

REPORT DOCUMENTATION PAGE				<i>Form Approved</i> <i>OMB No. 0704-0188</i>	
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				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S) Maj Alan Hale				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) USAF School of Aerospace Medicine Occupational and Environmental Health Dept/OEC 2510 Fifth St. Wright-Patterson AFB, OH 45433-7913				8. PERFORMING ORGANIZATION REPORT NUMBER AFRL-SA-WP-CL-2013-0002	
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13. SUPPLEMENTARY NOTES					
14. ABSTRACT At the request of the USAF Radioisotope Committee Secretariat (RICS), the USAF School of Aerospace Medicine Consultative Services Division completed an independent radiological assessment/verification survey of sites 321 B North and PRL-S006 at former McClellan AFB, CA, from 12-13 Sep 12. This verification survey was conducted at each of the sites post-remediation and after the contractor had completed its Final Status Survey (FSS) sampling. Radium-226 was the sole radionuclide of concern. Environmental Dimensions, Inc., under contract with CH2M Hill, conducted all radiological field work to include FSSs. This letter details the findings of this visit and is meant to assist the RICS when evaluating the contractor's FSS reports of these sites.					
15. SUBJECT TERMS USAF School of Aerospace Medicine (USAFSAM), former McClellan AFB, radium-226, verification survey, final status survey, independent radiological assessment					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT U	b. ABSTRACT U	c. THIS PAGE U			Col Mark E. Smallwood
			SAR	22	19b. TELEPHONE NUMBER (include area code)



**DEPARTMENT OF THE AIR FORCE
USAF SCHOOL OF AEROSPACE MEDICINE (AFMC)
WRIGHT-PATTERSON AFB OHIO 45433**

22 January 2013

MEMORANDUM FOR AFMSA/SG3PB

Attn: Maj Daniel Shaw
USAF Radioisotope Committee Secretariat
Air Force Medical Support Agency
7700 Arlington Boulevard, Suite 5158
Falls Church, VA 22042-5158

FROM: USAFSAM/OEC
2510 Fifth Street
Wright-Patterson AFB, OH 45433

SUBJECT: Consultative Letter, AFRL-SA-WP-CL-2013-0002, 321 B North and PRL-S006
Verification Surveys at Former McClellan AFB, Sacramento, CA

1. Introduction:

a. *Purpose:* At the request of the USAF Radioisotope Committee Secretariat (RICS), the USAF School of Aerospace Medicine Consultative Services Division (USAFSAM/OEC) completed an independent radiological assessment/verification survey of sites 321 B North and PRL-S006 at former McClellan AFB, CA, from 12-13 Sep 12. This verification survey was conducted at each of the sites post-remediation and after the contractor had completed its Final Status Survey (FSS) sampling. Radium-226 (Ra-226) was the sole radionuclide of concern. Environmental Dimensions, Inc. (EDi), under contract with CH2M Hill, conducted all radiological field work to include FSSs. This letter details the findings of this visit and is meant to assist the RICS when evaluating the contractor's FSS reports of these sites.

b. Survey Personnel:

Maj Alan Hale, Chief, Radiation Health Consulting Branch, USAFSAM/OEC

c. Personnel Contacted:

- (1) Mr. Milton (Buddy) Walser, Radiation Program Manager, AFCEC/CIBW
- (2) Mr. Philip Mook, Senior Representative, AFCEC/CIBW

d. Equipment:

- (1) Ludlum – Model 2221, serial number 218606, calibrated on 23 Nov 11
- (2) Ludlum – Model 44-10, serial number PR276614, calibrated on 23 Nov 11

2. Methodology:

a. *Background Area.* The background area of 400 m² has been routinely used as a reference area, since it has been determined to be radiologically nonimpacted. The background area was characterized with the 2x2 sodium iodide detector using a gamma walkover technique. No soil samples were taken in the background area, as the background soil concentrations for former McClellan AFB have been determined previously and were not relevant for this survey. After gamma walkover surveys at the survey sites, it was determined that the background area was not consistent with the survey areas, most likely due to the fact the background area still had vegetation in place. The background data are therefore irrelevant and are not presented.

b. *Survey Areas.* EDi was responsible for conducting a total of 17 FSSs across 17 different sites. The week of the visit, three sites were available for USAFSAM verification. After consultation with the RICS, two of these sites were chosen for verification survey: 321 B North and PRL-S006. The survey areas underwent gamma walkover surveys and soil sampling. This verification survey required at least 10% of the survey area to be scanned by the gamma walkover technique and soils sampling numbering at least 10% of the number taken by the contractor. Further information on the surveys can be found in Attachments 1-3.

(1) *Gamma Walkover Survey in Survey Areas.* The goals of the walkover survey were to detail site radiological conditions, identify potential spots of elevated residual Ra-226 concentrations, and identify locations for biased soil sampling. Since the gamma walkover data were to qualitatively assess the site in terms of mean reading plus amount of standard deviation (SD), minimum detectable concentration and count rates were not calculated. Table 1 in section 3 summarizes the results of the gamma walkover survey.

(2) *Soil Sampling in Survey Areas.* Since the contractor planned to collect less than 20 soil samples in each survey area, two biased soil samples were collected based on walkover data exhibiting elevated count rates. Each sample was taken from an area of about 8 in² to a depth of 6 in. The volume sampled was enough for laboratory analysis (approximately 0.25 gal). Field soil sampling procedures were in place to prevent cross-contamination of samples. Table 2, in section 3, summarizes the soil sample results.

3. *Results.* The results are summarized below along with some basic discussion. Additional substantiating data, including maps and survey data, can be found in Attachments 1-4.

Table 1. Gamma Walkover Results Summary

Survey Unit	Approximate Scan Coverage (%)	Mean Count Rate (cpm)	SD (cpm)	No. of Readings > Mean + 3 SD
321 B North	75	9182	550	3
PRL-S006	100	10777	862	0

Table 2. Soil Sampling Results Summary

Sample No.	Survey Unit	Ra-226 Concentration (pCi/g)	Ra-226 Concentration Uncertainty (pCi/g)
0GS0001	321 B North	0.890	±0.0417
0GS0002	321 B North	0.679	±0.0372
0GS0003	PRL-S006	0.794	±0.0427
0GS0004	PRL-S006	0.708	±0.0446

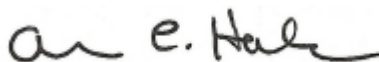
4. Conclusions:

a. All soil samples were taken in biased locations where the expected maximum Ra-226 concentrations were expected to be found. The maximum Ra-226 concentration was 0.890 ± 0.0417 pCi/g. All the concentrations were less than the cleanup goal of 2.0 pCi/g, which is inclusive of background.

b. Based upon the findings of this verification survey, USAFSAM finds that sites 321 B North and PRL-S006 are suitable for unrestricted free release of radiological controls, assuming the contractor reached the same results during its more comprehensive FSS.

c. If these independent verification surveys are consistent with EDi's results, the RICS should have increased confidence in the contractor's FSS reports at all 17 remediated areas.

5. If you have any questions or need further information, please contact Maj Alan Hale at 937-938-3320 (DSN 798-3320) or alan.hale@us.af.mil.



ALAN C HALE, Maj, USAF, BSC
Chief, Radiation Health Consulting Branch

Attachments:

1. Instrumentation and Survey Methodology
2. Survey of 321 B North
3. Survey of PRL-S006
4. Laboratory Soil Analysis
5. Instrument Calibration Sheets
6. Radiation Meter Quality Control (QC) Log

ATTACHMENT 1

INSTRUMENTATION AND SURVEY METHODOLOGY

1. Sodium Iodide Detector: The sodium iodide detector used was Ludlum 44-10 2x2-in detector coupled with a Ludlum 2221 Ratemeter/Scaler. For walkover surveys, the Ludlum 2221 was connected via cable to a Trimble GeoXT handheld GPS unit. The Trimble GeoXT logged the count rates with the corresponding GPS coordinates every 1 s. The detector was held at 10 cm above the ground for soil readings and walkover surveys. During walkovers, the scan speed was approximately 0.5 m/s. This is consistent with the methodology EDi used during gamma walkover surveys.
2. Laboratory Analysis of Soil. Soil samples were counted at the USAFSAM Radioanalytical Laboratory (OEAL) at WPAFB, OH. The soil was counted on a high purity germanium detector. The soils were also analyzed by OEAL using the appropriate in-growth method to determine Ra-226 levels in soil. Attachment 4 contains the laboratory reports.
3. All field instruments were function checked and field tested before and after use with check sources. All instruments were within a 25% tolerance during field checks. All instruments are calibrated on an annual basis at WPAFB, OH. Attachment 5 contains all annual calibration sheets, and Attachment 6 is the Radiation Meter QC Log.

ATTACHMENT 2

SURVEY OF 321 B NORTH

1. Location. Figure A2-1 is a photograph of the 321 B North survey area.



Figure A2-1. Photograph of 321 B North

2. Survey Results. Two samples were taken in the 321 B North survey area. The gross Ra-226 soil concentration results, shown in Table A2-1, are inclusive of the background Ra-226 concentration and can be compared directly to the cleanup goal of 2.0 pCi/g. The locations of the soil samples are in Figure A2-2. The 321 B North survey area of approximately 380 m² was characterized with a sodium iodide detector using a gamma walkover technique. Scan coverage was approximately 75%. Due to the shallow nature of the excavation, only the floor of the excavation was scanned and did not include the side walls of the excavation. The resultant data of this walkover are found in Figure A2-3. Since there was a disparity in the mean count rates of the background survey area and the survey unit due to soil difference and through analysis of the statistics, the mean count rate of the survey unit itself and associated statistics were used as the “background” for this survey unit. The lowest readings of the survey are marked in green and correspond to less than 2 SDs above the mean background value. This green area is where soil concentrations are expected to be the lowest. The other colors represent areas of statistical significance, where higher concentrations are expected to be found. Yellow and red colors correspond to greater than 2 and 3 SDs, respectively, above the mean count rate value. The color

scheme demonstrates a scale of instrument data based upon SDs from background, where no regulatory values are implied.

Table A2-1. Soil Sample Results for 321 B North

Sample No.	GPS Coordinates (°N/°E)	Gross Ra-226 Concentration (pCi/g)
0GS0001	38.653394 / -121.403085	0.890 ± 0.0417
0GS0002	38.653384 / -121.402969	0.679 ± 0.0372

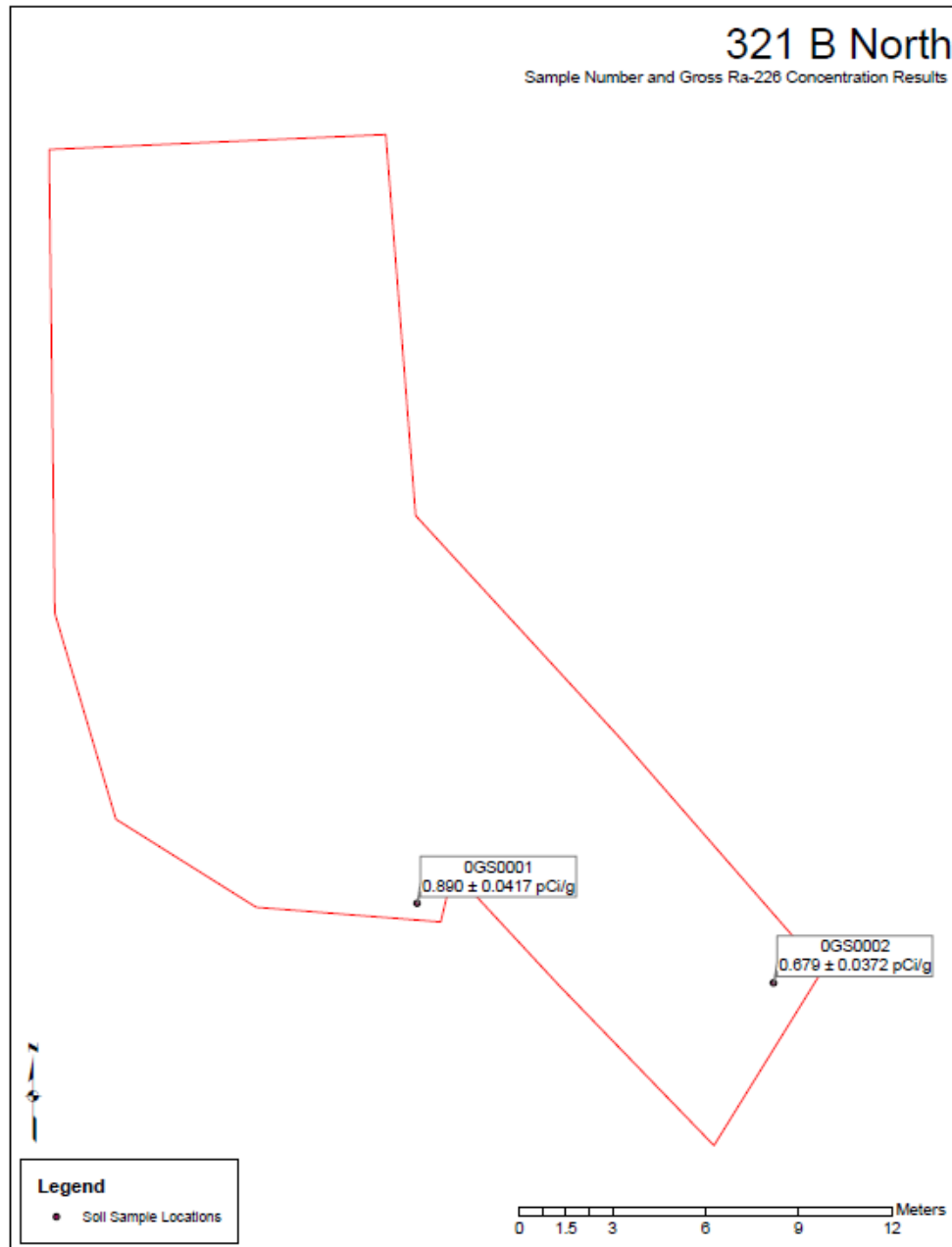


Figure A2-2. Soil Sample Locations for 321 B North



Figure A2-3. Gamma Walkover Data for 321 B North

ATTACHMENT 3

SURVEY OF PRL-S006

1. Location. Figures A3-1, A3-2, and A3-3 are photographs of the PRL-S006 survey area.



Figure A3-1. Photograph of PRL-S006, Overview



Figure A3-2. Photograph of PRL-S006, Viewed from Southwest



Figure A3-3. Photograph of PRL-S006, Viewed from Southeast

2. Survey Results. Two samples were taken in the PRL-S006 survey area. The gross Ra-226 soil concentration results, shown in Table A3-1, are inclusive of the background Ra-226 concentration and can be compared directly to the cleanup goal of 2.0 pCi/g. The locations of the soil samples are in Figure A3-4. The PRL-S006 survey area of approximately 40 m² was characterized with a sodium iodide detector using a gamma walkover technique. Scan coverage was approximately 100% of the excavation floor. Due to the deep nature of the excavation, the side walls of the excavation were also scanned, with a coverage of approximately 10%. The map has many points overlayed, since the GPS location uncertainty is on the order of 1 m, the site is small, and the side walls were scanned. The resultant data of this walkover are found in Figure A3-5. Since there was a disparity in the mean count rates of the background survey area and the survey unit due to soil difference and through analysis of the statistics, the mean count rate of the survey unit itself and associated statistics were used as the “background” for this survey unit. The lowest readings of the survey are marked in green and correspond to less than 2 SDs above the mean background value. This green area is where soil concentrations are expected to be the lowest. The other colors represent areas of statistical significance, where higher concentrations are expected to be found. Yellow and red colors correspond to greater than 2 and 3 SDs, respectively, above the mean count rate value. The color scheme demonstrates a scale of instrument data based upon SDs from background, where no regulatory values are implied.

Table A3-1. Soil Sample Results for PRL-S006

Sample No.	GPS Coordinates (°N/°E)	Gross Ra-226 Concentration (pCi/g)
0GS0003	38.654593 / -121.389503	0.794 ± 0.0427
0GS0004	38.654629 / -121.389506	0.708 ± 0.0446



Figure A3-4. Soil Sample Locations for PRL-S006



Figure A3-5. Gamma Walkover Data for PRL-S006

ATTACHMENT 4
LABORATORY SOIL ANALYSIS

Sample Analysis Results Reported on 14-Nov-2012

USAFSAM/ONHHL ID 11200264

Customer Address 0117 Z
77 MDOS/SGPB
5342 DUDLEY BLVD

MCCLELLAN AFB CA 95652-1074

IDENTIFICATION

Base Sample # OGS00001 Serial #
Date Collected 9/13/2012 Received 9/17/2012 Completed 11/7/2012

Analytes	Activity +/- Uncertainty	Lc / MDA
POTASSIUM 40	1.54E+01 +/- 9.72E-01 pci/g	2.02E-01 / 4.27E-01 pci/g
RADIUM	8.90E-01 +/- 4.17E-02 pci/g	4.33E-02 / 8.90E-02 pci/g
THALLIUM 208	2.68E-01 +/- 3.33E-02 pci/g	2.24E-02 / 4.62E-02 pci/g
BISMUTH 212	8.84E-01 +/- 2.94E-01 pci/g	2.32E-01 / 4.83E-01 pci/g
LEAD 212	9.34E-01 +/- 5.26E-02 pci/g	3.00E-02 / 6.13E-02 pci/g
RADIUM 224	9.44E-01 +/- 3.32E-01 pci/g	2.75E-01 / 5.64E-01 pci/g
ACTINIUM 228	8.80E-01 +/- 7.54E-02 pci/g	8.03E-02 / 1.67E-01 pci/g
THORIUM 228	2.00E+00 +/- 7.66E-01 pci/g	1.17E+00 / 2.38E+00 pci/g
THORIUM 234	2.35E+00 +/- 8.43E-01 pci/g	1.05E+00 / 2.13E+00 pci/g
URANIUM 235	6.31E-02 +/- 3.26E-02 pci/g	2.64E-02 / 5.36E-02 pci/g

COMMENTS

WORKPLACE: 321 B NORTH
RA 226

RESULTS ACCURATE TO 2 SIGNIFICANT FIGURES.
UNCERTAINTY AT 95% CONFIDENCY LEVEL.

If you have any questions concerning the information provided above, please
contact the ESOH Service Center at 1-888-232-2353.

STEVEN C. DEWEY, Major, USAF, BSC
Chief, Radioanalysis Branch

Sample Analysis Results Reported on 14-Nov-2012

USAFSAM/OMHHL ID 11200266

Customer Address 01172

77 MDOS/SGPB

5342 DUDLEY BLVD

MCCLELLAN AFB

CA 95652-1074

IDENTIFICATION

Base Sample # 0G800002

Serial #

Date Collected 9/13/2012

Received 9/17/2012

Completed 11/7/2012

Analytes	Activity +/- Uncertainty	Lc / MDA
POTASSIUM 40	1.58E+01 +/- 9.84E-01 pci/g	2.13E-01 / 4.48E-01 pci/g
RADIUM	6.79E-01 +/- 3.72E-02 pci/g	3.97E-02 / 8.18E-02 pci/g
THALLIUM 208	2.67E-01 +/- 3.53E-02 pci/g	2.55E-02 / 5.22E-02 pci/g
BISMUTH 212	1.01E+00 +/- 3.11E-01 pci/g	2.40E-01 / 4.99E-01 pci/g
LEAD 212	9.07E-01 +/- 1.01E-01 pci/g	3.02E-02 / 6.16E-02 pci/g
RADIUM 224	5.71E-01 +/- 3.27E-01 pci/g	2.70E-01 / 5.54E-01 pci/g
ACTINIUM 228	8.49E-01 +/- 6.76E-02 pci/g	6.81E-02 / 1.42E-01 pci/g
THORIUM 228	9.28E-01 +/- 7.31E-01 pci/g	1.19E+00 / 2.43E+00 pci/g
THORIUM 234	2.59E+00 +/- 7.81E-01 pci/g	1.08E+00 / 2.19E+00 pci/g
RADIUM 226	1.57E+00 +/- 4.95E-01 pci/g	3.87E-01 / 7.87E-01 pci/g

COMMENTS

WORKPLACE: 321 B NORTH

RA 226

RESULTS ACCURATE TO 2 SIGNIFICANT FIGURES.
UNCERTAINTY AT 95% CONFIDENCY LEVEL.

If you have any questions concerning the information provided above, please
contact the ESOH Service Center at 1-888-232-2353.

STEVEN C. DEWEY, Major, USAF, BSC
Chief, Radioanalysis Branch

Sample Analysis Results Reported on 14-Nov-2012

USAFSAM/ONHHL ID 11200263

Customer Address 0117 E

77 MDOS/SGPB

5342 DUDLEY BLVD

MCCLELLAN AFB

CA 95652-1074

IDENTIFICATION

Base Sample # 0G800003

Serial #

Date Collected 9/13/2012

Received 9/17/2012

Completed 11/7/2012

Analytes	Activity +/- Uncertainty	Lc / MDA
POTASSIUM 40	1.57E+01 +/- 1.03E+00 pci/g	2.33E-01 / 4.92E-01 pci/g
RADIUM	7.94E-01 +/- 4.27E-02 pci/g	4.22E-02 / 8.68E-02 pci/g
THALLIUM 208	2.67E-01 +/- 3.62E-02 pci/g	2.51E-02 / 5.18E-02 pci/g
BISMUTH 212	1.13E+00 +/- 3.61E-01 pci/g	2.76E-01 / 5.75E-01 pci/g
LEAD 212	1.06E+00 +/- 1.21E-01 pci/g	3.62E-02 / 7.39E-02 pci/g
RADIUM 224	1.40E+00 +/- 4.46E-01 pci/g	3.21E-01 / 6.59E-01 pci/g
ACTINIUM 228	9.95E-01 +/- 6.93E-02 pci/g	7.34E-02 / 1.54E-01 pci/g
THORIUM 228	1.70E+00 +/- 9.71E-01 pci/g	1.34E+00 / 2.72E+00 pci/g
THORIUM 232	1.64E+01 +/- 1.58E+01 pci/g	1.29E+01 / 2.62E+01 pci/g
URANIUM 235	7.08E-02 +/- 3.58E-02 pci/g	2.91E-02 / 5.92E-02 pci/g

COMMENTS

SEND RESULTS ALSO TO MAJ ALAN HALE DSN: 798-3320

WORKPLACE: PRL-5006

RA 226

RESULTS ACCURATE TO 2 SIGNIFICANT FIGURES.
UNCERTAINTY AT 95% CONFIDENCY LEVEL.

If you have any questions concerning the information provided above, please
contact the ESOH Service Center at 1-888-232-2353.

STEVEN C. DEWEY, Major, USAF, BSC
Chief, Radioanalysis Branch

Sample Analysis Results Reported on 14-Nov-2012

USAFSAM/ONHHL ID 11200265

Customer Address 0117 Z

77 MDOS/SGPB

5342 DUDLEY BLVD

MCCLELLAN AFB

CA 95652-1074

IDENTIFICATION

Base Sample # 0G800004

Serial #

Date Collected 9/13/2012

Received 9/17/2012

Completed 11/7/2012

Analytes	Activity +/- Uncertainty	Lc / MDA
POTASSIUM 40	1.52E+01 +/- 9.77E-01 pci/g	2.23E-01 / 4.68E-01 pci/g
RADIUM	7.08E-01 +/- 4.46E-02 pci/g	4.19E-02 / 8.59E-02 pci/g
THALLIUM 208	3.56E-01 +/- 3.45E-02 pci/g	2.00E-02 / 4.14E-02 pci/g
BISMUTH 212	1.07E+00 +/- 2.89E-01 pci/g	2.29E-01 / 4.78E-01 pci/g
RADIUM 224	9.27E-01 +/- 3.20E-01 pci/g	2.70E-01 / 5.54E-01 pci/g
ACTINIUM 228	1.12E+00 +/- 7.62E-02 pci/g	7.19E-02 / 1.50E-01 pci/g
THORIUM 228	1.34E+00 +/- 7.80E-01 pci/g	1.02E+00 / 2.09E+00 pci/g
THORIUM 234	1.90E+00 +/- 8.45E-01 pci/g	1.06E+00 / 2.15E+00 pci/g
URANIUM 235	6.99E-02 +/- 3.30E-02 pci/g	2.66E-02 / 5.41E-02 pci/g

COMMENTS

WORKPLACE: PRL-5006

RA 226

RESULTS ACCURATE TO 2 SIGNIFICANT FIGURES.
UNCERTAINTY AT 95% CONFIDENCY LEVEL.

If you have any questions concerning the information provided above, please
contact the ESOH Service Center at 1-888-232-2353.

STEVEN C. DEWEY, Major, USAF, BSC
Chief, Radioanalysis Branch

ATTACHMENT 5

INSTRUMENT CALIBRATION SHEETS

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DEPARTMENT OF THE AIR FORCE
USAF SCHOOL OF AEROSPACE MEDICINE (AFMC)
OCCUPATIONAL ENVIRONMENTAL HEALTH/RADIATION HEALTH (OEHH)
WRIGHT-PATTERSON AFB OHIO
CERTIFICATE OF CALIBRATION

Mfg. Ludlum Model 2221 Serial # 218606 Index # 099333 Date: 23 Nov 11
Mfg. Ludlum Model 44-10 Serial # PR276614 Index # 100861 Cal. Due Date: 23 Nov 12

TEST, MEASUREMENT AND DIAGNOSTIC EQUIPMENT

NIST Traceable Check Sources				Reference Instruments			
Isotope	Serial #	Cert. Date	DPM	Mfg.	Model	Serial #	Cal. Due Date
Cs-137	RP3067	1 Nov 04	2,454,000	Ludlum	500-1	102951	8 Feb 2012

Measurement Standards and test equipment used are traceable to the National Institute of Standards and Technology, to the extent allowed by the Institute's calibration facilities.

☒ Battery Ck. ☒ Mechanical Ck. ☒ Meter Zeroed ☒ Reset Ck. ☐ Alarm Ck.
☒ Audio Ck. ☒ Geotripism Ck. ☒ F/S Resp. Ck. ☒ Window Op.

As Found HV 991 VDC Temperature 72.7 °F Relative Humidity 55 %

Final Volt. Set 100 VDC Threshold (LLD) 10 mV Window (ULD) 20 mV Window width 10 mV

HV Readout (2 points) Reference: 500 V Reference: 1000 V
Inst. Readout: 500 V ± 2% Inst. Readout: 1000 V ± 2%

RANGE MULTIPLIER	REFERENCE CAL. POINT	"AS FOUND" READING	CORRECTED READING
x 1000	400 CPM	400,000 CPM	400,000 CPM
x 1000	100 CPM	100,000 CPM	100,000 CPM
x 100	400 CPM	40,000 CPM	40,000 CPM
x 100	100 CPM	10,000 CPM	10,000 CPM
x 10	400 CPM	4,000 CPM	4,000 CPM
x 10	100 CPM	1,000 CPM	1,000 CPM
x 1	400 CPM	400 CPM	400 CPM
x 1	100 CPM	100 CPM	100 CPM
Log Scale	200 CPM	200 CPM	200 CPM

DIGITAL SCALER READOUT

CAL. REF. POINT	AS FOUND READING	CORRECTED READING
40,000 CPM	39,886 CPM	39,886 CPM

*UNCERTAINTY WITHIN ± 10% CORRECTION FACTOR WITHIN ± 20%

COMMENTS: Calibration Interval = 1 year Use "Window Out"
CS-137 Eff: 6,500 CPM/μCi/m² @ 12"
Procedural Authority - ICP#22210000

Calibrated By: Stu Hutchinson

Date: 23 Nov 2011

Reviewed By: Piper Miller

Date: 30 Nov 11

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DEPARTMENT OF THE AIR FORCE
USAF SCHOOL OF AEROSPACE MEDICINE (AFMC)
OCCUPATIONAL ENVIRONMENTAL HEALTH/RADIATION HEALTH (OEHH)
WRIGHT-PATTERSON AFB OHIO
CERTIFICATE OF CALIBRATION

Meter
Mfg. Ludlum Model 2221 Serial # 218606 Index # 099333 Date: 23 Nov 11
Cal. Due Date: 23 Nov 12

TEST, MEASUREMENT AND DIAGNOSTIC EQUIPMENT

NIST Traceable Check Sources

Isotope	Serial #	Cert. Date	DPM
Cs-137	RP3067	1 Nov 04	2,454,000

Reference Instruments

Mfg.	Model	Serial #	Cal. Due Date
Ludlum	500-1	102951	8 Feb 2012

Measurement Standards and test equipment used are traceable to the National Institute of Standards and Technology, to the extent allowed by the Institute's calibration facilities.

NaI DETECTOR HIGH VOLTAGE OPTIMIZATION

Probe #1
Mfg. Ludlum
Model 44-10
Serial # PR276614
Index # 100861
Isotope: Cs-137

High Voltage	CPM
750	7834
800	9969
850	11523
900	12240
950	12771
1000	12851
1050	13589
1100	13500
1150	13697
1200	13684
1250	13908
1300	13966
1350	17910
Bkgd @ 1100	4664

Final Volt. Set 1100 VDC

Efficiency 6500 CPM/ $\mu\text{Ci/m}^2$ @ 12"

Probe #2
Mfg. _____
Model _____
Serial # _____
Index # _____
Isotope: _____

High Voltage	CPM

Final Volt. Set _____ VDC

Efficiency _____ CPM/ $\mu\text{Ci/m}^2$ @ 12"

Probe #3
Mfg. _____
Model _____
Serial # _____
Index # _____
Isotope: _____

High Voltage	CPM

Final Volt. Set _____ VDC

Efficiency _____ % 2π @ 12"

COMMENTS: Calibration Interval = 1 year Use "Window LUT"

Calibrated By: Stu Hutchinson

Date: 23 Nov 2011

Reviewed By: K. N. V. L.

Date: 30 Nov 11

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HotSpot FIDLER Text File Output:
HotSpot FIDLER Calibration Information

Report Date : Nov 23 2011 07:07 AM
Calibration Date : 23 Nov, 2011
Target Mix : Other Nuclide Check Source
Radionuclide : Cs-137
Detector Barcode Number : 100861
Meter Barcode Number : 099333
Detector Manufacturer : Ludlum
Detector Model Number : 44-10
Detector Serial Number : PR276614
Meter Manufacturer : Ludlum
Meter Model Number : 2221
Meter Serial Number : 218606

Check Source I.D. : RP 3067
Calibration Date : 23 Nov, 2011
Calibrated by : Stu Hutchinson
Check Source Activity (uCi) : 1.100E+00
Check Source 17-keV Self : 1.000E+00

Sample Counting Time (minutes) : 1.000E+00
Detector Height (cm) : 3.000E+01

Cs-137 Window Information:

Background (cpm) : 4,669
Areal Limit of Sensitivity (uCi/m2) : 4.9E-02
Point Limit of Sensitivity (uCi) : 1.0E-01
K-factor (m2) : 2.07

Counting Data (counts):

0-cm: 8120
20-cm: 7179
40-cm: 6081
60-cm: 5469
80-cm: 5167
100-cm: 5069

Instrument Type : Other

Window Option: Only 60 keV

Units: Classic

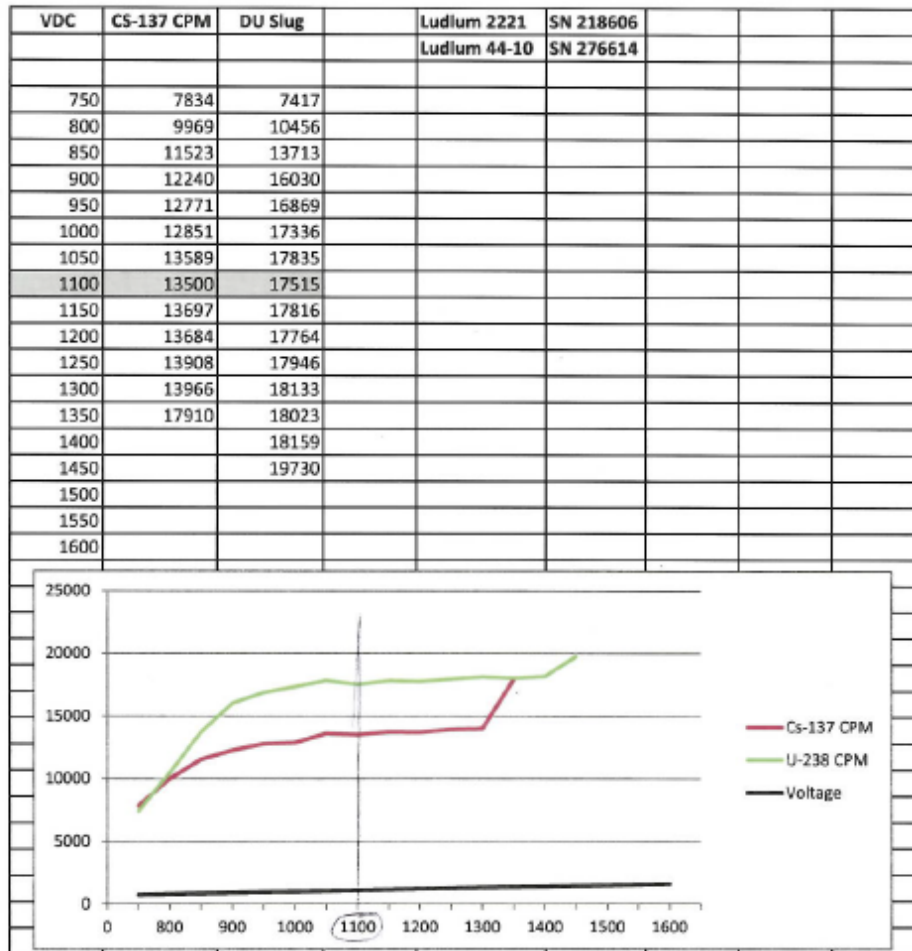
This is an actual 2 x 2 calibration and the values are typical of most 2 x 2 configurations.

Detector Calibration Results

Cs-137 Window Information:

Cs-137 Detector Efficiency (cpm/(uCi/m2)): 6.5E+03
Cs-137 Detector Areal LOS (uCi/m2) : 4.9E-02
Cs-137 Detector Point LOS (uCi) : 1.0E-01
Cs-137 Detector Background Rate (cpm) : 4,669
Cs-137 Detector Check Source Rate (cpm) : 3,451
Cs-137 Detector K-Factor (m2) : 2.07
Cs-137 Detector K-Factor sdev (%) : 7.5

Cs-137 Eff: 6,500 CPM/uCi/m2 @ 12"



ATTACHMENT 6

RADIATION METER QC LOG

Radiation Meter QC Log

Model	S/N	Date/Time	HV/cables/Bat check	Source Check Reading	Acceptable Range
2201 SPA-3	218600 PR276614	10 Sep @ 1335	✓	21015 cpm	16812 - 25218 cpm
2201 SPA-3	218600 PR276615	10 Sep @ 1337	✓	21818 cpm	17454 - 26181 cpm
2201 SPA-3	218600 PR276614	12 Sep @ 1031	✓	20102 cpm	16812 - 25218 cpm
2201 SPA-3	218600 PR276614	22 Sep @ 1152	✓	19576 cpm	16812 - 25218 cpm
2201 SPA-3	218600 PR276614	12 Sep @ 1314	✓	22887 cpm	16812 - 25218 cpm
2201 SPA-3	218600 PR276614	12 Sep @ 1502	✓	19258 cpm	16812 - 25218 cpm
2201 SPA-3	218600 PR276614	13 Sep @ 0948	✓	19708 cpm	16812 - 25218 cpm
2201 SPA-3	218600 PR276614	13 Sep @ 1135	✓	19689 cpm	16812 - 25218 cpm