9.11 DETAILED RESULTS FOR SURVEY UNIT 011

Room 2007 Walls & Ceiling (Class 2 Interior Area)

INDEX

ENERGYSOLUTIONS

Survey Package Worksheet for NIST Boulder SU011

Package Identification No.: SU11F/SU11S	**Prepared by:** Paul C. Ely
Location: Room 2007 Walls & Ceiling (Class 2 Interior Area)	**Date Prepared:** 2/17/2009
Area Classification: Class 2	**Signature:** Paul Ely

Area Description

The survey area includes all wall areas and ceiling.

Historical Information

On June 9, 2008, researchers ruptured a glass vial of 0.25 grams of mixed plutonium isotopes in the form of $PuSO_4$-$4H_2O$ resulting in the contamination of laboratory rooms 2124, 2124A, 2120, 2120A and 2007 in Building 1 on the NIST campus in Boulder, Colorado. Room 2124 is the room where the glass vial ruptured and is the room that was the most contaminated. This room is a Class 2 area because it had activity in excess of the release limit of 696 dpm/100 cm^2 (44 cpm/100 cm^2). The isotopes of concern are Pu-238, Pu-239, Pu-240, Pu-241, Pu-242 and Am-241.

General Survey Instructions

1. Use gas proportional detector model numbers 43-68, or equivalent detector as approved by the ES PM for alpha surface activity surveys. The total instrument efficiency should use the following factors:
   - ε_i, 2π instrument efficiency from calibration papers. If a 4π efficiency is reported, calculate the 2π efficiency as follows using a 5% alpha Back Scatter factor (BS). $\varepsilon_i = (2 * \varepsilon_{4\pi}) \setminus (1 + BS)$
   - ε_s, the alpha surface efficiency is 25%.
   - ε_f, the fraction of radionuclides detected in the survey, 52% for the NIST-Boulder broken vial material.
   - ε_t, the total alpha efficiency = $\varepsilon_i * \varepsilon_s * \varepsilon_f$
2. Perform surface scans at a scan speed of 1 probe width per four seconds or less for the 43-68. Any locations that exceed 35 cpm alpha must be marked with a felt tip pen or equivalent and the extent of the elevated area recorded. Alternatively the 43-37 large area detector may be used for scanning at a scan speed of 1 probe width per four seconds or less and any locations that exceed 256 cpm alpha must be marked with a felt tip pen or equivalent and the extent of the elevated area recorded.
   - 20% scan of walls and ceiling for alpha contamination.
   - Complete a FSS Grid Scan Record to document scan data.
3. Perform direct alpha surface activity measurements at each measurement location provided on survey map(s).
4. Collect a removable surface activity sample over an area of 100 cm^2 in size at each measurement location provided on survey maps. Removable activity results are for information only and the same limits apply as for fixed contamination as a 10% smear activity removal factor is incorporated into the smear counting results. Notify the Project Manager if alpha smear results exceed 696 dpm/100 cm^2.
5. Irregular structure and fixed equipment flat surfaces are surveyed as above, curved surfaces are scanned using 43-68 probes (126 cm^2) with additional smear samples obtained and documented on a judgmental basis with a least one sample per two (2) square meters of irregular surface area.

Special Instructions

- Source check instrumentation to Th-230 for alpha measurements.
- The static MDC for total alpha activity measurements shall be less than 345 dpm/100 cm^2.
- Perform a minimum of three one-minute field backgrounds using the plastic shield on the survey surface.
- Record maximum scan measurement results in cpm on a FSS Grid Scan Record.
- Measurement and sampling locations are based on a random-start rectangular pattern. If any location is inaccessible, offset the measurement location to the nearest usable location and document the x and y coordinates for the location used.
- The attached map provides measurement and sampling locations.
- Notify the ES Project Manager of locations that exceed 44 cpm/100 cm^2 total alpha surface activity.
- Attach photographic records if available and provide descriptive comments for each image under Survey Comments.

Survey performance (Initial and date as each survey is complete)

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Location Code					General Description	Beta Scan	Direct Beta	Direct Alpha	Alpha Scan	Direct Gamma	Smear Gross
L1	L2	L6	L7	L8							
NIST Boulder SU011 Class 2 Area											
Package ID	Surface or Structure	Material Code	Row	Column Number				@60 sec	20%	@100 cm	α
SU11F	W01	B0010	A thru B	1 thru 2	Wall	N/A	N/A	4 SM 3-31-09	N/A	N/A	4 SM 3-31-09
SU11F	W02	B0010	A thru B	3 thru 4	Wall	N/A	N/A	4 SM 3-31-09	N/A	N/A	4 SM 3-31-09
SU11F	W03	B0010	A thru B	5 thru 7	Wall	N/A	N/A	6 SM 3-31-09	N/A	N/A	6 SM 3-31-09
SU11F	W04	B0010	A thru B	8 thru 9	Wall	N/A	N/A	4 SM 3-31-09	N/A	N/A	4 SM 3-31-09
SU11F	C01	B0010	A thru C	10 thru 11	Ceiling	N/A	N/A	6 SM 3-31-09	N/A	N/A	6 SM 3-31-09
SU11S	W01	B0010	A thru B	1 thru 2	Wall	N/A	N/A	N/A	es 4/1/09	N/A	N/A
SU11S	W02	B0010	A thru B	3 thru 4	Wall	N/A	N/A	N/A	es 4/1/09	N/A	N/A
SU11S	W03	B0010	A thru B	5 thru 7	Wall	N/A	N/A	N/A	es 4/1/09	N/A	N/A

SU11S	W04	B0010	A thru B	8 thru 9	Wall	N/A	N/A	N/A	ACE 3-30-09 N/A	N/A	N/A
SU11S	C01	B0010	A thru C	10 thru 11	Ceiling	N/A	N/A	N/A	00 4-1-09	N/A	N/A

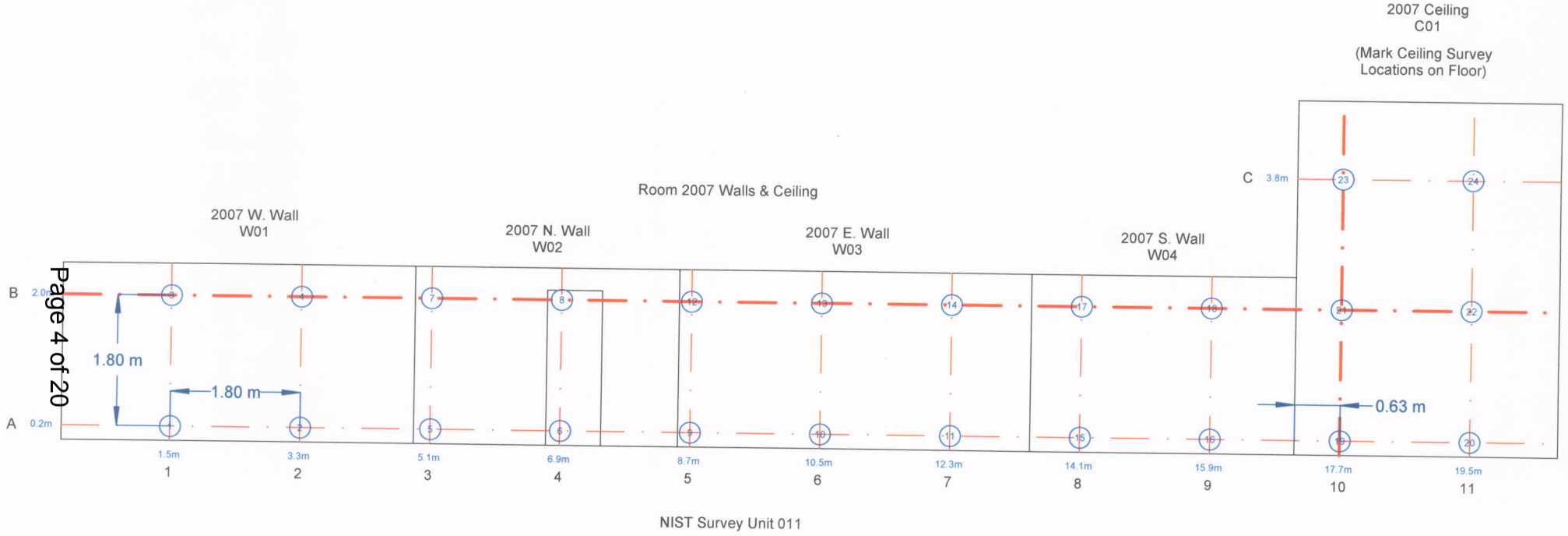
Survey Comments

Package Review

Surveyor(s) Signatures: Sharon McChesney Edward E. Sum

Date Package Completed: 4/1/09

Package Reviewed by and Date (Signature): Paul Ely 4/1/09


2007 Ceiling
C01
(Mark Ceiling Survey
Locations on Floor)
Room 2007 Walls & Ceiling
2007 W. Wall
W01
2007 N. Wall
W02
2007 E. Wall
W03
2007 S. Wall
W04
C 3.8m
B 2.0m
A 0.2m
1.80 m
1.80 m
0.63 m
1.5m
3.3m
5.1m
6.9m
8.7m
10.5m
12.3m
14.1m
15.9m
17.7m
19.5m
1
2
3
4
5
6
7
8
9
10
11
NIST Survey Unit 011

ATTACHMENT 14 - SURVEY DOWNLOAD DATA SHEET

Download Technician: Print Name: Sean McChesney **Signature:** [signature] **Date:** 3/20/09

Download Station #: #3 Download File #: 30
Serial # Verification: Model 2350-1 ☐ Detector: ☐ Problems: (See Comments)

Survey Technician(s):
Print Name: Sharon McChesney **User ID** SXM1098 **Signature:** [signature] **Date:** 3-20-09

Print Name: _____ **User ID** _____ **Signature:** _____ **Date:** _____

Instrument Serial #(s): Model 2350-1: 117566

Survey Unit Description: 5407F 5411F Rm2007 Points on Floor A1-A20, Walls A1-B18, Ceiling A19-C24
(Example: Survey Package + description i.e. D16, Building 43, Area 09, Room 100, Floor - Grid Locations A1 through A7)

Instrument Calibration Due Date: 10-8-09 Detector Calibration Due Date: 8-8-09

Type Of Survey: ☒ Term Survey ☒ ~~Characterization~~ ☐ Information Only
Other (explain): PEER 3-21-09

Type of Measurement	Detector Serial Number	Detector Model Number	Detector Efficiency	Source Mean BKG Value	Pre & Post Use Info	
					Pre File#	Post File#
☐ Alpha α		43-37				
☐ Beta β		43-68B				
☒ Alpha α	092508	43-68A	.0414		28	
☐ Gamma γ		44-2	N/A	N/A		
☐ Alpha α		43-93				

Local Area Background Measurements — MEAN Value in cpm ↓

β Beta	1	2	3	4	5	6	
α Alpha	1 1	2 3	3 2	4 11	5	6	4.3

COMMENTS: _____

Duratek™

M2350-1 Download ALPHA Report

5407F PCE 3-21-09

Station 3 File : 00000030	Survey Description :SU11F Room 2007 Points on Floor, Walls and Ceiling	
Survey Reason : ~~Characterization~~ FSS PCE 3-30-09		
User ID : SXM1098	Technician Name : Sharon McChesney	
Instrument Model : 2350-1	Instrument S/N : 117566	Instrument Cal. Due : 10/8/2009
Detector Model : 43-68A	Detector S/N : 092508	Detector Cal. Due : 8/8/2009
Measurement Type : ALPHA	Detector Type : 01200 : 126 cm2 Gas Proportional Detector, Alpha Window	
Detector Area : 126	Efficiency : 0.0414	Survey Date : 3/20/2009

Print Name	Signature	Date
Sharon McChesney	Sharon McChesney	3-20-09

Comments:

Sign-Off

Print Name	Signature	Date
PAUL ELY	Paul C Ely	3-21-09

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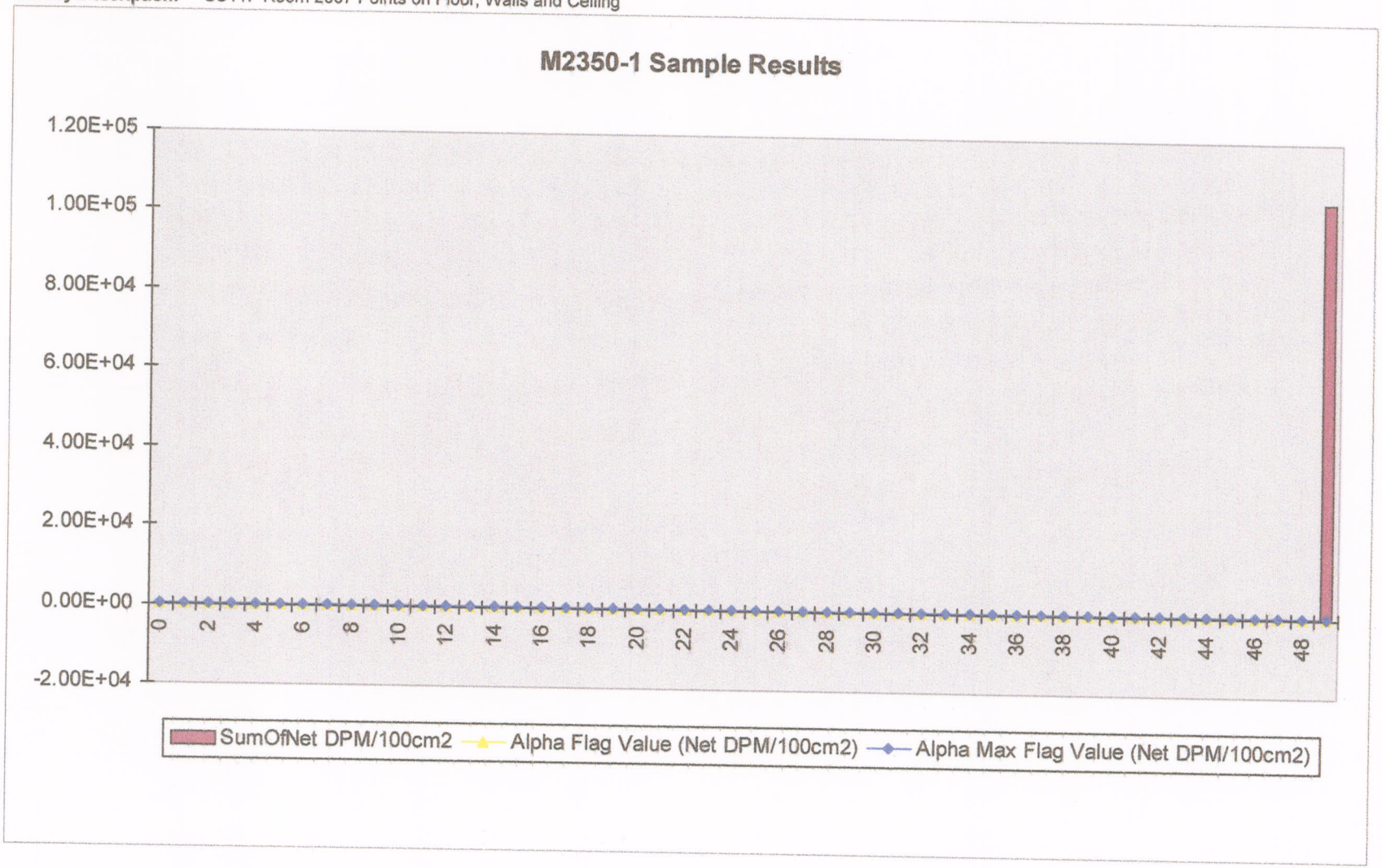
Download Name: 00000030

Survey Description: SU11F Room 2007 Points on Floor, Walls and Ceiling



Duratek Alpha Survey Report

Download File Name: 00000030

Package ID(L1)	Surface (L2)	Sample #	Counts	Time (sec)	Count Type (L5)	Material Type (L6)	Grid ID(L7)	Location # (L8)	Bkgd	Net DPM/100cm2
SU07F	FL01	0	1.0	60	FLDBK	B0002	ZZZZZ	1	4	-58
SU07F	FL01	1	7.0	60	FLDCT	B0002	A	1	4	58
SU07F	FL01	2	9.0	60	FLDCT	B0002	A	2	4	96
SU07F	FL01	3	1.0	60	FLDCT	B0002	A	3	4	-58
SU07F	FL01	4	6.0	60	FLDCT	B0002	A	4	4	38
SU07F	FL01	5	6.0	60	FLDCT	B0002	B	5	4	38
SU07F	FL01	6	3.0	60	FLDCT	B0002	B	6	4	-19
SU07F	FL01	7	2.0	60	FLDCT	B0002	B	7	4	-38
SU07F	FL01	8	4.0	60	FLDCT	B0002	B	8	4	0
SU07F	FL01	9	7.0	60	FLDCT	B0002	C	9	4	58
SU07F	FL01	10	0.0	60	FLDCT	B0002	C	10	4	-77
SU07F	FL01	11	2.0	60	FLDCT	B0002	C	11	4	-38
SU07F	FL01	12	0.0	60	FLDCT	B0002	C	12	4	-77
SU07F	FL01	13	4.0	60	FLDCT	B0002	D	13	4	0
SU07F	FL01	14	7.0	60	FLDCT	B0002	D	14	4	58
SU07F	FL01	15	8.0	60	FLDCT	B0002	D	15	4	77
SU07F	FL01	16	2.0	60	FLDCT	B0002	D	16	4	-38
SU07F	FL01	17	1.0	60	FLDCT	B0002	E	17	4	-58
SU07F	FL01	18	6.0	60	FLDCT	B0002	E	18	4	38
SU07F	FL01	19	10.0	60	FLDCT	B0002	E	19	4	115
SU07F	FL01	20	4.0	60	FLDCT	B0002	E	20	4	0
SU07F	FL01	21	3.0	60	FLDBK	B0002	ZZZZZ	2	4	-19
SU11F	W01	22	5.0	60	FLDCT	B0010	A	1	4	19
SU11F	W01	23	3.0	60	FLDCT	B0010	A	2	4	-19
SU11F	W01	24	9.0	60	FLDCT	B0010	B	3	4	96
SU11F	W01	25	7.0	60	FLDCT	B0010	B	4	4	58
SU11F	W02	26	5.0	60	FLDCT	B0010	A	5	4	19
SU11F	W02	27	7.0	60	FLDCT	B0010	A	6	4	58
SU11F	W02	28	3.0	60	FLDCT	B0010	B	7	4	-19
SU11F	W02	29	6.0	60	FLDCT	B0010	B	8	4	38
SU11F	W03	30	9.0	60	FLDCT	B0010	A	9	4	96
SU11F	W03	31	6.0	60	FLDCT	B0010	A	10	4	38
SU11F	W03	32	2.0	60	FLDCT	B0010	A	11	4	-38
SU11F	W03	33	9.0	60	FLDCT	B0010	B	12	4	96
SU11F	W03	34	7.0	60	FLDCT	B0010	B	13	4	58
SU11F	W03	35	9.0	60	FLDCT	B0010	B	14	4	96
SU11F	W04	36	3.0	60	FLDCT	B0010	A	15	4	-19
SU11F	W04	37	5.0	60	FLDCT	B0010	A	16	4	19

Alpha Flag	50 -
Alpha Max Flag	100

Friday, March 20, 2009

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Package ID(L1)	Surface (L2)	Sample #	Counts	Time (sec)	Count Type (L5)	Material Type (L6)	Grid ID(L7)	Location # (L8)	Bkgd	Net DPM/100cm2
SU11F	W04	38	12.0	60	FLDCT	B0010	B	17	4	153
SU11F	W04	39	6.0	60	FLDCT	B0010	B	18	4	38
SU11F	W04	40	2.0	60	FLDBK	B0010	ZZZZZ	3	4	-38
SU11F	C01	41	12.0	60	FLDCT	B0010	A	19	4	153
SU11F	C01	42	12.0	60	FLDCT	B0010	A	20	4	153
SU11F	C01	43	15.0	60	FLDCT	B0010	B	21	4	211
SU11F	C01	44	13.0	60	FLDCT	B0010	B	22	4	173
SU11F	C01	45	17.0	60	FLDCT	B0010	C	23	4	249
SU11F	C01	46	15.0	60	FLDCT	B0010	C	24	4	211
SU11F	C01	47	11.0	60	FLDBK	B0010	ZZZZZ	4	4	134
ZZZZZ	ZZZZZ	48	68.0	600	PTABK	B9999	ZZZZZ	1	0	130
ZZZZZ	ZZZZZ	49	5,461.0	60	PTSC1	B9999	ZZZZZ	1	0	104,689

Alpha Flag	50	-
Alpha Max Flag	100	

2007

ATTACHMENT 14 - SURVEY DOWNLOAD DATA SHEET ✓

Download Technician: Print Name: Sean McChesney **Signature:** [signature] **Date:** 3/20/09

Download Station #: 13 Download File #: 29

Serial # Verification: Model 2350-1 ☐ Detector: ☐ Problems: (See Comments)

Survey Technician(s):

Print Name: Siemers **User ID** ees 658 **Signature:** [signature] **Date:** 3.20.09

Print Name: _____ **User ID** _____ **Signature:** _____ **Date:** _____

Instrument Serial #(s): Model 2350-1: 80502

Survey Unit Description: Rm 2007 Walls 1, 2, 3 / ceiling B-21

(Example: Survey Package + description i.e. D16, Building 43, Area 09, Room 100, Floor - Grid Locations A1 through A7)

Instrument Calibration Due Date: 9.12.09 Detector Calibration Due Date: 2.10.10

Type Of Survey: ☒ Term Survey ☐ Characterization ☐ Information Only

Other (explain): FSS

Type of Measurement	Detector Serial Number	Detector Model Number	Detector Efficiency	Source Mean BKG Value	Pre & Post Use Info	
					Pre File#	Post File#
☐ Alpha α		43-37				
☐ Beta β		43-68B				
☒ Alpha α	75614	43-68A	.0428			
☐ Gamma γ		44-2	N/A	N/A		
☐ Alpha α		43-93				

Local Area Background Measurements — MEAN Value in cpm ↓

β Beta	1	2	3	4	5	6	—
α Alpha	1	2	3	4	5	6	5

COMMENTS: _____

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M2350-1 Download ALPHA Report

Station 3 File : 00000029	Survey Description :Room 2007 wall 1,2,3,ceiling B-21 54011	
Survey Reason : ~~Characterization~~ FSS 3-21-09 PRE		
User ID : EES6581	Technician Name : Ed Siemers	
Instrument Model : 2350-1	Instrument S/N : 80502	Instrument Cal. Due : 9/12/2009
Detector Model : 43-68A	Detector S/N : 075164	Detector Cal. Due : 2/25/2010
Measurement Type : ALPHA	Detector Type : 01200 : 126 cm2 Gas Proportional Detector, Alpha Window	
Detector Area : 126	Efficiency : 0.0482	Survey Date : 3/20/2009

Print Name	Signature	Date
Ed Siemers	Ed Siemers	3/20/09

Comments:

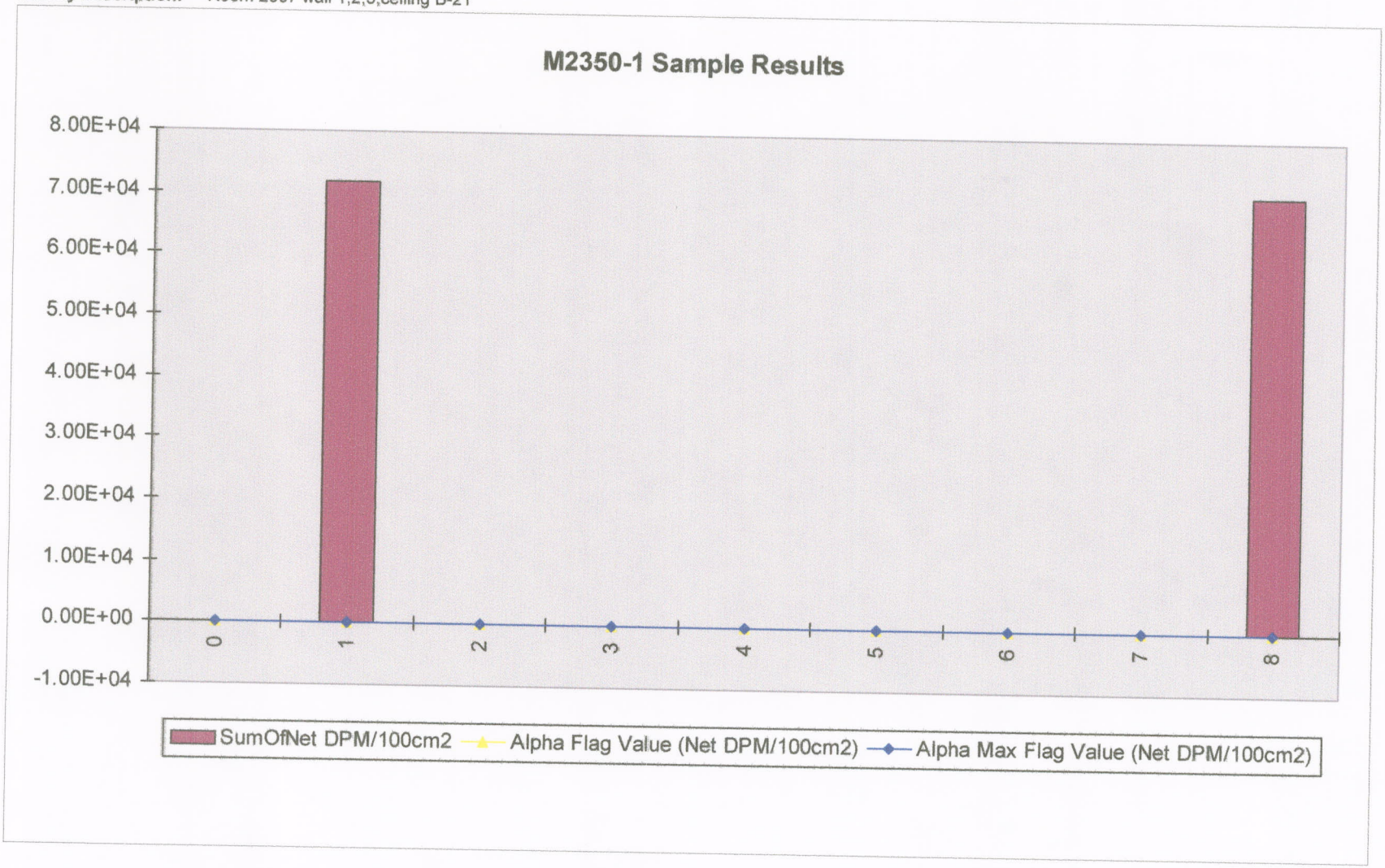
Sign-Off

Print Name	Signature	Date
Paul Ely	Paul Ely	3-21-09

Page 1 of 3

Download Name: 00000029

Survey Description: Room 2007 wall 1,2,3,ceiling B-21



Duratek Alpha Survey Report

Download File Name: 00000029

Package ID(L1)	Surface (L2)	Sample #	Counts	Time (sec)	Count Type (L5)	Material Type (L6)	Grid ID(L7)	Location # (L8)	Bkgd	Net DPM/100cm2
ZZZZZ	ZZZZZ	0	32.0	600	PRABK	B0002	ZZZZZ	1	0	53
ZZZZZ	ZZZZZ	1	4,363.0	60	PRSC1	B0002	ZZZZZ	1	0	71,840
SU11S	W1	2	3.0	60	FLDBK	B0010	B	3	5	-33
SU11S	W2	3	5.0	60	FLDBK	B0010	B	7	5	0
SU11S	W2	4	8.0	60	FLDBK	B0010	B	8	5	49
SU11S	W3	5	5.0	60	FLDBK	B0010	B	13	5	0
SU11S	C01	6	7.0	60	FLDBK	B0010	B	21	5	33
SU11S	C01	7	58.0	600	PTABK	B0010	B	21	5	13
SU11S	C01	8	4,319.0	60	PTSC1	B0010	B	21	5	71,033

Alpha Flag	50 -
Alpha Max Flag	100

Friday, March 20, 2009

NIST BOULDER FSS GRID RECORD

Survey Package:	SWIS	Room / Surface:	2007-walls
Instrument Model No:	2350-1	Instrument Serial No:	80502
Detector Model No:	43 68A	Detector Serial No:	75164
Detector Area (cm^2)	126	Detector Total α Eff:	.0428
Technician Name	Siemens		

GRID	MAX READING (cpm)	INITIALS	DATE
B-3	9	[illegible]	3.20.09
B7	15	[illegible]	3.20.09
B-8	11	[illegible]	3.20.09
B-13	6	[illegible]	3-20-09
B-21	7	[illegible]	3.20.09

FSS ENGINEER REVEIW Paul Ely DATE 3-21-09

Tennelec XLB Series 5 - NIST Boulder - FSS Smear Analysis (Fixed Activity Equivalent)

Report Revision: NIST-2 NIST09-0424

Date: 3/20/2009 2:38:24PM

Counting Unit ID: Tennelec 84920

Batch Name: FSS Smears 3 min - 200903201438

Batch Start Time: Fri, March 20, 2009 02:38:24 PM

Geometry: 1/8" Stainless Steel

Alpha Surface Eff. (including self Absorption) %: 0.25

Beta Surface Eff. (including self Absorption) %: 0.25

Alpha Detection Factor: 0.52 **Beta Detection Factor:** 1.00

Alpha BS: 0.05

Beta BS: 0.30

Alpha Activity Action Level (DPM): 696.00

Beta Activity Action Level (DPM): 10,000.00

Certainty Level for MDA and Flags: 95%

High Voltage Setting: 1380

Count Minutes: 3.00

Total alpha Efficiency %: 0.85

Total beta Efficiency %: 0.93

Smear Removal Factor: 0.10

Background Subtract: Background Subtracted

Batch ID: 54011

Alpha Eff. Std:	060101 Alpha Th-230
4 π Alpha Eff. %:	34.29 ± 0.30
2 π Alpha Eff. %:	65.32 ± 0.58
Alpha BG CPM:	0.08 ± 0.04
Beta Eff. Std:	079706 Beta Tc-99
4 π Beta Eff. %:	24.19 ± 0.32
2 π Beta Eff. %:	37.22 ± 0.49
Beta BG CPM:	1.52 ± 0.16

Cal Due: Aug 15 2009

Carrier	Sample ID	Alpha Activity DPM	Alpha Activity 2 Sigma	Alpha Activity Fla	Alpha Activity MDA	Beta Activity DPM	Beta Activity 2 Sigma	Beta Activity Fla	Beta Activity MDA	Count time (min)	Alpha CPM	Beta CPM	Count Start
46	1	-9.81	8.78	<MDA	172.40	159.40	217.67	<MDA	354.52	3.00	0.00	3.00	3/20/2009 4:46:08PM
47	2	-9.81	8.78	<MDA	172.40	-91.34	106.95	<MDA	354.52	3.00	0.00	0.67	3/20/2009 4:49:20PM
48	3	29.44	79.01	<MDA	172.40	123.58	205.52	<MDA	354.52	3.00	0.33	2.67	3/20/2009 4:52:33PM
49	4	-9.81	8.78	<MDA	172.40	159.40	217.67	<MDA	354.52	3.00	0.00	3.00	3/20/2009 4:55:46PM
50	5	29.44	79.01	<MDA	172.40	51.94	178.79	<MDA	354.52	3.00	0.33	2.00	3/20/2009 4:58:59PM
51	6	29.44	79.01	<MDA	172.40	123.58	205.52	<MDA	354.52	3.00	0.33	2.67	3/20/2009 5:02:12PM
52	7	29.44	79.01	<MDA	172.40	266.87	250.62	<MDA	354.52	3.00	0.33	4.00	3/20/2009 5:05:25PM
53	8	-9.81	8.78	<MDA	172.40	-55.52	128.72	<MDA	354.52	3.00	0.00	1.00	3/20/2009 5:08:38PM
54	9	29.44	79.01	<MDA	172.40	16.12	163.80	<MDA	354.52	3.00	0.33	1.67	3/20/2009 5:11:51PM
55	10	-9.81	8.78	<MDA	172.40	51.94	178.79	<MDA	354.52	3.00	0.00	2.00	3/20/2009 5:15:04PM
56	11	-9.81	8.78	<MDA	172.40	123.58	205.52	<MDA	354.52	3.00	0.00	2.67	3/20/2009 5:18:17PM
57	12	-9.81	8.78	<MDA	172.40	159.40	217.67	<MDA	354.52	3.00	0.00	3.00	3/20/2009 5:21:30PM
58	13	-9.81	8.78	<MDA	172.40	195.22	229.17	<MDA	354.52	3.00	0.00	3.33	3/20/2009 5:24:43PM
59	14	29.44	79.01	<MDA	172.40	87.76	192.62	<MDA	354.52	3.00	0.33	2.33	3/20/2009 5:27:55PM
60	15	-9.81	8.78	<MDA	172.40	123.58	205.52	<MDA	354.52	3.00	0.00	2.67	3/20/2009 5:31:08PM
61	16	-9.81	8.78	<MDA	172.40	51.94	178.79	<MDA	354.52	3.00	0.00	2.00	3/20/2009 5:34:21PM
69	17	29.44	79.01	<MDA	172.40	51.94	178.79	<MDA	354.52	3.00	0.33	2.00	3/20/2009 5:37:34PM
62	18	29.44	79.01	<MDA	172.40	195.22	229.17	<MDA	354.52	3.00	0.33	3.33	3/20/2009 5:40:47PM
63	19	68.70	111.39	<MDA	172.40	195.22	229.17	<MDA	354.52	3.00	0.67	3.33	3/20/2009 5:44:00PM
64	20	-9.81	8.78	<MDA	172.40	87.76	192.62	<MDA	354.52	3.00	0.00	2.33	3/20/2009 5:47:13PM
65	21	-9.81	8.78	<MDA	172.40	16.12	163.80	<MDA	354.52	3.00	0.00	1.67	3/20/2009 5:50:26PM
66	22	-9.81	8.78	<MDA	172.40	16.12	163.80	<MDA	354.52	3.00	0.00	1.67	3/20/2009 5:53:39PM
67	23	29.44	79.01	<MDA	172.40	159.40	217.67	<MDA	354.52	3.00	0.33	3.00	3/20/2009 5:56:52PM
68	24	-9.81	8.78	<MDA	172.40	87.76	192.62	<MDA	354.52	3.00	0.00	2.33	3/20/2009 6:00:05PM

2007 Walls & Ceilings

QA Reviewer: Paul Ely **Date:** 3-30-09 **Technician:** LC. Finn **Date:** 3-23-09

Static and Scan MDC Worksheet for 43-68 Gas Flow Proportional Detectors

Static MDC (43-68)

$$MDC_{alpha} = \frac{\frac{3}{t_s} + 3.29 * \sqrt{\left(\frac{R_b}{t_s} + \frac{R_b}{t_b}\right)}}{\varepsilon_i * \varepsilon_s * \frac{A}{100}}$$

CS-FO-PR-001 Rev. 1, Section 4.8.1.2

Scan MDC (43-68)

$$MDC_{Scan} = \frac{d' * \sqrt{b_i} * \frac{60}{i}}{\sqrt{p} * \varepsilon_i * \varepsilon_s * \frac{A}{100}}$$

CS-FO-PR-001 Rev. 1, Section 4.8.3.3 to 4.8.3.5

Inputs		
INST#=	80502	Instrument Serial Number
DET#=	75164	Detector Serial Number
R_B =	2.6	Background Count Rate (cpm)
t_b =	10	Background Count Time (min)
t_s =	1	Sample Count Time (min)
A =	126	Area of Detector (cm^2)
$\varepsilon_{4\pi}$ =	0.192	Detector Efficiency (4π)
BS =	0.05	Backscatter
ε_i =	0.366	Detector Efficiency (2π)
ε_s =	0.25	Surface Efficiency
S_ε =	0.52	source efficiency (radionuclide detectability)

Outputs		
ε_t =	0.0475	**Total Detection Efficiency**
MDC =	143	**dpm/100 cm^2**

Enter data

Formula, enter 2π efficiency data directly if available

Change if neccesary

Inputs		
INST#=	80502	Instrument Serial Number
DET#=	75164	Detector Serial Number
d' =	1.38	Index of Sensitivity
p =	0.50	Surveyor Efficiency
Scan ε_i =	0.33	Scanning Instrument Efficiency (2π)
Scan ε_s =	0.25	Scanning Surface Efficiency
S_ε =	0.52	source efficiency (radionuclide detectability)
43-68		
Scan Speed =	2.2	(cm/sec)
R_B =	2.6	Background Count Rate (cpm)
b_i =	0.173333	Background counts per observation interval
Detector Width =	8.8	width of detector in direction of scan (cm)
A =	126	Area of Detector (cm^2)

Outputs		
43-68		
ε_t =	0.0428	**Total Detection Efficiency**
i =	4.00	**Observation interval in seconds (detector width divided by the scan speed)**
Scan MDC =	226	**dpm/100 cm^2**

Reviewed by: Paul Ely

Date: 3-21-09

Static and Scan MDC Worksheet for 43-68 Gas Flow Proportional Detectors

Static MDC (43-68)

$$MDC_{alpha} = \frac{\frac{3}{t_s} + 3.29 * \sqrt{\left(\frac{R_b}{t_s} + \frac{R_b}{t_b}\right)}}{\varepsilon_i * \varepsilon_s * \frac{A}{100}}$$

CS-FO-PR-001 Rev. 1, Section 4.8.1.2

Inputs		
INST#=	117566	Instrument Serial Number
DET#=	92508	Detector Serial Number
R_B =	1.6	Background Count Rate (cpm)
t_b =	10	Background Count Time (min)
t_s =	1	Sample Count Time (min)
A =	126	Area of Detector (cm^2)
$\varepsilon_{4\pi}$ =	0.167	Detector Efficiency (4π)
BS =	0.05	Backscatter
ε_i =	0.318	Detector Efficiency (2π)
ε_s =	0.25	Surface Efficiency
S_ε =	0.52	source efficiency (radionuclide detectability)

Outputs		
ε_t =	0.0414	**Total Detection Efficiency**
MDC =	**141**	**dpm/100 cm^2**

Enter data

Formula, enter 2π efficiency data directly if available

Change if neccesary

Scan MDC (43-68)

$$MDC_{Scan} = \frac{d' * \sqrt{b_i} * \frac{60}{i}}{\sqrt{p} * \varepsilon_i * \varepsilon_s * \frac{A}{100}}$$

CS-FO-PR-001 Rev. 1, Section 4.8.3.3 to 4.8.3.5

Inputs		
INST#=	117566	Instrument Serial Number
DET#=	92508	Detector Serial Number
d' =	1.38	Index of Sensitivity
p =	0.50	Surveyor Efficiency
Scan ε_i =	0.29	Scanning Instrument Efficiency (2π)
Scan ε_s =	0.25	Scanning Surface Efficiency
S_ε =	0.52	source efficiency (radionuclide detectability)
43-68		
Scan Speed =	2.2	(cm/sec)
R_B =	1.6	Background Count Rate (cpm)
b_i =	0.106667	Background counts per observation interval
Detector Width =	8.8	width of detector in direction of scan (cm)
A =	126	Area of Detector (cm^2)

Outputs		
43-68		
ε_t =	0.0372	**Total Detection Efficiency**
i =	**4.00**	**Observation interval in seconds (detector width divided by the scan speed)**
Scan MDC =	**204**	**dpm/100 cm^2**

Reviewed by: Paul Ely

Date: 3-18-09

BUILDING SURFACE SURVEY PLAN

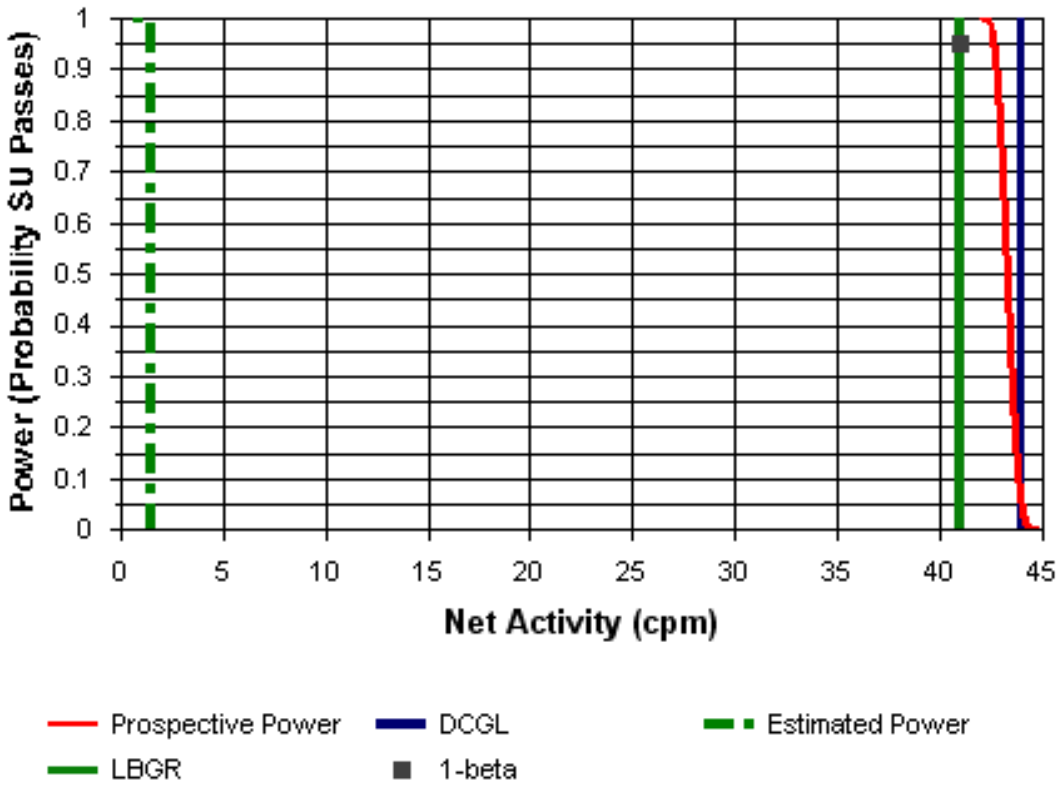
Survey Plan Summary

Site Name:	NIST Boulder Campus
Planner(s):	p ely
Survey Unit Name:	SU011 Room 2007 Walls & Ceiling
Comments:	N/A

Statistical Design Details

Area (m²):	60	Classification:	2
Selected Test:	Sign	Estimated Sigma (cpm/100 cm²):	1.2
DCGL (cpm/100 cm²):	44	Sample Size (N):	**14**
LBGR (cpm/100 cm²):	41	Estimated Conc. (cpm/100 cm²):	1.4
Alpha:	0.050	Estimated Power:	1.0
Beta:	0.050		

Prospective Power Curve



Gross Activity Efficiency Data

Instrument Description:	Ludlum 43-68 Gas Flow Proportional
Physical Detector Area (cm²):	126
DCGLw (dpm/100 cm²):	696
Total Efficiency:	0.05
DCGLw (cpm/100 cm²):	44

Contaminant	HTDC[a]	Energy[b]	Fract[c]	Inst. Eff.	Surf. Eff.	Total Eff.
Am-241	No	N/A	0.10	0.36	0.25	0.01
Pu-238	No	N/A	0.01	0.36	0.25	0.00
Pu-239	No	N/A	0.31	0.36	0.25	0.03
Pu-240	No	N/A	0.10	0.36	0.25	0.01
Pu-241	Yes	5.23	0.48	0.00	0.00	0.00

[a]Hard-to-detect contaminant [b]Average beta energy (keV) [N/A indicates alpha emission] [c]Activity fraction

Gross Activity Mean and Sigma Data

Count Time (min):	1
Sign Test Sigma (cpm/100 cm²):	1.2

Data/Material	Mean (cpm/100 cm²)	Std. Dev. (cpm/100 cm²)	MDC (dpm/100 cm²)
SU	1.4	1.2	135

Report Created 02/18/2009 1038 (*COMPASS v1.1.0*)

Survey Unit 011
Class 2
Walls & Ceiling in Room 2007

X (Max):	**68.0**	feet	20.7	meters	Estimated dimension
Y (Max):	**16.0**	feet	4.9	meters	Estimated dimension
A (Area):	1,088	ft^2	101	m^2	Area of Survey area
Actual Survey Area:	640	ft^2			
Required Survey Points:	**14**	41%	Percent void area		
N (Points):	**32**	24	Estimated Minimum Points		

$$L = \left[\frac{A}{N} \right]^{1/2}$$

Spacing for a square grid

L=	1.8	meters	(distance between measurement points)

X (Random):	5.5	random generated number
Y (Random):	0.9	random generated number
X (Origin):	17.7	initially generated random number
Y (Origin):	2.0	initially generated random number