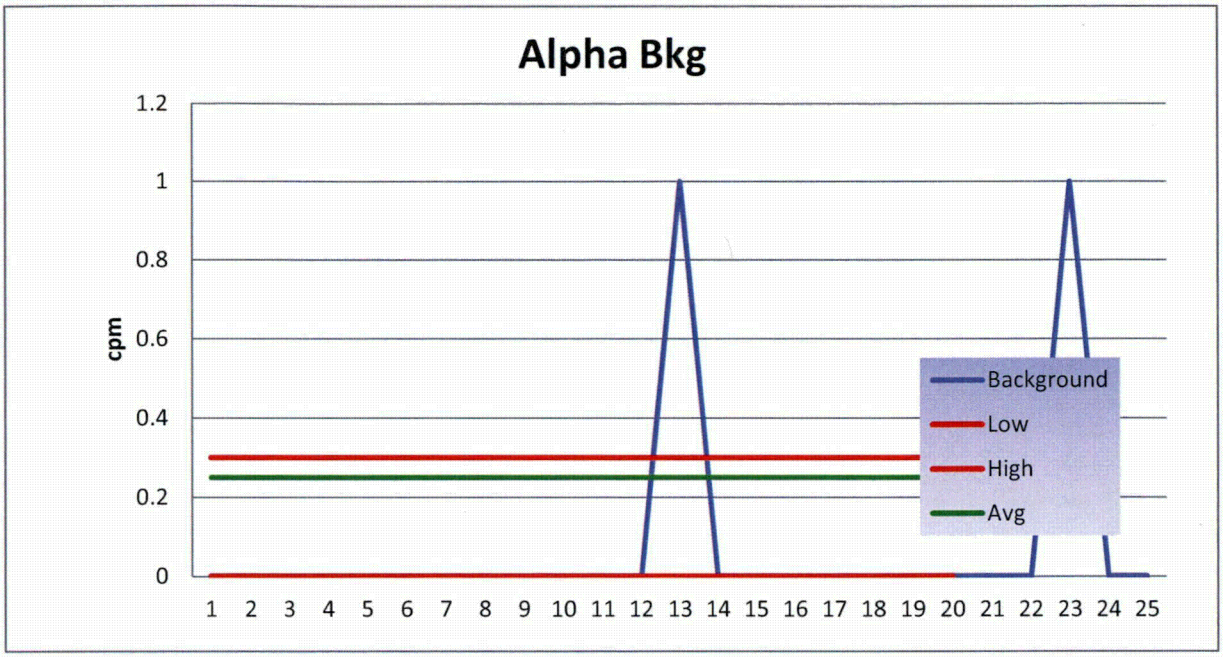
DATE	TIME	BKG CPM Alpha	Beta	SOURCE CPM Alpha	Beta	COMMENTS	Tech Initials
1/27/2014	7:00:00 AM	0	45	13758	11091		AM
1/28/2014	7:00:00 AM	0	36	13661	11354		AM
1/29/2014	7:00:00 AM	0	37	14501	11086		AM
1/30/2014	7:00:00 AM	0	42	13249	11495		AM
1/31/2014	7:00:00 AM	0	38	14659	11752		AM
2/3/2014	7:00:00 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

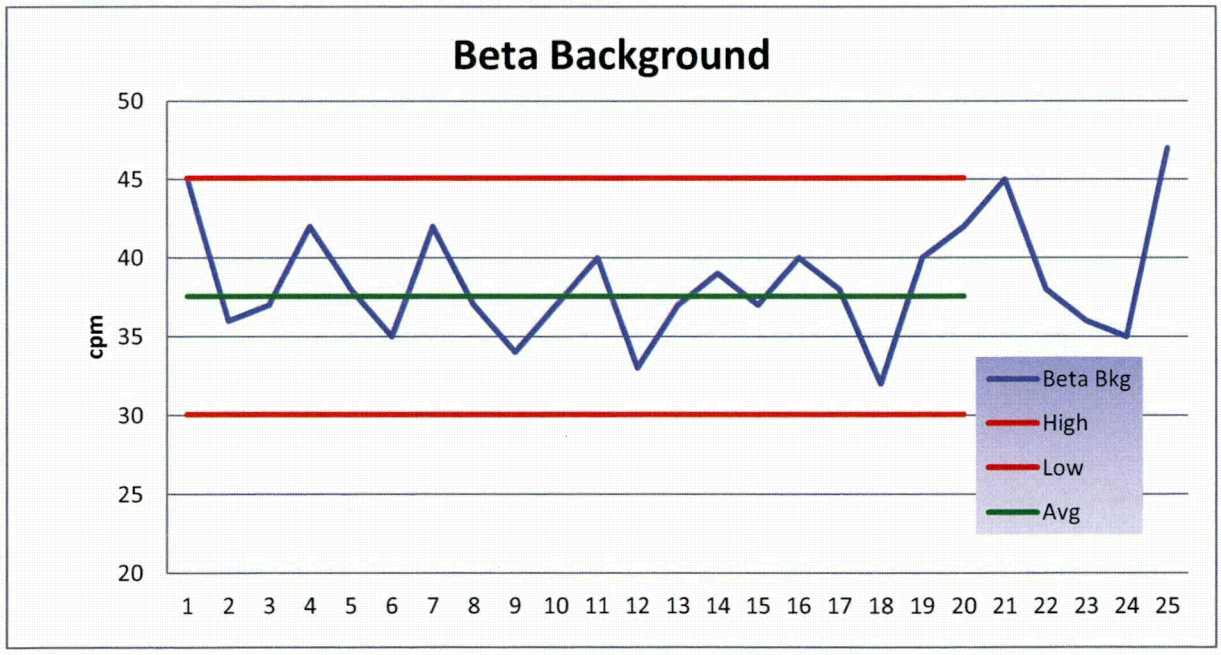
Mean from form RS-013.0-1 Background			Mean from form RS-013.0-1 Source		
0	Alpha		13790.6	Alpha	
37.55	Beta		11213	Beta	

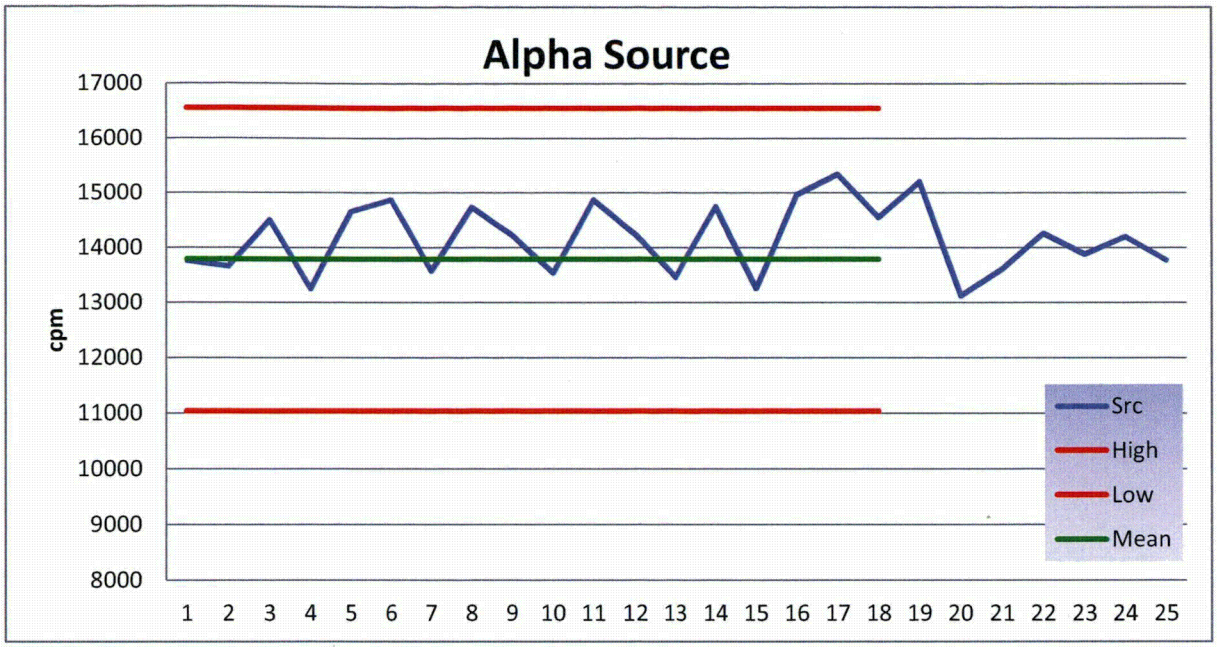
Background Acceptance Limits				
M-20%	0.2	M+20%	0.3	Alpha
M-20%	30	M+20%	45	Beta

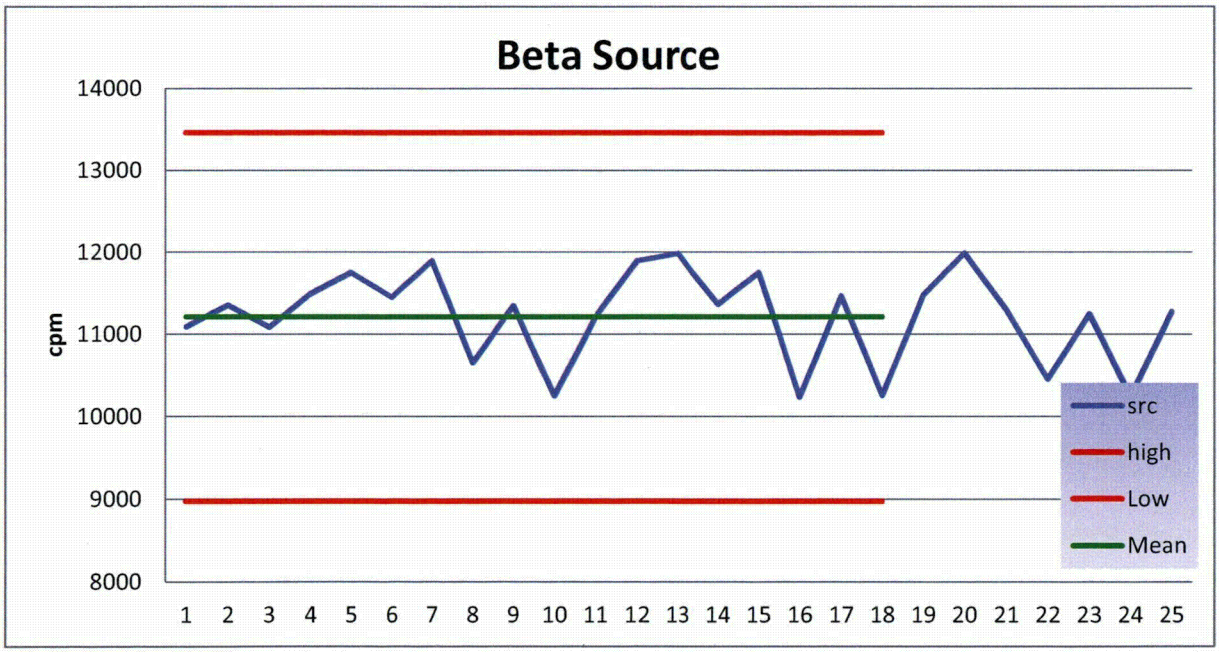
Source Acceptance Limits				
M-20%	11032	M+20%	16549	Alpha
M-20%	8970	M+20%	13456	Beta

Reviewed by: Date:


Alpha Bkg
cpm
1.2
1
0.8
0.6
0.4
0.2
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
Background
Low
High
Avg


Beta Background
cpm
50
45
40
35
30
25
20
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
Beta Bkg
High
Low
Avg


Alpha Source
cpm
17000
16000
15000
14000
13000
12000
11000
10000
9000
8000
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
Src
High
Low
Mean


Beta Source
cpm
14000
13000
12000
11000
10000
9000
8000
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
src
high
Low
Mean

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

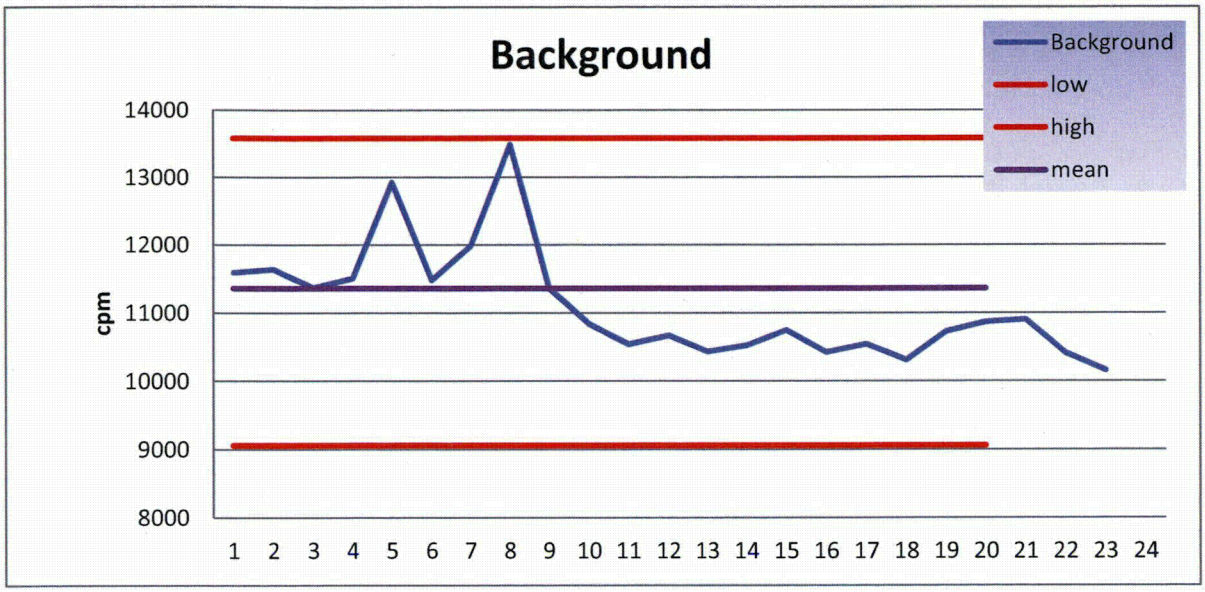
Mean from form RS-013.0-1 Background: 0 / 11376.45 gamma

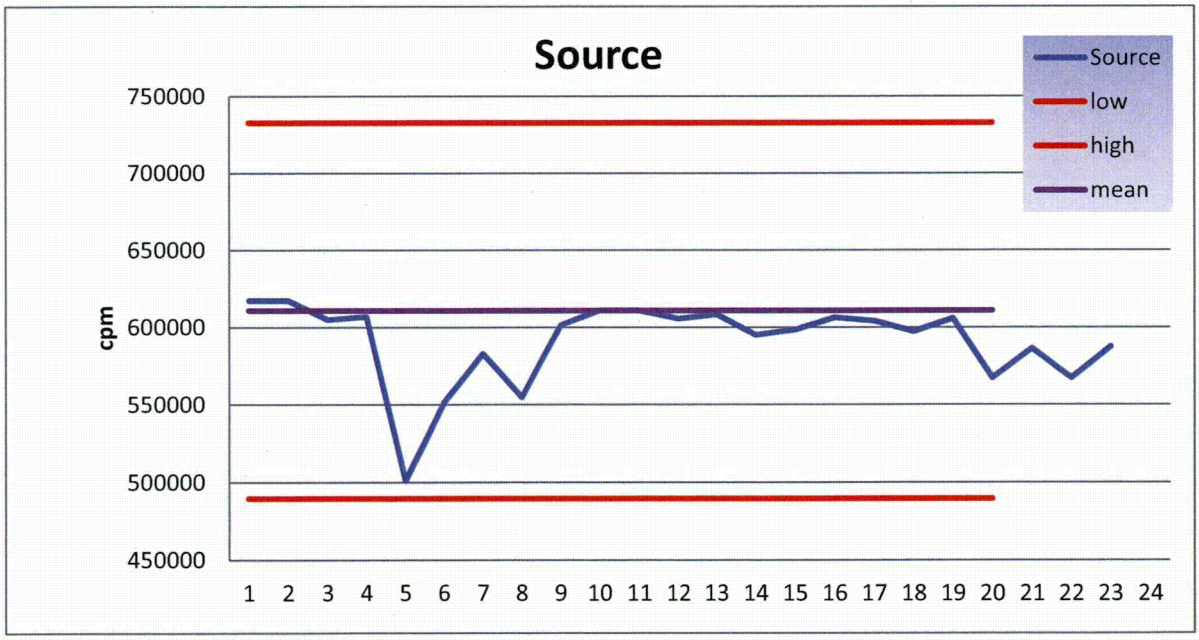
Mean from form RS-013.0-1 Source: 0 / 610840.8 gamma

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: _____


Background
Background
low
high
mean
14000
13000
12000
11000
10000
9000
8000
cpm
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24


Source
Source
low
high
mean
750000
700000
650000
600000
550000
500000
450000
cpm
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24

STANDARD DEVIATION DATA TABLE
Form RS-013.0-1

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
Mode (count or dose)	Count
Data Type (Src, Bkg)	Background

Source Information		Gamma
Source Isotope		N/A
Source ID		N/A

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

Source Information		Gamma
Initial Source Activity (A_o) (dpm)		
Source ID		
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		BETA	
Count #	Bkgrd Counts/minute	Srce Counts/minute	Bkgrd Counts/minute	Srce Counts/minute
1	N/A	N/A	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	0	0
Average	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

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

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

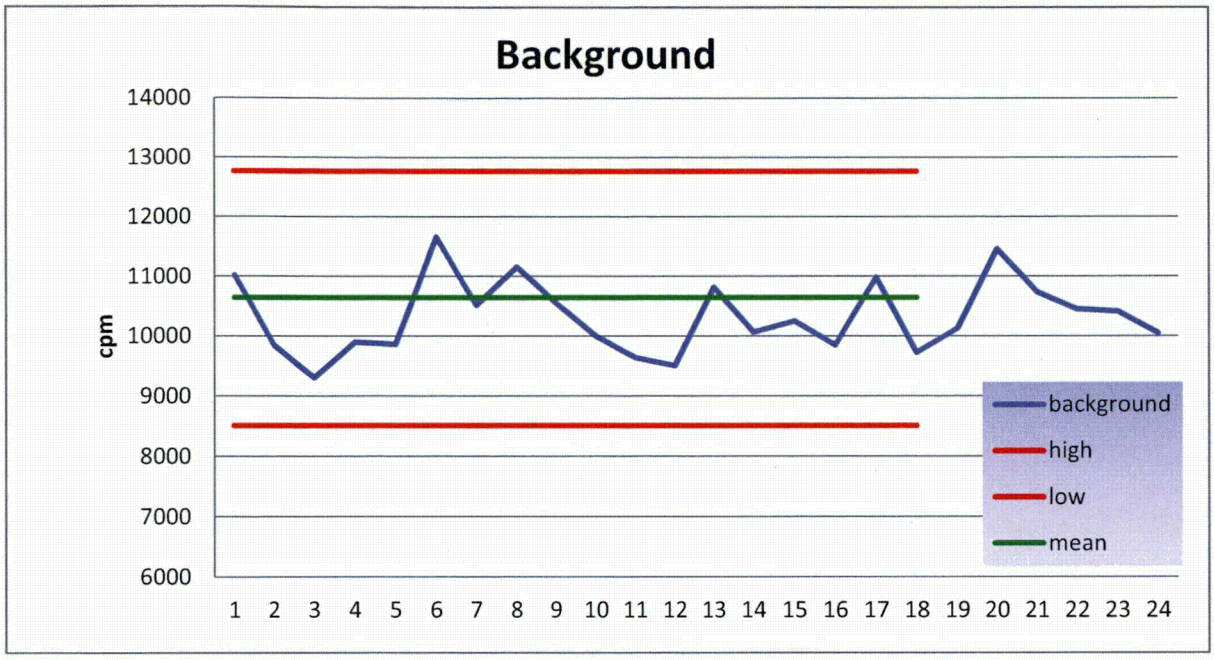
DATE	TIME	BACKGROUND CPM Gamma	SOURCE CPM Gamma	COMMENTS	Tech Initials
1/9/2014	7:00	11022	501249		ALR
1/13/2014	7:00	9849	410284		SRR
1/14/2014	7:00	9305	430872		SRR
1/15/2014	7:00	9895	445126		SRR
1/16/2014	7:00	9856	488558		SRR
1/17/2014	7:00	11658	500557		SRR
1/20/2014	7:00	10510	457286		SRR
1/21/2014	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			Mean from form RS-013.0-1 Source		
0	Alpha		0	Alpha	
10638.5	Gamma		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: _____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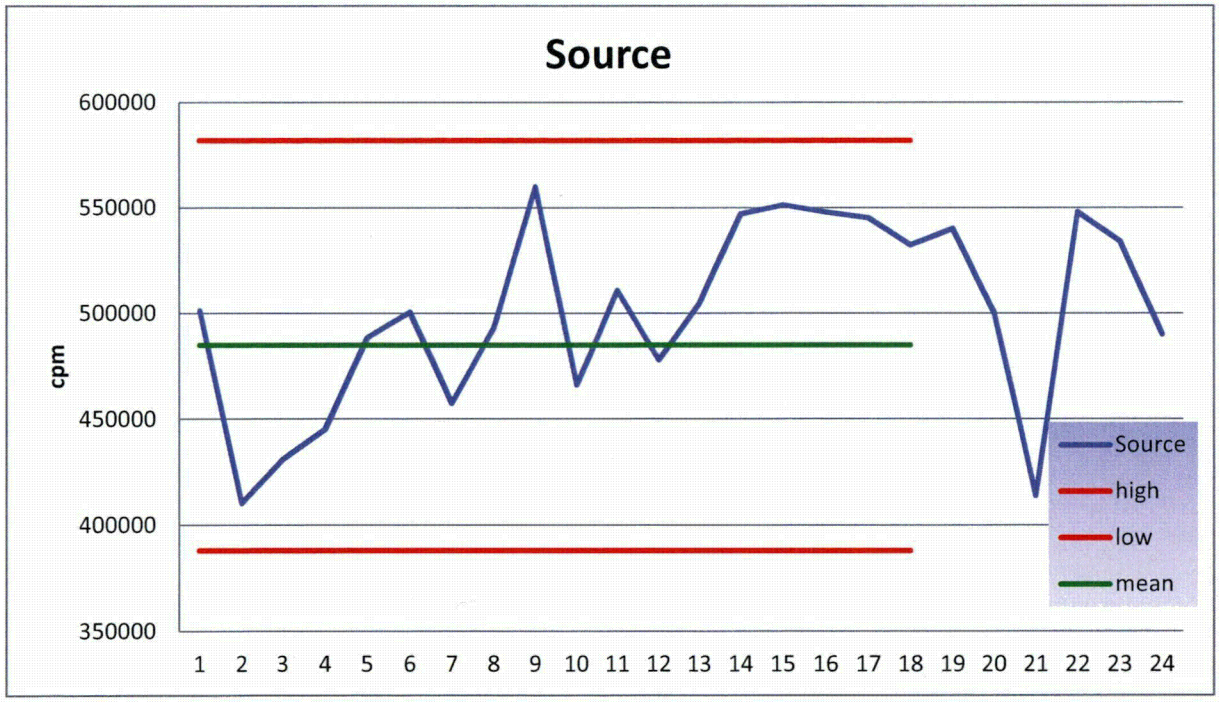
13000
12000
11000
10000
9000
8000
7000
6000
cpm
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
background
high
low
mean


Source
600000
550000
500000
450000
400000
350000
cpm
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Source
high
low
mean

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

Source Information		Gamma
Initial Source Activity (A_o) (dpm)		
Source ID		
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		BETA	
Count #	Bkgrd Counts/minute	Srce Counts/minute	Bkgrd Counts/minute	Srce Counts/minute
1	N/A	N/A	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	0	0
Average	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

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

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:** 1/14-2/14

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
2/14/2014	7:00	9782	553688		AO
2/17/2014	7:00	9601	552718		AO
2/18/2014	7:00	9868	547461		AO
2/19/2014	7:00	9823	535964		AO
2/20/2014	7:00	9832	513391		AO
2/21/2014	7:00	9795	548275		AO
2/24/2014	7:00	9918	549958		AO
2/25/2014	7:00	10024	518410		AO
2/26/2014	7:00	9825	534070		AO
2/27/2014	7:00	9951	556236		AO
3/3/2014	7:00	9800	544719		AO

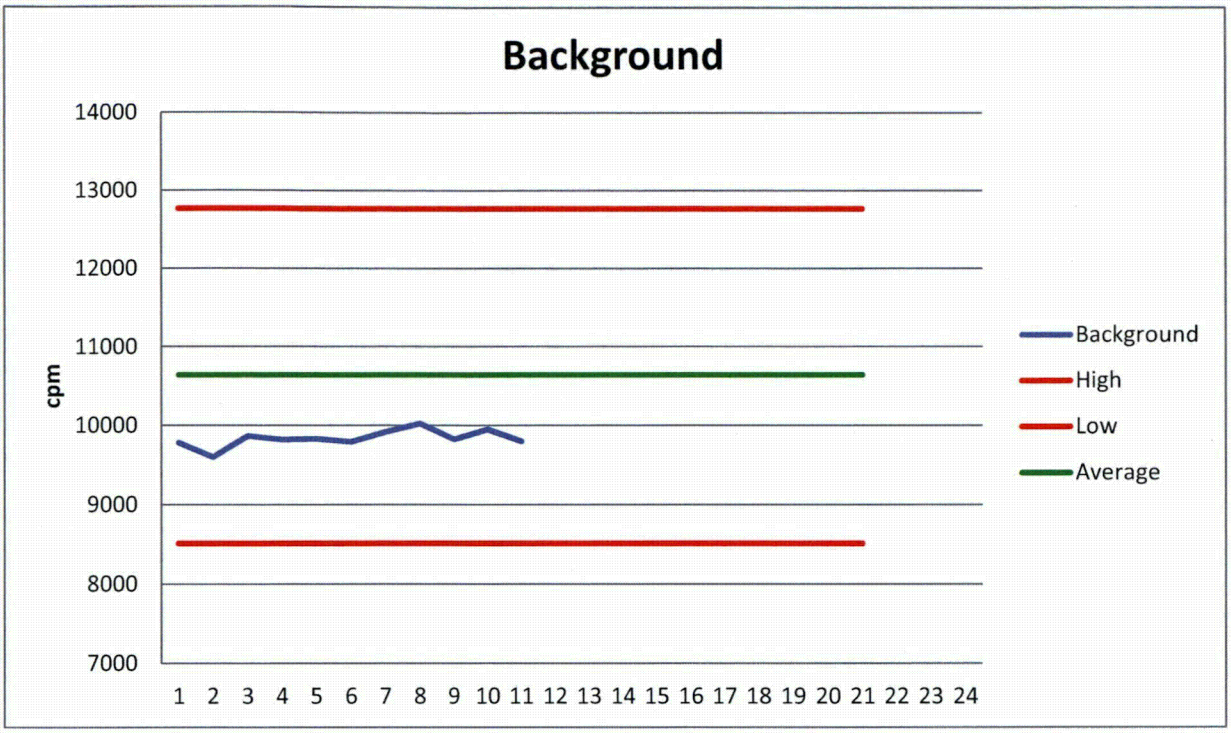
Mean from form RS-013.0-1	0	Alpha
Background	10638.5	Gamma

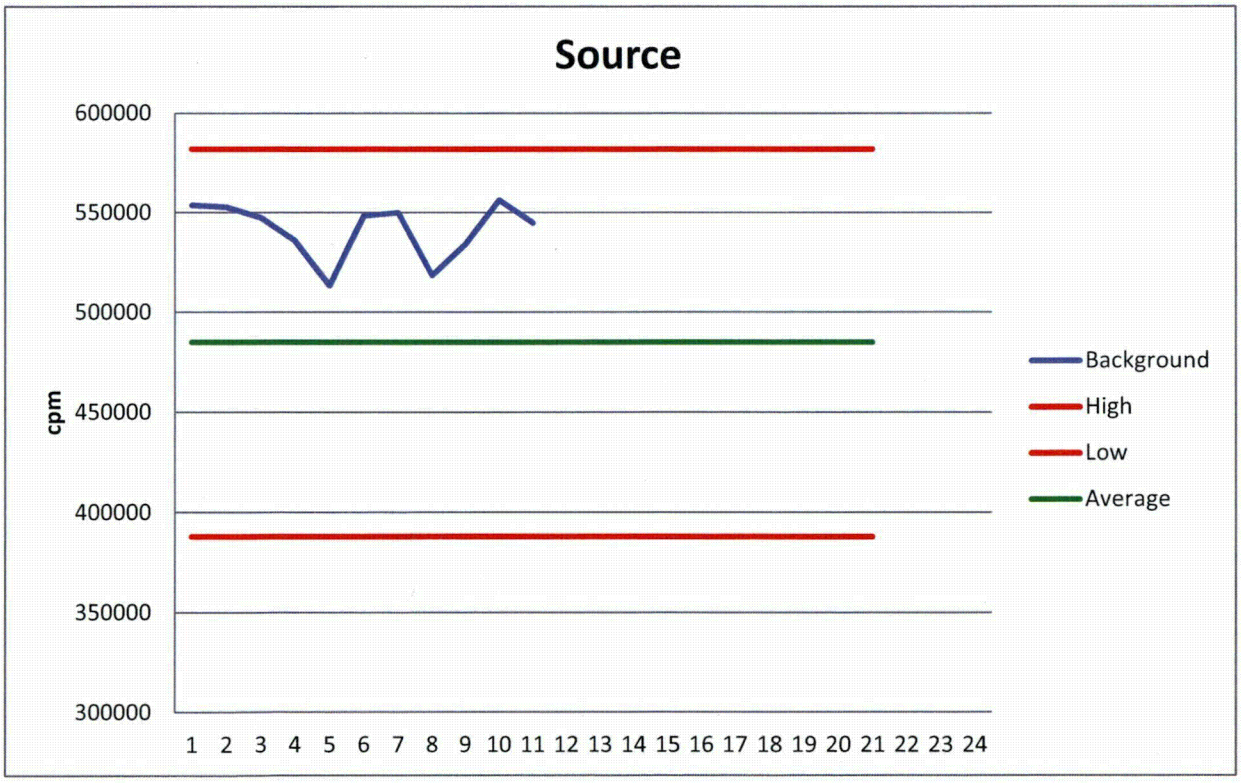
Mean from form RS-013.0-1	0	Alpha
Source	484908.9	Gamma

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: _____


Background
14000
13000
12000
11000
10000
9000
8000
7000
cpm
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Background
High
Low
Average


Source
600000
550000
500000
450000
400000
350000
300000
cpm
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Background
High
Low
Average

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 **16826**
Reference Inst. **HI-Q Model HFC-50C** Inst. s/n **4911**

Cal. Date **18 June 2012** Due Date **18 June 2013** Cal. Interval **1 year**

Barometric Press: Actual **29.80** Corrected to: **29.80 in. Hg**
Temperature: Actual **76°F** Corrected to: **76°F**
Filters Used: ☒Particulate ☐Charcoal/silver zeolite ☐Other:

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** Calibrator Serial No. **4911**
Air Sampler Model **HI-Q CF-973T** 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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$$\text{Air Sampler Temp/Press Corr Factor} = \sqrt{\frac{530°R}{\text{Inlet temp (°F)} + 460°R} \times \frac{(\text{Inlet Press} - \text{Gauge Press})}{29.92 \text{ in. Hg}}}$$

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

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

Corrected Flow = (Indicated Flow) x (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** Inst. Model **CF-973T** Inst. s/n **16831**
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# 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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$$\text{Air Sampler Temp/Press Corr Factor} = \sqrt{\frac{530°R}{\text{Inlet temp (°F)} + 460°R}} \times \frac{(\text{Inlet Press} - \text{Gauge Press})}{29.92 \text{ in. Hg}}$$

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

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

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

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

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

Corrected Flow = (Indicated Flow) x (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** Calibrator Serial No. **4911**
Air Sampler Model **HI-Q CF-973T** 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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$$\text{Air Sampler Temp/Press Corr Factor} = \sqrt{\frac{530°R}{\text{Inlet temp (°F)} + 460°R}} \times \frac{(\text{Inlet Press} - \text{Gauge Press})}{29.92 \text{ in. Hg}}$$

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

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

Corrected Flow = (Indicated Flow) x (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

RSCS
Radiation Safety & Control Services

Calibration Certificate
ID Number: 0027441660153-0

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

Instrument	Serial Number
Thermo Scientific Model EPD-G Mk 2.5	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 (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%

RSCS
Radiation Safety & Control Services

Calibration Certificate
ID Number: 0027439160156-0

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

Instrument	Serial Number
Thermo Scientific Model EPD-G Mk 2.5	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%

Radiation Safety and Control Services, Inc.
91 Portsmouth Ave. Stratham, NH 03885
1-800-525-8339 (603) 778-2871 Fax (603) 778-6879 www.radsafety.com

RSCS
Radiation Safety & Control Services

Calibration Certificate
ID Number: 0027436960542-0

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

Instrument	Serial Number
Thermo Scientific Model EPD MK2+	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%

RSCS
Radiation Safety & Control Services

Calibration Certificate
ID Number: 0027439360540-0

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

Instrument	Serial Number
Thermo Scientific Model EPD MK2+	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: 29.65in/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%

Radiation Safety and Control Services, Inc.
91 Portsmouth Ave. Stratham, NH 03885
1-800-525-8339 (603) 778-2871 Fax (603) 778-6679 www.radsafety.com

RSCS
Radiation Safety & Control Services

Calibration Certificate
ID Number: 0027439460541-0

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

Instrument	Serial Number
Thermo Scientific Model EPD MK2+	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: 29.65in/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%

Radiation Safety and Control Services, Inc.
91 Portsmouth Ave. Stratham, NH 03885
1-800-525-8339 (603) 778-2871 Fax (603) 778-0879 www.radsafety.com

RSCS
Radiation Safety & Control Services

Calibration Certificate
ID Number: 0027441860539-0

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

Instrument	Serial Number
Thermo Scientific Model EPD MK2+	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: 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: 8.0%

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1-800-525-8339 (603) 778-2871 Fax (603) 778-6879 www.radsafety.com

RSCS
Radiation Safety & Control Services

Calibration Certificate
ID Number: 0027440260543-0

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

Instrument	Serial Number
Thermo Scientific Model EPD MK2+	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%

RSCS
Radiation Safety & Control Services

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: 30.06in/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: 361R. 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%

RSCS
Radiation Safety & Control Services

Calibration Certificate
ID Number: 0027439760154-0

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

Instrument	Serial Number
Thermo Scientific Model EPD-G Mk 2.5	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. Shepherd and Associates Model 89 calibrator: 2.7%
Estimated uncertainty for measurements collected using the Tech Ops Model 773 calibrator: 6.0%

RSCS
Radiation Safety & Control Services

Calibration Certificate
ID Number: 0027399660152-0

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

Instrument	Serial Number
Thermo Scientific Model EPD-G Mk 2.5	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%

Radiation Safety and Control Services, Inc.
91 Portsmouth Ave. Stratham, NH 03885
1-800-525-8338 (603) 778-2871 Fax (603) 778-6879 www.radsafety.com

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. 20208021/382888

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

Mfg. Ludlum Measurements, Inc. Model 44-20 Serial No. PR294126

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. +-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 / 501 V Ref./Inst. 2000 / 1987 V

COMMENTS:

	Peak settings	Gross Counts	
High Voltage:	704 V	1050 V	Model 2221 currently set
Threshold dial:	642	100(10mv)	for gross counts.
Window dial:	40	n/a	High voltage set with detector
Window Position:	"IN"	"OUT"	connected.
Resolution for Cs137:	≈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 ± 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	399.83 kcpm	399.83 kcpm	Log Scale	500kcpm	500k cpm	500k cpm
	40kcpm	39.98	39.98		50kcpm	50	50
	4kcpm	399	399		5kcpm	5	5
	400cpm	400	400		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: Thad Ludlum Date 26 Sep 12

This certificate shall not be reproduced except in full, without the written approval of Ludlum Measurements, Inc.

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

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Scientific and Industrial
Instruments

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.

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

High Voltage	Background	Isotope Am241 Size ≈0.1 µCi	Isotope ____ Size ____	Isotope ____ Size ____	Isotope ____ Size ____
800	1074	14299			
850	1131	15446			
900	1061	17418			
950	1190	18213			
1000	1192	18824			
* 1050	1085	19071			
1100	1135	18950			
1150	1071	19174			
1200	1222	18796			
1250	1240	19141			
1300	14159	19259			

Signature Jeremy Thompson Date 25 Sep 12

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Designer and Manufacturer of Scientific and Industrial Instruments

CERTIFICATE OF CALIBRATION

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Sweetwater, TX 79556, U.S.A.

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

CUSTOMER CABRERA SERVICES ORDER NO. 20207566/382613

Mfg. Ludlum Measurements, Inc. Model 2221 Serial No. 216493

Mfg. Ludlum Measurements, Inc. Model 44-20 Serial No. PR262403

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. +-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 / 1999 V

COMMENTS:

	Peak settings	Gross Counts
High Voltage:	665 V	1000 V
Threshold dial:	642	100(10mv)
Window dial:	40	n/a
Window Position:	"IN"	"OUT"
Resolution for Cs137:	≈9.36%	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: JT 20,551cpm

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*
Digital Readout	400kcpm	39968cpm	39968cpm
	40kcpm	3993	3993
	4kcpm	399	399
	400cpm	40	40
	40cpm	4	4

	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
Log Scale	500kcpm	500k cpm	500k cpm
	50kcpm	50	50
	5kcpm	5	5
	500cpm	500	500
	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 19-Sep-12

Reviewed By: Brad H. Date 20 Sep 12

This certificate shall not be reproduced except in full, without the written approval of Ludlum Measurements, Inc.

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

Designer and Manufacturer
of
Scientific and Industrial
Instruments

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

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

Bench Test Data For Detector

Detector 44-20 Serial No. PR262403

Customer CABRERA SERVICES Order #. 20207566/382613

Counter 2221 Serial No. 216423 Counter Input Sensitivity 10 mV

Count Time 6 Seconds Distance Source to Detector Surface

Other

High Voltage	Background	Isotope Am241 Size ≈0.1 μCi	Isotope ____ Size	Isotope ____ Size	Isotope ____ Size
900	2106	19132			
950	2037	19480			
* 1000	2085	19290			
1050	2296	19579			
1100	2196	19444			
1150	2413	19613			
1200	2296	19558			
1250	2833	20344			
1300	8312	22181			

Signature Jeremy Thompson Date 19-Sep-12

Designer and Manufacturer of Scientific and Industrial Instruments

CERTIFICATE OF CALIBRATION

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☐ 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. PR324757

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 Dial Ratio 100 = 10 mV

☑ HV Readout (2 points) Ref./Inst. 500 / 503 V Ref./Inst. 2000 / 1956 V

COMMENTS:

	Peak settings	Gross Counts	
High Voltage:	673 V	1000 V	Model 2221 currently set for gross counts.
Threshold dial:	642	100(10mv)	High voltage set with detector connected.
Window dial:	40	n/a	
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	400/4 (01)	400/4 (01)	Log Scale	500kcpm	500k cpm	500k cpm
	40kcpm	400	400		50kcpm	50	50
	4kcpm	400	400		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: [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. Only ☐ Passed Dielectric (Hi-Pot) and Continuity Test ☐ Failed:

Designer and Manufacturer
of
Scientific and Industrial
Instruments

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

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

Bench Test Data For Detector

Detector 44-20 Serial No. PR324957

Customer CABRERA SERVICES Order #. 20211633/385041

Counter 2221 Serial No. 161580 Counter Input Sensitivity 10 mV

Count Time 6 Seconds Distance Source to Detector Surface

Other

High Voltage	Background	Isotope Am241 Size 20.77 μCi	Isotope Size	Isotope Size	Isotope Size
800	1626	16184			
850	1650	18439			
900	1434	19077			
950	1410	19380			
*1000	1489	19666			
1050	1339	19422			
1100	1570	19596			
1150	1743	19630			
1200	2537	20187			
1250	2688	21137			

Signature Jeremy Thompson Date 27-Dec-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. 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 / 502 V Ref./Inst. 1500 / 1510 V

COMMENTS: see attachment for cpm & dpm (2pi)

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
Beta Sensitivity:3.5mv
Beta Window:30mv
Overload set to simulate a light leak with Am-241 91mdpm.
Instrument calibrated with 5' cable.
H.V. set with detector disconnected.

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	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*
Digital Readout	400kcpm	400819	400819
	40kcpm	40091	40091
	4kcpm	4010	4010
	400cpm	400	400
	40cpm	40	40

	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
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/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 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: Duane Adkison Date 16-Aug-12

Reviewed By: Date 20 Aug 12

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

Designer and Manufacturer
of
Scientific and Industrial
Instruments

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.

Bench Test Data For Detector

Detector 43-93 Serial No. PR 291930 Order #. 20205329/381338

Customer CABRERA SERVICES Alpha Input Sensitivity 120 mV

Counter 2224-1 Serial No. 271539 Beta Input Sensitivity 3.5 mV

Count Time 1Minute Beta Window 30 mV

Other _____ Distance Source to Detector Surface

High Voltage	Background		Isotope Pu-239 Size 25.2Kdpm		Isotope Tc-99 Size 33,200dpm		Isotope S1390490 Size 35,150dpm	
	Alpha	Beta	Alpha	Beta	Alpha	Beta	Alpha	Beta
700	1	203	5479	358	9	5821	1	11689
* 725	0	226	5719	508	11	6909	2	12910
750	1	800	5808	683	12	8083	7	13261

☐ Gas Proportional detector count rate decreased ≤ 10% after 16 hour static test using 39" cable.

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

Signature Lucia Ackson Date 16-Aug-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. 20204774/381039

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

Mfg. Ludlum Measurements, Inc. Model 43-93 Serial No. PR244545

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	800kcpm	800434	800434	Log Scale			
	80kcpm	80044	80044				
	8kcpm	8004	8004				
	800cpm	800	800				
	80cpm	80	80				

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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 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: Date 8-Aug-12

Reviewed By: Date 8 Aug 12

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

Designer and Manufacturer
of
Scientific and Industrial
Instruments

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.

Bench Test Data For Detector

Detector 43-93 Serial No. PR244545 Order #. 20204774/381039

Customer CABRERA SERVICES Alpha Input Sensitivity 120 mV

Counter 2224-1 Serial No. 227244 Beta Input Sensitivity 3.5 mV

Count Time 1Minute Beta Window 30 mV

Other _____ Distance Source to Detector Surface

High Voltage	Background		Isotope TH230 Size 19800dpm		Isotope Tc99 Size 93200dpm		Isotope Sr/Y90 Size 98550dpm		Isotope Ni63 Size 278834dpm	
	Alpha	Beta	Alpha	Beta	Alpha	Beta	Alpha	Beta	Alpha	Beta
925	1	217	4041	748	49	19638	4	35227	3	632
950	2	248	4112	987	34	22481	1	36376	2	1320
975	3	337	4265	1365	30	25476	5	37484	1	2470

☐ Gas Proportional detector count rate decreased ≤ 10% after 15 hour static test using 39" cable.

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

Signature Jason Ferm Date 8-Aug-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. 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 Rdng:≈  5744cpm 4 Pi Eff:≈ 18.92% 2 Pi Eff:≈ 30.33%
Sr90Y90 Size: 35204dpm  (24643cpm) Bkgd:≈ 285cpm Rdng:≈ 12468cpm 4 Pi Eff:≈ 34.61% 2 Pi Eff:≈ 49.44%
Ni63 Size:  278697dpm (139349cpm) Bkgd:≈ 285cpm Rdng:≈  1039cpm 4 Pi Eff:≈  2.71% 2 Pi Eff:≈  5.41%
Th230 Size:  19800dpm  (10100cpm) Bkgd:≈   2cpm Rdng:≈  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*
Digital Readout	400 kcpm	400280	400280
	40 kcpm	4003	4003
	4 kcpm	401	401
	400 cpm	40	40
	40 cpm	4	4

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

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Reference Instruments and/or Sources: ☐ 73410 ☐ 1131 ☐ 761 ☐ 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
Sr90Y90#99SR2204016

☑ 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 Mikell Date 25JUL12

Reviewed By: Date 27 Jul 12

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

Designer and Manufacturer
of
Scientific and Industrial
Instruments

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.

Bench Test Data For Detector

Detector 43-93 Serial No. PR211706 Order #. 20204106/380582

Customer CABRERA SERVICES Alpha Input Sensitivity 120 mV

Counter 2360 Serial No. 202398 Beta Input Sensitivity 3.5 mV

Count Time 1Minute Beta Window 30 mV

Other Plateaud with a 5' C-cable Distance Source to Detector Surface

High Voltage	Background		Isotope Th230 Size 19800dpm		Isotope Tc99 Size 28860 dpm		Isotope Sr90Y90 Size 35204 dpm		Isotope Ni63 Size 278697dpm	
	Alpha	Beta	Alpha	Beta	Alpha	Beta	Alpha	Beta	Alpha	Beta
725	1	197	3634	502	8	4552	5	10835	2	372
750	2	285	3967	744	7	5744	3	12468	1	1039
775	2	317	4064	1169	5	7529	12	12697	1	2247

☐ Gas Proportional detector count rate decreased ≤ 10% after 15 hour static test using 39" cable.

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

Signature James Mills Date 25JUL12

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. PR232046

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

Instrument in DPM mode.

QC mode turned ☑ OFF ☐ ON

Firmware version: 39013 / 16

Overload checked but not set.

Battery voltage measured at 12.6 Vdc.

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

(EEPROM Settings)

(PC) Count Time: 1666.7

Alpha Alarm: 999999 cpm

Beta Alarm: 999999 cpm

Alpha/Beta Alarm: 999999 cpm

Calibration Due Date: 4/30/2013

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

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

*Uncertainty within ± 10% C.F. within ± 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: Date 30-Apr-12

Reviewed By: Date 30 Apr 12

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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%

Ludlum Measurements, Inc.

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

	ALPHA				BETA			
HV	Source (Beta)	Background	Eff	CrossTalk	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
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. 20208023/382889

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

Mfg. Ludlum Measurements, Inc. Model 44-9 Serial No. PR073106

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/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 ☐ 1698 ☐ 5105 ☐ 5717CO ☐ 5719CO
☐ 60646 ☐ 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 247891 ☐ Oscilloscope S/N ☑ Multimeter S/N 17500076

Calibrated By: Date 25Sep12

Reviewed By: Date 26 Sep 12

This certificate shall not be reproduced except in full, without the written approval of Ludlum Measurements, Inc.

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

Designer and Manufacturer
of
Scientific and Industrial
Instruments

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.

CONVERSION CHART

Customer CABRERA SERVICES Date 25-Sep-12 Order #. 20208023/382889

Model 3 Serial No. 79498 Detector Model 44-9 Serial No. PR073106

Source Cs-137 194.6 mCi Cs-137 20 mCi High Voltage 900 V

Input Sensitivity 26 mV

	"As Found" Readings (CPM):		After Adjustment Readings (CPM):	
Reference Point	Meter Reading	Range/Scale	Meter Reading	Range/Scale
150 mR/hr	2.5 k	x 100	2.5k	x 100
50 mR/hr	1.3 k	x 100	1.3k	x 100
15 mR/hr	4.7 k	x 10	4.7k	x 10
5 mR/hr	1.8 k	x 10	1.8k	x 10
1.5 mR/hr	4.7 k	x 1	4.7k	x 1
1.0 mR/hr	3.1k	x 1	3.1k	x 1

Signature: [signature] Date 25 Sep 12

• *Serving The Nuclear Industry Since 1962* •

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. +-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 Rdng: ≈  12 kcpm 2 Pi Eff: ≈ 66.37 %
Sr90Y90 Size:  68856 cpm Bkgd: ≈ 53 cpm Rdng: ≈  22 kcpm 2 Pi Eff: ≈ 31.87 %
   Ni63 Size: 139343 cpm Bkgd: ≈ 53 cpm Rdng: ≈ 1.6 kcpm 2 Pi Eff: ≈  1.11 %
  Th230 Size:  10100 cpm Bkgd: ≈ 53 cpm Rdng: ≈ 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 ± 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/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 Th230#E121495 ☑ Beta S/N Tc99#5279;Sr90Y90#5281;Ni63 #99Ni220401? ☐ Other

☑ m 500 S/N 251106 ☐ Oscilloscope S/N ☑ Multimeter S/N 15060230

Calibrated By: James McBeth Date 26JUL12

Reviewed By: Date 27 Jul 12

This certificate shall not be reproduced except in full, without the written approval of Ludlum Measurements, Inc.

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

Designer and Manufacturer
of
Scientific and Industrial
Instruments

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.

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 Cs137 (54 mCi) Co137 (4 mCi) High Voltage 900 V

Input Sensitivity 37 mV

Reference Point	"As Found" Readings (CPM): Meter Reading	Range/Scale	After Adjustment Readings (CPM): Meter Reading	Range/Scale
150 mR/hr	4.9K	X100	4.9K	X100
50 mR/hr	2.5K		2.5K	
15 mR/hr	5K	X10	5K	X10
5 mR/hr	1.8K		1.8K	
1.5 mR/hr	0.55K		0.55K	
1.0 mR/hr	3.5K	X1	3.5K	X1

Signature: James McBride Date 26JUL12

• *Serving The Nuclear Industry Since 1962* •

ENERGYSOLUTIONS

CALIBRATION CERTIFICATE

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

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) Before Calibration	After Calibration	Comments
				Calibrated in accordance with CP-IN-WI-203
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 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	1 R/hr	1.05 R/hr	1 R/hr	
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: As Found: 0 As Left: 0
50 R/hr	25 R/hr	25 R/hr	25 R/hr	
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 ( )			
Over Range Test	Sat (✓) Unsat ( )			

$$BCF = \frac{I}{WO - WC}\left(I = Source\ Dose\ Rate_{(mRad/hr)}\right)$$

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. Patterson	Date: 1/15/13
Calibration Date: 01/15/2013	Calibration Due: 01/15/2014	

ENERGYSOLUTIONS

CALIBRATION CERTIFICATE

EnergySolutions Services, Inc.
1570 Bear Creek Road
Oak Ridge, TN 37830
Phone: (877) 462-4873
Email: ISFStaff@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 µRem/hr	Instrument Response (± 10% of Calibration Standard Values)		Comments	
		Before Calibration	After Calibration	Calibration performed in accordance with CP-IN-WI-209	
		µRem/hr	µRem/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	
Cs^{137}	019701	05/31/2012	05/31/2013	**Indicates use of pulser to electronically generate calibration points shown**
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.

ENERGY*SOLUTIONS*

CALIBRATION CERTIFICATE

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

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

CUSTOMER INFORMATION		INSTRUMENT INFORMATION	
Customer Name: Energy*Solutions* 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	Calibrated in accordance with CP-IN-WI-213
mR/hr					
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	Temp: 20.9 °C Pressure: 746 mmHg Humidity: 40.5 %
R/hr					
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 As Left: SAT
1000	400	320 - 480 (+/-20%)	Off scale *	400	
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 Calibrated By: Mike Yoman	Reviewed By:	Date: 1/16/13
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 μCi)

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:

Calibration Technician: Art Reust Q.A. Manager: Charlotte McCuistion

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 μCi)

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:

Calibration Technician: 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.

Daniel James Van Dalsem — Quality Control

16-Apr-12 — Date

EZIP Ref. No.: 1592-30

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: Dorsey Austin Reviewed By: GDS 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

α	β	β	
1 13.873	11 13,606	1 11178	11 11240
2 13,838	12 ~~13,79~~ 13,723	2 11220	12 11038
3 13,901	13 13,798	3 11446	13 11066
4 14,037	14 13,736	4 11212	14 11060
5 13.524	15 13.860	5 11266	15 11361
6 13,861	16 13,916	6 11379	16 11218
7 13.686	17 13937	7 11279	17 11079
8 13.721	18 13769	8 11184	18 11349
9 13.846	19 13639	9 11114	19 11150
10 13.882	20 13659	10 11316	20 11105

BK α	β	β	
1 0	11 0	1 35	11 34
2 0	12 0	2 34	12 32
3 0	13 0	3 42	13 26
4 0	14 0	4 38	14 30
5 1	15 0	5 43	15 41
6 0	16 2	6 31	16 37
7 0	17 0	7 44	17 46
8 0	18 0	8 38	18 37
9 0	19 0	9 36	19 44
10 2	20 0	10 49	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	**Customer:**	J. STEWART BLAND ASSOCIATES, INC.
Half-life:	(2.13 ± 0.05)E+05 years	**P.O. No.:**	VISA
Catalog No.:	BF-099-32SS	**Reference Date:**	15-Oct-01 12:00 PST
Source No.:	A2-771	**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.

Irma U Khan
Quality Control

12-Oct-01
Date Signed

IPL Ref. No.: 752-54

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.

Quality Control

12-Oct-01
Date Signed

IPL Ref. No.: 752-54

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

CONTACT: Chico Reyes
PHONE: (610) 310-1031

PO NO: N303

INSTRUMENT: LUDLUM
MODEL: 19
TYPE: MICRO R
SN: 180302

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
50	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 CHECKS

BATTERY 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: RWA Cal Date: 12/16/2013

Richard Emmons

Maryland License MD-33-021-01

14654

Columbia, MD 21046

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: Dorsey Austin Reviewed By: GDS 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

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

PO NO: N303

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

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: D W Austin Reviewed By: ROE Cal Date: 12/16/2013
Dorsey Austin

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: D W 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

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.

Quality Control

12-Oct-01
Date Signed

IPL Ref. No.: 752-54

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	**Customer:**	J. STEWART BLAND ASSOCIATES, INC.
Half-life:	(2.13 ± 0.05)E+05 years	**P.O. No.:**	VISA
Catalog No.:	BF-099-32SS	**Reference Date:**	15-Oct-01 12:00 PST
Source No.:	A2-771	**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.

Linda U Khan
Quality Control

12-Oct-01
Date Signed

IPL Ref. No.: 752-54

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** | Inst. Type **MCA** | Inst. s/n **200124**
Det. Mfr. & Model **Rexon** | Det. Type **3x3 NaI** | Det s/n **081107-2**
Cal Date **20 November 2013** | Due Date **20 November 2014** | Cal. Interval **1 year**

Pre-calibration Checks:

☑ Contamination Survey	☐ Battery Check	☐Slow Response Check	☐Det Volts
☑ Mechanical Check	☐Audio Check	☑ Window Operation	
☐ Meter Zero	☐ Reset Check	☐ Plateau Check	☐ Threshold
☐ Geotropism Check	☐ Fast Response Check	☐Alarm Set	

☐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 μSec	Negative	x35	x0.762	x26.660

Exposure Rate Data:

μR/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 ±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** | Inst. Type **MCA** | Inst. s/n **200124**
Det. Mfr. & Model **Ludlum 44-10** | Det. Type **2x2 NaI** | Det s/n **186962**
Cal Date **20 November 2013** | Due Date **20 November 2014** | Cal. Interval **1 year**

Pre-calibration Checks:

☑ Contamination Survey	☐ Battery Check	☐Slow Response Check	☐Det Volts
☑ Mechanical Check	☐Audio Check	☑ Window Operation	
☐ Meter Zero	☐ Reset Check	☐ Plateau Check	☐ Threshold
☐ Geotropism Check	☐ Fast Response Check	☐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 μSec	Negative	x35	x0.703	x24.609

μR/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 ±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** | Inst. Type **MCA** | Inst. s/n **200124**
Det. Mfr. & Model **Alpha Spectra 20DT063QB2/5B** | Det. Type **NaI FIDLER** | Det s/n **050307AY1**
Cal Date **20 November 2013** | Due Date **20 November 2014** | Cal. Interval **1 year**

Pre-calibration Checks:

☑ Contamination Survey	☐ Battery Check	☐Slow Response Check	☐Det Volts
☑ Mechanical Check	☐Audio Check	☑ Window Operation	
☐ Meter Zero	☐ Reset Check	☐ Plateau Check	☐ Threshold
☐ Geotropism Check	☐ Fast Response Check	☐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 μSec	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 ±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** | Inst. Type **MCA** | Inst. s/n **200130**
Det. Mfr. & Model **Alpha Spectra 20DT063QB2/5B** | Det. Type **NaI FIDLER** | Det s/n **050307AZ1**
Cal Date **19 November 2013** | Due Date **19 November 2014** | Cal. Interval **1 year**

Pre-calibration Checks:

☑ Contamination Survey	☐ Battery Check	☐Slow Response Check	☐Det Volts
☑ Mechanical Check	☐Audio Check	☑ Window Operation	
☐ Meter Zero	☐ Reset Check	☐ Plateau Check	☐ Threshold
☐ Geotropism Check	☐ Fast Response Check	☐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 μSec	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 ±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** | Inst. Type **MCA** | Inst. s/n **200130**
Det. Mfr. & Model **Rexon** | Det. Type **3x3 NaI** | Det s/n **081107-1**
Cal Date **19 November 2013** | Due Date **19 November 2014** | Cal. Interval **1 year**

Pre-calibration Checks:

☑ Contamination Survey	☐ Battery Check	☐Slow Response Check	☐Det Volts
☑ Mechanical Check	☐Audio Check	☑ Window Operation	
☐ Meter Zero	☐ Reset Check	☐ Plateau Check	☐ Threshold
☐ Geotropism Check	☐ Fast Response Check	☐Alarm Set	

☐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
880 V	100 mV	1 μSec	Negative	x35	x0.742	x25.977

Exposure Rate Data:

μR/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 ±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** | Inst. Type **MCA** | Inst. s/n **200130**
Det. Mfr. & Model **Ludlum 44-10** | Det. Type **2x2 NaI** | Det s/n **186955**
Cal Date **19 November 2013** | Due Date **19 November 2014** | Cal. Interval **1 year**

Pre-calibration Checks:

☑ Contamination Survey	☐ Battery Check	☐Slow Response Check	☐Det Volts
☑ Mechanical Check	☐Audio Check	☑ Window Operation	
☐ Meter Zero	☐ Reset Check	☐ Plateau Check	☐ Threshold
☐ Geotropism Check	☐ Fast Response Check	☐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
1050 V	50 mV	1 μSec	Negative	x250	x0.742	x185.547

μR/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 ±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**