

9.16 DETAILED RESULTS FOR SURVEY UNIT 016

Room 2120 Upper Walls & Ceiling in Low Ceiling Area (Class 1 Interior Area)

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Survey Package Worksheet for
NIST Boulder SU016

Package Identification No.: SU16F/SU16S	Prepared by: Paul C. Ely
Location: Room 2120 Upper Walls & Ceiling in Low Ceiling Area (Class 1 Interior Area)	Date Prepared: 4/6/2009
Area Classification: Class 1	Signature: <i>Paul Ely</i>

Area Description

The survey area includes all wall areas above 2 meters and the ceiling in the Low Ceiling Area.

Historical Information

On June 9, 2008, researchers ruptured a glass vial of 0.25 grams of mixed plutonium isotopes in the form of $\text{PuSO}_4 \cdot 4\text{H}_2\text{O}$ 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. The low ceiling area of SU015 was changed from Class 2 to Class 1 after a contaminated wall smear was obtained during the final status survey from near where ductwork was removed from the Room 2120 vent hood.

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). $\epsilon_i = (2 * \epsilon_{4\pi}) \setminus (1 + \text{BS})$
 - 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 = $\epsilon_i * \epsilon_s * \epsilon_f$
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.
 - 100% 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 at 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 cm².
- 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 cm² total alpha surface activity.
- Attach photographic records if available and provide descriptive comments for each image under Survey Comments.

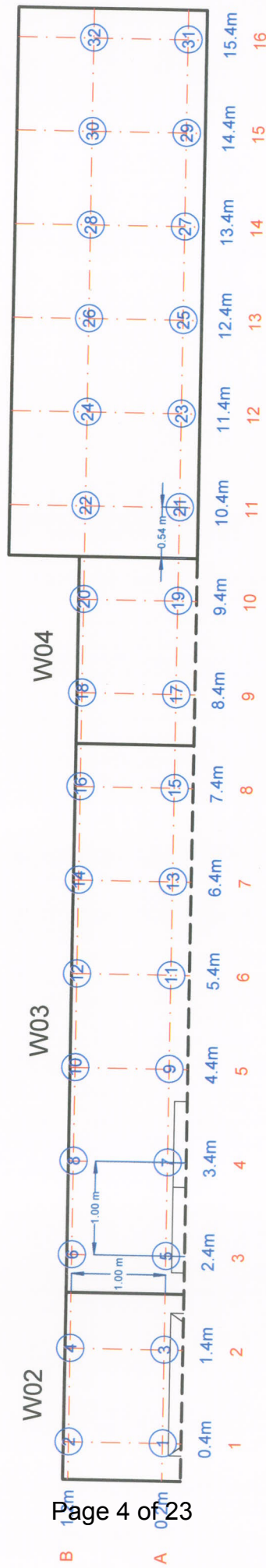
Survey performance (Initial and date as each survey is complete)

Location Code					General Description	Beta Scan	Direct Beta	Direct Alpha	Alpha Scan	Direct Gamma	Smear Gross
L1	L2	L6	L7	L8							
NIST Boulder SU015 Class 2 Area											
Package ID	Surface or Structure	Material Code	Row	Column Number			@60 sec	100%	@100 cm	α	
SU16F	W02	B0005	A thru B	1 thru 2	Upper Wall	N/A	4 VB 4-6-09	N/A	N/A	4 SM 4-6-09	
SU16F	W03	B0005	A thru B	3 thru 8	Upper Wall	N/A	12 VB 4-6-09	N/A	N/A	12 SM 4-6-09	
SU16F	W04	B0005	A thru B	9 thru 10	Upper Wall	N/A	4 VB 4-6-09	N/A	N/A	4 SM 4-6-09	
SU16F	C01	B0010	A thru B	11 thru 16	Ceiling	N/A	12 VB 4-6-09	N/A	N/A	12 SM 4-6-09	
SU16S	W02	B0005	A thru B	1 thru 2	Upper Wall	N/A	N/A	SM 4-6-09	N/A	N/A	
SU16S	W03	B0005	A thru B	3 thru 8	Upper Wall	N/A	N/A	SM 4-6-09	N/A	N/A	
SU16S	W04	B0005	A thru B	9 thru 10	Upper Wall	N/A	N/A	SM 4-6-09	N/A	N/A	
SU16S	C01	B0010	A thru D	11 thru 16	Ceiling	N/A	N/A	SM 4-6-09	N/A	N/A	

[illegible]

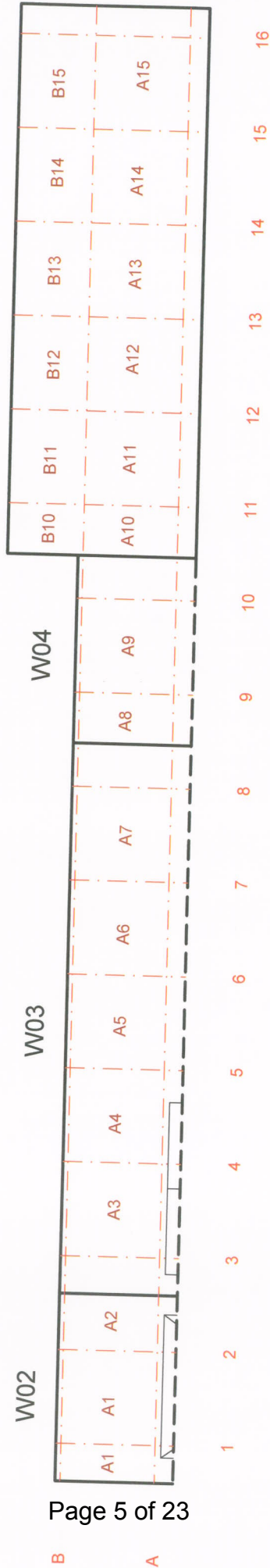
Surveyor(s) Signatures:	Sharon McQuinn, Vicki Baldwin
Date Package Completed:	4/8/09
Package Reviewed by and Date (Signature):	Paul Ely 4/8/09

Room 2120 Low Ceiling Area Upper Walls & Ceiling
C01



NIST Survey Unit 016

Room 2120 Low Ceiling Area Upper Walls & Ceiling
 Scan Grids
 2120 Low Ceiling
 C01



NIST Survey Unit 016

ATTACHMENT 14 - SURVEY DOWNLOAD DATA SHEET

Download Technician: Print Name: Sean McChesney

Signature: [Signature]

Date: 4/7/09

Download Station #: 1

Download File #: 188

Serial # Verification: Model 2350-1 ☐

Detector: ☐

Problems: (See Comments)

Survey Technician(s):

Print Name: Vicky Baldwin

User ID: VMBU153

Signature: [Signature]

Date: 4-6-09

Print Name: _____

User ID: _____

Signature: _____

Date: _____

Instrument Serial #(s): Model 2350-1: 95359

Survey Unit Description: Rm 2120 Low Ceiling & Upper Walls Direct Measurements

(Example: Survey Package + description i.e. D18, Building 43, Area 09, Room 100, Floor - Grid Locations A1 through A7)

Instrument Calibration Due Date: 9/3/09

Detector Calibration Due Date: 7/15/09

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	<u>119445</u>	43-68A	<u>0.0473</u>			
☐ Gamma γ		44-2	N/A	N/A		
☐ Alpha α		43-93				

Local Area Background Measurements

MEAN Value in cpm ↓

	1	2	3	4	5	6	
β Beta							
α Alpha	<u>3</u>	<u>4</u>	<u>5</u>				<u>4.0</u>

COMMENTS: _____



Station 1 00000188	Survey Description :Rm 2120 Low ceiling and Upper walls, Direct measur	
Survey Reason : Termination		
User ID : VMB6153	Technician Name : Vicky Baldwin	
Instrument Model : 2350-1	Instrument S/N : 95359	Instrument Cal. Due : 9/3/09
Detector Model : 43-68A	Detector S/N : 119445	Detector Cal. Due : 7/15/09
Measurement Type : ALPHA	Detector Type : 01200 : 126 cm2 Gas Proportional Detector, Alpha Window	
Detector Area : 126	Efficiency : 0.0473	Survey Date : 4/6/09

Date _____

Date _____

- $\propto$ Direct measurements

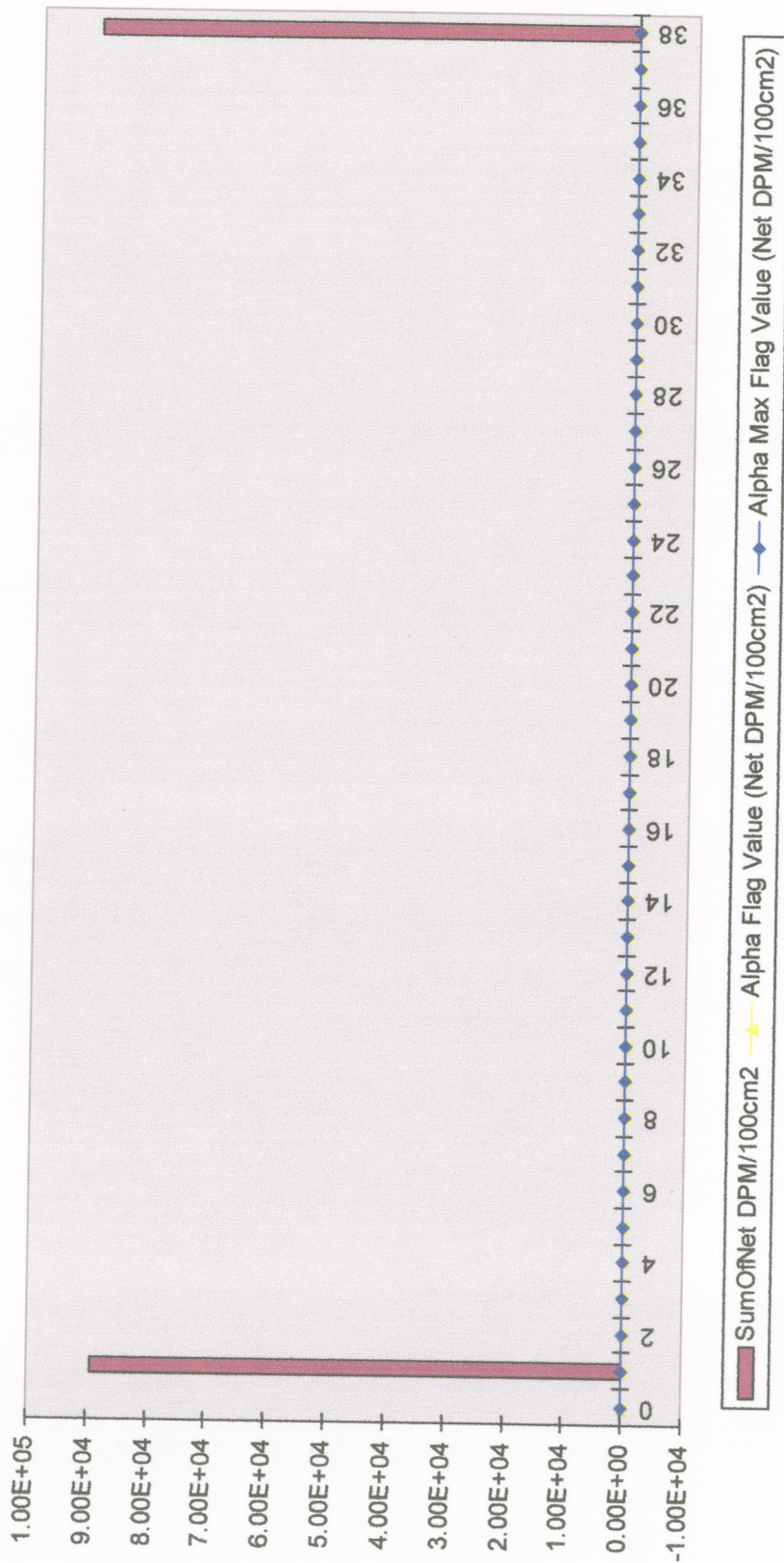
Date _____

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Download Name: 00000188

Survey Description: Rm 2120 Low ceiling and Upper walls, Direct measur

M2350-1 Sample Results



Duratek Alpha Survey Report

Download File Name: 00000188

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	18.0	600	PRABK	B9999	ZZZZZ	1	0	30
ZZZZZ	ZZZZZ	1	5,313.0	60	PRSC1	B9999	ZZZZZ	2	0	89,147
ZZZZZ	ZZZZZ	2	3.0	60	FLDBK	B9999	ZZZZZ	1	0	50
SU16F	W02	3	4.0	60	FLDBK	B0005	A	1	4	0
SU16F	W02	4	5.0	60	FLDCT	B0005	B	2	4	17
SU16F	W02	5	14.0	60	FLDCT	B0005	A	3	4	168
SU16F	W02	6	5.0	60	FLDCT	B0005	B	4	4	17
SU16F	W03	7	8.0	60	FLDCT	B0005	A	5	4	67
SU16F	W03	8	3.0	60	FLDCT	B0005	B	6	4	-17
SU16F	W03	9	4.0	60	FLDCT	B0005	A	7	4	0
SU16F	W03	10	3.0	60	FLDCT	B0005	B	8	4	-17
SU16F	W03	11	3.0	60	FLDCT	B0005	A	9	4	-17
SU16F	W03	12	5.0	60	FLDCT	B0005	B	10	4	17
SU16F	W03	13	5.0	60	FLDCT	B0005	A	11	4	17
SU16F	W03	14	4.0	60	FLDCT	B0005	B	12	4	0
SU16F	W03	15	5.0	60	FLDCT	B0005	A	13	4	17
SU16F	W03	16	5.0	60	FLDCT	B0005	B	14	4	17
SU16F	W03	17	2.0	60	FLDCT	B0005	A	15	4	-34
SU16F	W03	18	4.0	60	FLDCT	B0005	B	16	4	0
SU16F	W04	19	4.0	60	FLDCT	B0005	A	17	4	0
SU16F	W04	20	3.0	60	FLDCT	B0005	B	18	4	-17
SU16F	W04	21	4.0	60	FLDCT	B0005	A	19	4	0
SU16F	W04	22	4.0	60	FLDCT	B0005	B	20	4	0
SU16F	C01	23	4.0	60	FLDBK	B0010	A	2	4	0
SU16F	C01	24	7.0	60	FLDCT	B0010	A	21	4	50
SU16F	C01	25	7.0	60	FLDCT	B0010	B	22	4	50
SU16F	C01	26	5.0	60	FLDCT	B0010	A	23	4	17
SU16F	C01	27	4.0	60	FLDCT	B0010	B	24	4	0
SU16F	C01	28	7.0	60	FLDCT	B0010	B	25	4	50
SU16F	C01	29	5.0	60	FLDCT	B0010	B	26	4	17
SU16F	C01	30	3.0	60	FLDCT	B0010	A	27	4	-17
SU16F	C01	31	3.0	60	FLDCT	B0010	B	28	4	-17
SU16F	C01	32	3.0	60	FLDCT	B0010	A	29	4	-17
SU16F	C01	33	2.0	60	FLDCT	B0010	B	30	4	-34
SU16F	C01	34	6.0	60	FLDCT	B0010	A	31	4	34
SU16F	C01	35	8.0	60	FLDCT	B0010	B	32	4	67
SU16F	C01	36	5.0	60	FLDBK	B0010	B	3	4	17
ZZZZZ	ZZZZZ	37	37.0	600	PTABK	B9999	ZZZZZ	1	0	62

Alpha Flag

50 -

Alpha Max Flag

100

Tuesday, April 07, 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
ZZZZZ	ZZZZZ	38	5,383.0	60	PRSC1	B9999	ZZZZZ	2	0	90,322

Alpha Flag

50

-

Alpha Max Flag

100

Tuesday, April 07, 2009

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ATTACHMENT 14 - SURVEY DOWNLOAD DATA SHEET

Download Technician: Print Name: Sean McChesney

Signature: Sean McChesney

Date: 4/7/09

Download Station #: 1

Download File #: 185

Serial # Verification: Model 2350-1 ☐

Detector: ☐

Problems: (See Comments)

Survey Technician(s):

Print Name: Sharon McChesney User ID: SM1098

Signature: Sharon McChesney

Date: 4-6-09

Print Name: _____

User ID: _____

Signature: _____

Date: _____

Instrument Serial #(s): Model 2350-1: 98625

Survey Unit Description: 540165 Scan of upper walls and ceiling in 2120

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

Instrument Calibration Due Date: 11-14-09

Detector Calibration Due Date: 8-10-09

Type Of Survey:

☒ Term Survey

☒ Characterization

☐ Information Only

Other (explain):

FSR PCE 4-8-09

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	<u>075150</u>	43-68A	<u>.03816</u>			
☐ Gamma γ		44-2	N/A	N/A		
☐ Alpha α		43-93				

Local Area Background Measurements

MEAN Value in cpm ↓

	1	2	3	4	5	6	
β Beta							
α Alpha	<u>1.33</u>	<u>2.2</u>	<u>3.4</u>				<u>2.34</u>

COMMENTS: _____



Duratek™

M2350-1 Download ALPHA Report

Station 1 00000185		Survey Description : Scan of upper walls and ceiling in room 2120	
Survey Reason : Termination			
User ID : SXM1098		Technician Name : Sharon McChesney	
Instrument Model : 2350-1		Instrument S/N : 98625	Instrument Cal. Due : 11/4/09
Detector Model : 43-68A		Detector S/N : 075150	Detector Cal. Due : 8/10/09
Measurement Type : ALPHA		Detector Type : 01200 : 126 cm2 Gas Proportional Detector, Alpha Window	
Detector Area : 126		Efficiency : 0.0386	Survey Date : 4/6/09

Sharon McChesney

Print Name

Sharon McChesney

Signature

4-6-09

Date

Print Name

Signature

Date

Comments:

*Smear results on FSS Smear Analysis
NIST09-0525*

Sign-Off

Paul Ely

Print Name

Paul Ely

Signature

4/8/09

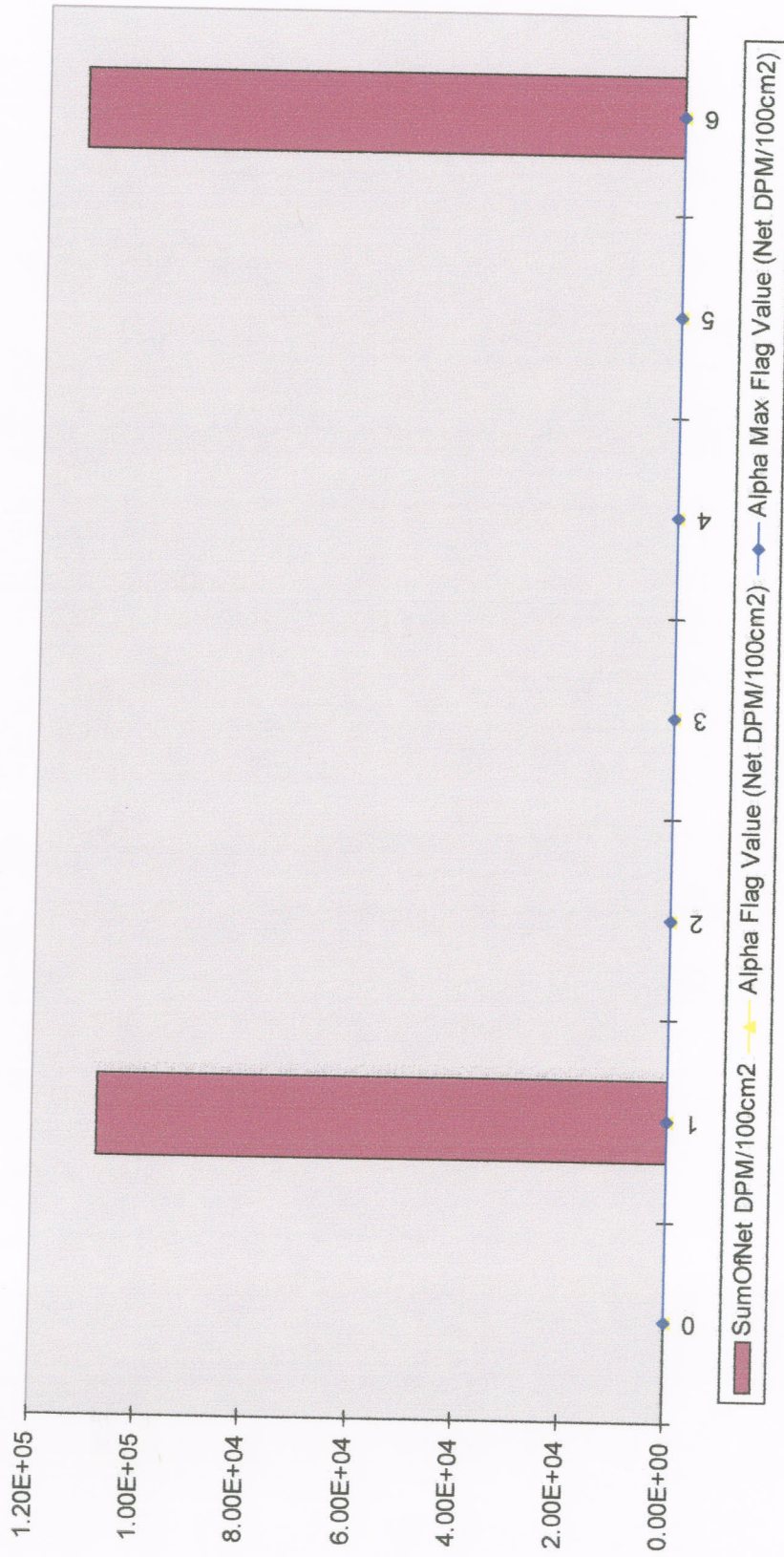
Date

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Download Name: 00000185

Survey Description: Scan of upper walls and ceiling in room 2120

M2350-1 Sample Results



Duratek Alpha Survey Report

Download File Name: 00000185

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	28.0	600	PRABK	ZZZZZ	ZZZZZ	1	0	58
ZZZZZ	ZZZZZ	1	5,234.0	60	PRSC1	ZZZZZ	ZZZZZ	2	0	107,616
SU16S	W02	2	3.0	60	FLDBK	B0005	ZZZZZ	1	3	0
SU16S	W02	3	2.0	60	FLDBK	B0005	ZZZZZ	2	3	-21
SU16S	W02	4	4.0	60	FLDBK	B0005	ZZZZZ	3	3	21
ZZZZZ	ZZZZZ	5	35.0	600	PTABK	B9999	ZZZZZ	1	0	72
ZZZZZ	ZZZZZ	6	5,485.0	60	PTSC1	B9999	ZZZZZ	1	0	112,777

Alpha Flag

50 -

Alpha Max Flag

100

Tuesday, April 07, 2009

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NIST BOULDER FSS GRID RECORD

Survey Package: <u>540165</u>	Room / Surface: <u>220/Wall & Ceiling</u>
Instrument Model No: <u>2350-1</u>	Instrument Serial No: <u>98625</u>
Detector Model No: <u>43-68A</u>	Detector Serial No: <u>075150</u>
Detector Area (cm ²): <u>126</u>	Detector Total α Eff: <u>.0386</u>
Technician Name: <u>Sharon McKeown</u>	

GRID	MAX READING (cpm)	INITIALS	DATE
A1	20	SXmc	4-6-09
A2	20	SXmc	
A3	15	SXmc	
A4	18	SXmc	
A5	18	SXmc	
A6	20	SXmc	
A7	20	SXmc	
A8	15	SXmc	
A9	15	SXmc	
A10	20	SXmc	
A11	8	SXmc	
A12	10	SXmc	
A13	15	SXmc	
A14	25	SXmc	
A15	20	SXmc	
B10	15	SXmc	
B11	20	SXmc	
B12	10	SXmc	
B13	10	SXmc	
B14	15	SXmc	
B15	20	SXmc	

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

Report Revision: NIST-2 N5709-0525

Date: 4/6/2009 3:44:37PM
 Counting Unit ID: Tennelec 84920
 Batch Name: FSS Smears 3 min - 200904061544
 Batch Start Time: Mon, April 06, 2009 03:44:37 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 Background Subtract: Background Subtracted
 Beta BS: 0.30 Batch ID:

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

Alpha Eff. Std:	060101 Alpha Th-230
4 π Alpha Eff. %:	34.29 $\pm$ 0.30
2 π Alpha Eff. %:	65.32 $\pm$ 0.58
Alpha BG CPM:	0.05 $\pm$ 0.03
Beta Eff. Std:	079706 Beta Tc-99
4 π Beta Eff. %:	24.19 $\pm$ 0.32
2 π Beta Eff. %:	37.22 $\pm$ 0.49
Beta BG CPM:	1.55 $\pm$ 0.16

Cal Due: Aug 15 2009

Carrier	Sample ID	Alpha Activity				Beta Activity				Count time (min)	Alpha CPM	Beta CPM	Count Start
		DPM	2 Sigma	Fla	MDA	DPM	2 Sigma	Fla	MDA				
1		33.37	78.81	<MDA	157.49	191.64	229.23	<MDA	357.34	3.00	0.33	3.33	4/6/2009 3:49:23PM
2		111.88	136.18	<MDA	157.49	-23.28	147.39	<MDA	357.34	3.00	1.00	1.33	4/6/2009 3:52:36PM
3		-5.89	6.80	<MDA	157.49	12.54	163.88	<MDA	357.34	3.00	0.00	1.67	4/6/2009 3:55:49PM
4		-5.89	6.80	<MDA	157.49	48.36	178.86	<MDA	357.34	3.00	0.00	2.00	4/6/2009 3:59:02PM
5		33.37	78.81	<MDA	157.49	12.54	163.88	<MDA	357.34	3.00	0.33	1.67	4/6/2009 4:02:15PM
6		72.63	111.25	<MDA	157.49	155.82	217.72	<MDA	357.34	3.00	0.67	3.00	4/6/2009 4:05:27PM
7		-5.89	6.80	<MDA	157.49	191.64	229.23	<MDA	357.34	3.00	0.00	3.33	4/6/2009 4:08:40PM
8		-5.89	6.80	<MDA	157.49	-23.28	147.39	<MDA	357.34	3.00	0.00	1.33	4/6/2009 4:11:53PM
9		-5.89	6.80	<MDA	157.49	227.46	240.18	<MDA	357.34	3.00	0.00	3.67	4/6/2009 4:15:06PM
10		-5.89	6.80	<MDA	157.49	48.36	178.86	<MDA	357.34	3.00	0.00	2.00	4/6/2009 4:18:19PM
11		-5.89	6.80	<MDA	157.49	48.36	178.86	<MDA	357.34	3.00	0.00	2.00	4/6/2009 4:21:32PM
12		-5.89	6.80	<MDA	157.49	-23.28	147.39	<MDA	357.34	3.00	0.00	1.33	4/6/2009 4:24:45PM
13		229.66	192.49	<Action Level	157.49	12.54	163.88	<MDA	357.34	3.00	2.00	1.67	4/6/2009 4:27:58PM
14		-5.89	6.80	<MDA	157.49	-59.10	128.82	<MDA	357.34	3.00	0.00	1.00	4/6/2009 4:31:11PM
15		-5.89	6.80	<MDA	157.49	84.18	192.68	<MDA	357.34	3.00	0.00	2.33	4/6/2009 4:34:24PM
16		-5.89	6.80	<MDA	157.49	155.82	217.72	<MDA	357.34	3.00	0.00	3.00	4/6/2009 4:37:37PM
17		33.37	78.81	<MDA	157.49	-23.28	147.39	<MDA	357.34	3.00	0.33	1.33	4/6/2009 4:40:50PM
18		-5.89	6.80	<MDA	157.49	48.36	178.86	<MDA	357.34	3.00	0.00	2.00	4/6/2009 4:44:03PM
19		-5.89	6.80	<MDA	157.49	12.54	163.88	<MDA	357.34	3.00	0.00	1.67	4/6/2009 4:47:15PM
20		-5.89	6.80	<MDA	157.49	120.00	205.58	<MDA	357.34	3.00	0.00	2.67	4/6/2009 4:50:28PM
21		-5.89	6.80	<MDA	157.49	84.18	192.68	<MDA	357.34	3.00	0.00	2.33	4/6/2009 4:53:41PM
22		-5.89	6.80	<MDA	157.49	-59.10	128.82	<MDA	357.34	3.00	0.00	1.00	4/6/2009 4:56:54PM
23		33.37	78.81	<MDA	157.49	12.54	163.88	<MDA	357.34	3.00	0.33	1.67	4/6/2009 5:00:07PM
24		72.63	111.25	<MDA	157.49	120.00	205.58	<MDA	357.34	3.00	0.67	2.67	4/6/2009 5:03:20PM
25		-5.89	6.80	<MDA	157.49	48.36	178.86	<MDA	357.34	3.00	0.00	2.00	4/6/2009 5:06:33PM
26		33.37	78.81	<MDA	157.49	120.00	205.58	<MDA	357.34	3.00	0.33	2.67	4/6/2009 5:09:46PM
27		-5.89	6.80	<MDA	157.49	48.36	178.86	<MDA	357.34	3.00	0.00	2.00	4/6/2009 5:12:59PM
28		33.37	78.81	<MDA	157.49	-59.10	128.82	<MDA	357.34	3.00	0.33	1.00	4/6/2009 5:16:12PM

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

Date: 4/6/2009 3:44:37PM

Counting Unit ID: Tennelec

Batch Name: FSS Smears 3 min - 200904061544

Batch Start Time: Mon, April 06, 2009 03:44:37 PM

Geometry: 1/8" Stainless Steel

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

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

Background Subtract: Background Subtracted

Batch ID:

Alpha Eff. Std: 060101 Alpha Th-230

4 π Alpha Eff. %: 34.29 $\pm$ 0.30

2 π Alpha Eff. %: 65.32 $\pm$ 0.58

Alpha BG CPM: 0.05 $\pm$ 0.03

Beta Eff. Std: 079706 Beta Tc-99

4 π Beta Eff. %: 24.19 $\pm$ 0.32

2 π Beta Eff. %: 37.22 $\pm$ 0.49

Beta BG CPM: 1.55 $\pm$ 0.16

Cal Due: Aug 15 2009

Carrier	Sample ID	Alpha Activity				Beta Activity				Count time (min)	Alpha CPM	Beta CPM	Count Start
		DPM	2 Sigma	Fla	MDA	DPM	2 Sigma	Fla	MDA				
29	29	33.37	78.81	<MDA	157.49	-23.28	147.39	<MDA	357.34	3.00	0.33	1.33	4/6/2009 5:19:25PM
30	30	72.63	111.25	<MDA	157.49	-23.28	147.39	<MDA	357.34	3.00	0.67	1.33	4/6/2009 5:22:38PM
31	31	-5.89	6.80	<MDA	157.49	12.54	163.88	<MDA	357.34	3.00	0.00	1.67	4/6/2009 5:25:50PM
32	32	-5.89	6.80	<MDA	157.49	12.54	163.88	<MDA	357.34	3.00	0.00	1.67	4/6/2009 5:29:03PM

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

Static MDC (43-68)

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

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

Scan MDC (43-68)

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

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

Inputs

INST#	82958	Instrument Serial Number
DET#	75150	Detector Serial Number
R _B	2.1	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)
ε _{4π}	0.173	Detector Efficiency (4π)
BS	0.05	Backscatter
ε _i	0.330	Detector Efficiency (2π)
ε _s	0.25	Surface Efficiency
S _e	0.52	source efficiency (radionuclide detectability)

Outputs

ε _t	0.0428	Total Detection Efficiency
MDC	148	dpm/100 cm ²
Enter data		
Formula, enter 2π efficiency data directly if available		
Change if necessary		

Reviewed by:

Paul Eley

Date: 3-20-09

Inputs

INST#	82958	Instrument Serial Number
DET#	75150	Detector Serial Number
d'	1.38	Index of Sensitivity
p	0.50	Surveyor Efficiency
Scan ε _i	0.30	Scanning Instrument Efficiency (2π)
Scan ε _s	0.25	Scanning Surface Efficiency
S _e	0.52	source efficiency (radionuclide detectability)

43-68

Scan Speed	2.2	(cm/sec)
R _B	2.1	Background Count Rate (cpm)
b _i	0.14	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

ε _t	0.0386	Total Detection Efficiency
i	4.00	Observation interval in seconds (detector width divided by the scan speed)
Scan MDC	225	dpm/100 cm ²

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

Static MDC (43-68)

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

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

Scan MDC (43-68)

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

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

Inputs

INST#	95359	Instrument Serial Number
DET#	119445	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)
ε _{4π}	0.191	Detector Efficiency (4π)
BS	0.05	Backscatter
ε ₁	0.364	Detector Efficiency (2π)
ε _s	0.25	Surface Efficiency
S _e	0.52	source efficiency (radionuclide detectability)

Outputs

ε _t	0.0473	Total Detection Efficiency
MDC	124	dpm/100 cm ²
Enter data		
Formula, enter 2π efficiency data directly if available		
Change if necessary		

Reviewed by: Paul Ely

Date: 3-27-09

Inputs

INST#	95359	Instrument Serial Number
DET#	119445	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 _e	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

ε _t	0.0426	Total Detection Efficiency
i	4.00	Observation interval in seconds (detector width divided by the scan speed)
Scan MDC	178	dpm/100 cm ²



BUILDING SURFACE SURVEY PLAN

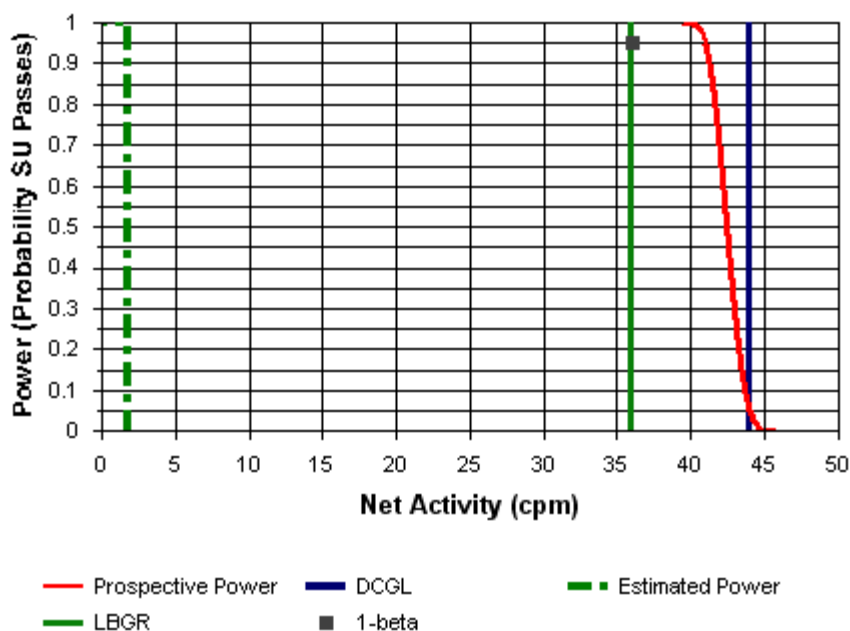
Survey Plan Summary

Site Name: NIST Boulder Campus
 Planner(s): p ely
 Survey Unit Name: Room 2120 Low Ceiling Area Upper Walls & Ceiling
 Comments: Portion of 2120 Upper Wall Changed to Class 1 Area

Statistical Design Details

Area (m ²):	32	Classification:	1
Selected Test:	Sign	Estimated Sigma (cpm/100 cm ²):	2.7
DCGL (cpm/100 cm ²):	44	Sample Size (N):	14
LBGR (cpm/100 cm ²):	36	Estimated Conc. (cpm/100 cm ²):	1.8
Alpha:	0.050	Estimated Power:	1.0
Beta:	0.050	Post-EMC Sample Size (N):	14

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

^aHard-to-detect contaminant ^bAverage beta energy (keV) [N/A indicates alpha emission] ^cActivity fraction

Gross Activity Mean and Sigma Data

Count Time (min): 1
 Sign Test Sigma (cpm/100 cm²): 2.7

Data/Material	Mean (cpm/100 cm ²)	Std. Dev. (cpm/100 cm ²)	MDC (dpm/100 cm ²)
SU	1.8	2.7	147

Elevated Measurement Comparison (EMC) for Gross Activity

Scanning Instrumentation Description: Ludlum 43-68 Gas Flow Proportional
 Background (cpm/100 cm²): 2.0
 Total Scanning Efficiency: 0.04
 True Positive Proportion: 0.95
 False Positive Proportion: 0.6
 Index of Sensitivity (d'): 1.38
 Observation Interval (sec): 1.0
 Surveyor Efficiency: 0.50
 Area Factor Table Interpolation Method: Linear

Statistical Design

N: 14
 Bounded Area (m²): 2.3
 Area Factor: 5.3
 DCGLw*: 358
 Scan MDC Required*: 1,912

Hot Spot Design

Actual Scan MDC*: 534
 Area Factor: N/A
 Bounded Area (m²): N/A
 Post-EMC N: 14

Contaminant	Energy ^a	Fract ^b	Inst. Eff.	Surf. Eff.	Total Eff.
Am-241	N/A	0.10	0.20	0.25	0.01
Pu-238	N/A	0.01	0.20	0.25	0.00
Pu-239	N/A	0.31	0.20	0.25	0.02
Pu-240	N/A	0.10	0.20	0.25	0.01

^aAverage beta energy (keV) [N/A indicates alpha emission] ^bActivity fraction

Contaminant	DCGLw*	Area Factor	Scan MDC Req'd*
Am-241	358	5.3	1,912
Pu-238	407	5.4	2,177
Pu-239	370	5.3	1,972
Pu-240	370	5.3	1,976

* dpm/100 cm²

Report Created 04/06/2009 1055 (COMPASS v1.1.0)

Survey Unit 016

Class 1

Upper Walls & Ceiling in Low Ceiling Area of Room 2120

X (Max):	51.6	feet	15.7	meters	Estimated dimension
Y (Max):	6.6	feet	2.0	meters	Estimated dimension
A (Area):	338	ft ²	31	m ²	Area of Survey area
Actual Survey Area:	212	ft ²	19.7	m ²	
Required Survey Points:	14	38%			Percent void area
N (Points):	30	22			Estimated Minimum Points

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

Spacing for a square grid

L= 1.0 meters (distance between measurement points)

X (Random):	8.6	random generated number
Y (Random):	0.2	random generated number
X (Origin):	12.4	initially generated random number
Y (Origin):	0.2	initially generated random number