

Memorandum

DATE 04 October 2016

TO Licensing Assistance Team
US Nuclear Regulatory Commission Region I
2100 Renaissance Boulevard, Suite 100
King of Prussia, PA 19406-2713

FROM Office of the Associate Director for Laboratory Science and Safety
Radiation Safety Office

SUBJECT U.S. Department of Health & Human Services, Request for Additional Information
Concerning Application for a License Amendment, Control 588982 *591780*

10-06772-01
03004001

1. The following calibration records did not appear to be submitted in either letter: Ludlum 2360 with 43-93 probe 236964; Ludlum 2360 with GP-13A probe #192611; and Ludlum 2350-01 #186177. These instruments were used in the static or scan surveys. Please provide calibration certificate for the meter and the associated probe, if not already submitted.

These instruments were used for backup and as quality assurance. The calibration certificates are attached.

2. In response to item 2 of the September 22, 2016, letter, your response on section 8.3.3.2 states that the alpha scan rate was 1.5 inches per second and then you give in a revised section 8.3.3.2a stating that the scan rate of 1.5 inches or less will meet a > 95% probability of detection for 75 dpm/100cm². But then later in this response you state the scan rate was 2.5 inches per second for alpha. Please state what scan rate you used for alpha scanning.

Corrected to alpha scan rate for the survey of 1.5 inches per second, highlighted below.

Responses

Section 8.3.3.2 indicated, "The scan rate to achieve a $\geq 95\%$ probability of detection while passing over the contaminated area of 75 dpm/100 cm² was **1.5 inches/second**. If the surveyor detected two counts while performing the alpha scan surveys, the surveyor stopped, acquired a timed count, and investigated to determine if an area of elevated activity exists, or if the error was erroneous." Additional text was added to describe and present the results done for suspect areas where the surveyor detected two counts while performing alpha scans and stopped and acquired a timed count.

Section 17.6 indicated "The probe was maintained at a constant distance of approximately 1/8-1/4" (ensuring < 1 cm or 0.4 inches) above the surface while moving at a scan rate of **1.5 in/sec** for large area probe alpha scans and 5 inches/second for large area probe beta/gamma scans." Large area probe is replaced with 821 cm² probe to ensure size of the probe is communicated. In

REC'D IN LAT *10/04/2016*

591780 Page 1 of 2
INSTRUM MATERIALS-002

addition, the Ludlum 2350-1 with a 43-37-1 was added to the list of instruments for the scan surveys.

3. In response to item 3 of the September 22, 2016, letter, you stated that the efficiency of the Protean was calculated inaccurately. However, in the revised Appendix D, the protean calibration remained the same number. The results of the additional wipes taken was shown as a stated result and individual counting data was not supplied. In order to concur on the Protean efficiency and additional surveys, please provide the specific counting information on the additional wipes like the data given in Appendix G. Additionally, provide the calculation on how you determined the Protean counting efficiency and the calibration certificate of the source used to determine the efficiency.

The efficiencies in Appendix D were correct. The error was in the calculations for instrument efficiencies in Appendix G. Please find the attached appended Appendix G to include additional superimposed sample results.

4. In response to item 4 of the September 22, 2016, letter, you supplied a revised Appendix D, Analytical Worksheets. The submitted worksheets still show the alpha efficiency for the static count remained at 10.32% for Tc-99 and 7.54% for Th-230. Please submit a corrected Appendix D.

Attached: Appended Appendix D

5. In your letter dated September 22, 2016, you provided a corrected Appendix D. In this appendix, you submitted the Alpha Scan MDC IAW Appendix J. The values used in this calculation, do not correlate with the survey performed. It is unclear why this section was provided as the probability calculation was provided in your letter.

Calculation in the letter provided was the correct calculation, disregard Appendix D (calculation removed).

For additional information regarding this License Amendment Application, Control No. 588982, please contact Narvaez L. Stinson, Deputy RSO at NStinson@cdc.gov or by telephone at 404-639-2486.

Narvaez L.
Stinson -S

Digitally signed by Narvaez L. Stinson -S
DN: c=US, o=U.S. Government, ou=HHS,
ou=CDC, ou=People,
0.9.2342.19200300.100.1.1=1000906652,
cn=Narvaez L. Stinson -S
Date: 2016.10.04 14:28:03 -04'00'

Narvaez L. Stinson, MHS, CEM

Radiation Safety Officer

Office of the Associate Director for Laboratory Science and Safety



GRIFFIN INSTRUMENTS



CALIBRATION CERTIFICATE FOR

2360

SERIAL#

225265

Owner: PHILOTECHNICS

DATE: 11/19/15

LOCATION:

Griffin Inst

TECH: D.Steinel

DATE LAST CAL EXPIRES:

04/28/16

Reason For Calibration:

☐ Due For Calibration☐ Repair (See Remarks)☒ Other (See Remarks)☐ Due and Repair (See Remarks)

NIST TRACEABLE EQUIPMENT USED DURING CALIBRATION

MODEL: M-500

SERIAL #: 134715

CAL. DUE: 12/08/15

☒ Audio Response☒ Geotropism

CABLE LENGTH: 39"

CONDITION: Sat

AF MECHANICAL ZERO: 0

AL MECHANICAL ZERO: 0

NEW BATTERIES:

☐ Yes ☒ No

BATTERY CHECK: Sat

HV (+/-10%)	AS FOUND HV	AS LEFT HV	WINDOW SETTINGS:	A.F.	A.L.
500 V:	500	A.F.	BT (3.5 mV +/- 1 mV):	3.5	4
1000 V:	1000	A.F.	BW (30 mV +/- 3 mV):	30	A.F.
1500 V:	1500	A.F.	AT (120 mV +/- 10 mV):	120	A.F.

RATE METER

SCALER

SCALE RATE CPM AS FOUND % ERROR AS LEFT % ERROR AS FOUND % ERROR AS LEFT % ERROR

x.1 or x1	100	100	0.0%	A.F.					
	250	250	0.0%	A.F.		249	0.4%	A.F.	
	400	395	1.3%	A.F.					
x1 or x10	1000	1000	0.0%	A.F.					
	2500	2450	2.0%	A.F.					
	4000	3950	1.3%	A.F.					
x10 or x100	10K	10	K	0.0%	A.F.				
	25K	25	K	0.0%	A.F.				
	40K	39.5	K	1.3%	A.F.				
x100 or x1000	100K	100	K	0.0%	A.F.				
	250K	250	K	0.0%	A.F.				
	400K	395	K	1.3%	A.F.				

Is the As Found Data Within 20% of the Set Point?:

☒ Yes ☐ NoOverload Light: ☒ Adjusted / Verified ☐ Not Adj.

REMARKS: Adjusted BT to 4mV due to high alpha to beta crosstalk.

Does Instrument Meet Final Acceptance Criteria?:

☒ Yes ☐ No

Calibration Sticker Attached?:

☒ Yes ☐ No

Date Instrument is Due For Next Calibration:

11/19/16

INSTRUMENT MARKED WITH

43-93

PR236964

Performed/Reviewed by:

D. Steinel

Date: 11/19/2015

Entered by: *DS* Initials



GRIFFIN INSTRUMENTS



CALIBRATION CERTIFICATE FOR 43-93 PROBE # PR236964

Owner: PHILOTECHNICS

DATE: 11/19/15

LOCATION: Griffin Inst

TECH: D.Steinel

DATE LAST CAL EXPIRES:

04/28/16

REASON FOR CALIBRATION:

☐ Due For Calibration ☐ Repair (See Remarks) ☒ Other (See Remarks) ☐ Due and Repair

CABLE LENGTH: 39"

INPUT SENSITIVITY: 35mV

NIST TRACEABLE EQUIPMENT AND STANDARDS USED DURING CALIBRATION

MODEL: 2360 SERIAL #: 225265 CAL. DUE: 11/19/16

NIST TRACEABLE SOURCES USED

Source Number	Isotope	4 pi Activity	Assay Date	2 pi Activity
00TC470-0654	Tc99 SS	17,300 dpm	06/15/09	10,800 cpm
94TH470-1593	Th230	16,672 dpm	05/27/14	7,671 cpm
2696-00	Pu239	18,500 dpm	12/02/09	9,370 cpm
2697-00	Sr90	12,200 dpm	03/01/00	8,530 cpm

Efficiencies from last cal.:

Condition: ☒ Sat ☐ UnsatPu: Th: 18.49% Sr: 32.20%Tc ss: 13.68% C14: Tc Ni:

As Found (AF) Efficiencies:

HV / Vernier:	Tc-99 Source Response Nickel (CPM):			Pu-239 Source Response (CPM):			Background (CPM):		Tc-99 Source Response Stainless Steel (CPM):		
	A ch.	B ch.	Net Eff.	A ch.	B ch.	Net Eff.	A ch.	B ch.	A ch.	B ch.	Net Eff.
825 V / N/A				3958	538	21.39%	1	179	1	2265	12.06%

Net A to B Xtalk: <10%	B to A Xtalk: <1%
8.3%	<1%

	<u>Pu239</u>	<u>Tc99 Ni</u>	<u>Tc99 ss</u>	<u>Th-230</u>	<u>Sr90</u>	<u>C-14</u>
AF CPM:	3958		2265	2832	2515	
AF 4 pi eff:	21.39%		12.06%	16.98%	27.92%	
AF 2 pi eff:	42.23%		19.31%	36.91%	39.94%	

Is as found efficiency within 20% of the efficiency from the last cal?

☒ Yes ☐ No (See Remarks)

Note: If the as found data is within 10% of the last calibration and the B-A Xtalk is <1% and the A-B Xtalk is <10%, then the technician may N/A the plateau section and go directly to remarks.





GRIFFIN INSTRUMENTS



PROBE #: **PR236964**

Date: 11/19/15

PLATEAU AND SET POINT DATA

HV / Vernier:	Tc-99 Source Response SS (CPM):			Pu-239 Source Response (CPM):			Background (CPM):		Net A to B Xtalk: <10%	B to A Xtalk: <1%
	A ch.	B ch.	Net Eff.	A ch.	B ch.	Net Eff.	A ch.	B ch.		
775	3	1010	5.4%	3576	312	19.3%	0	81	6.1%	<1%
800	0	1827	9.9%	3875	381	20.9%	0	116	6.4%	<1%
825	4	2440	13.1%	4125	610	22.3%	0	172	9.6%	<1%
850	2	2822	15.2%	4208	610	22.7%	1	192	9.0%	<1%
875	3	3064	16.3%	4238	858	22.9%	0	242	12.7%	<1%

Alpha / Beta Bkg (cpm)		2		153					
HV / Vernier		Pu-239	Tc-99 Ni	Tc-99 SS	Th-230	C-14	Sr-90		
825 / N/A	CPM:	4181		2493	3212		2848		
	4 pi AL Efficiencies:	22.59%		13.53%	19.25%		32.21%		
	2 pi AL Efficiencies:	44.60%		21.67%	41.85%		46.07%		

REMARKS: Tagged out low beta eff. As found taken w/ 5' cable. Replaced mylar verified scintillator. Re-cal'd w/ 39" cable. Posted " Use 39" cable only".

Does Instrument Meet Final Acceptance Criteria?: ☒ Yes ☐ No

Calibration Sticker Attached?: ☒ Yes ☐ No

Date Instrument is Due For Next Calibration: 11/19/16

INSTRUMENT MARRIED WITH 2360 # 225265

Performed/Reviewed by:

D. Steimel

Date: 11/19/2015

Entered by: *DS* Initials

2 pi efficiencies denoted in Italics.

Calibrations performed to ANSI N323A-1997 standards.



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

CALIBRATION CERTIFICATE

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

CUSTOMER INFORMATION		INSTRUMENT INFORMATION		
Customer Name: Griffin Instruments		Manufacturer: Ludlum		
Address: 131 Gallaher Road, Kingston, TN 37763		Model: 2350-1	Serial Number: 192611	
Contact Name: Joanne Glenn		Probe: N/A	Serial Number: N/A	
Customer Purchase Order Number: N/A	Work Order Number: 2015-14337	Calibration Method: Electronic		
INSTRUMENT CALIBRATION INFORMATION				
Instrument Range (CPM)	Calibration Standard Value (CPM)	Instrument Response ($\pm 10\%$)		Comments
		Before Calibration	After Calibration	
400	400	399	399	DVM: 88020324 Cal Due: 03/27/16
4,000	4,000	3,989	3,989	Temp/Press: 3076 Cal Due: 01/06/16
40,000	40,000	39,890	39,890	Humidity: 958670 Cal Due: 01/30/16
400,000	400,000	398,896	398,896	Pulser: 246163 Cal Due: 02/04/16
HV Cal Values (M2350 HV Entry)	Desired HV Tolerance (Voltmeter) (VDC)	As Found (VDC)	As Left (VDC)	CP Firmware Version: 37122N28 I/O Firmware Version: 37123N05
500	(490 - 510)	493	498	
1,500	(1,498 - 1,502)	1,487	1,500	
2,000	(1,940 - 2,060)	1,979	1,997	Temp: 21.0 °C Pressure: 740 mmHg Humidity: 37.0 %
Parameter	Tolerance ($\pm 10\%$)	As Found	As Left	
Threshold T = 100	10 \pm (9 to 11) mVDC	8.7	10.0	Geotropism: SAT ACK/Scroll: SAT
Threshold T = 500	50 \pm (45 to 55) mVDC	43.9	50.3	BAT > 4.5V: SAT Volume: SAT
Threshold T = 1000	100 \pm (90 to 110) mVDC	89	102	Count: SAT Audio Divide: SAT
Window Width W = 100	10 \pm (9 to 11) mVDC	8.8	10.1	Alarms: SAT Lamp: SAT
Display-to-mV ratio:	100 to 10 mV		Overload Test: SAT Physical Cond: SAT	
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: <i>Mike Yance</i>		Reviewed By: <i>[Signature]</i>	Date: <i>8/5/15</i>	
Calibration Date: 08/04/2015		Certification Due (12 mo.): 08/04/2016		



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Email: ISFStaff@energysolutions.com

CALIBRATION CERTIFICATE

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CUSTOMER INFORMATION				DETECTOR INFORMATION		
Customer Name: Griffin Instruments				Manufacturer: NE Technology		
Address: 131 Gallaher Road, Kingston, TN 37763				Model: GP13A	Serial Number: 363	
Contact Name: Joanne Glenn				Calibration Method:		
Contract Purchase Order Number: Credit Card		Work Order Number: 2015-14337		Source		
DETECTOR PARAMETER SETUPS						
Parameter	As Found	As Left	Parameter	As Found	As Left	Comments
Model	GP13A	GP13A	CC	1.0	1.0	DVM: 88020324 Cal Due: 02/04/16
S/N	360	360	DT	4.0 uSec	4.0 uSec	Temp/Press: 3076 Cal Due: 01/06/16
Units	7 = counts	7 = counts	Threshold	350 = 35 mV	350 = 35 mV	Humidity: 958670 Cal Due: 01/30/16
multiplier	0 = auto	0 = auto				
Time base	1 = minutes	1 = minutes				Temp: 21.0 °C Pressure: 740 mmHg
HV	880V	900V				Humidity: 37.0 %
Count time	60 sec	60 sec				** Detector specific parameters must be entered into instrument manually to be used with another 2350-1 **
Saved as Detector #1						
INSTRUMENT INFORMATION						
<u>Model</u>		<u>Serial Number</u>		<u>Calibration Due Date</u>		
2350-1		192611		08/04/16		
USED FOR EFFICIENCY DETERMINATION AND HV PLATEAUING						
I^{129} #040202 at 95,682 DPM Certification Date: 04/13/99						
Background (CPM)	Gross Source Counts (CPM)		Net Source Counts (CPM)		Efficiency in % (Determined on contact)	
3,710	17,320		13,610		14.2 % for I^{129}	
** Gross source counts taken from an average of three one minute counts from the Heel, Middle, and Toe of Detector **						
COMMENTS						
** Detectors set up with a 2350-1 may be used with any 2350-1 provided that the setup parameters are scanned into the 2350-1 prior to use with that specific detector and the threshold ratio is 100 = 10 mV on the instrument **						
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: <i>Mike Young</i>		Reviewed By: <i>[Signature]</i>		Date: 8/5/15		
Calibration Date: 08/04/2015				Calibration Due: 08/04/2016		

8/6-15



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Oak Ridge, TN 37830
Phone: (877) 462-4873
Email: JSFStaff@energysolutions.com

CALIBRATION CERTIFICATE

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

CUSTOMER INFORMATION				DETECTOR INFORMATION		
Customer Name: Griffin Instruments				Manufacturer: NE Technology		
Address: 131 Gallaher Rd., Kingston, TN 37763				Model: GP13A	Serial Number: 362	
Contact Name: Joanne Glenn				Calibration Method:		
Contract Purchase Order Number: Credit Card		Work Order Number: 2015-14423		Source		
DETECTOR PARAMETER SETUPS						
Parameter	As Found	As Left	Parameter	As Found	As Left	Comments
Model	GP13A	GP13A	CC	1.0	1.0	DVM: 88020324 Cal Due: 03/27/16
S/N	362	362	DT	4 uSec	4 uSec	Temp/Press: 3076 Cal Due: 01/06/16
Units	7 = counts	7 = counts	Threshold	350 = 35 mV	350 = 35 mV	Humidity: 958670 Cal Due: 01/30/16
multiplier	0 = auto	0 = auto				
Time base	1 = minutes	1 = minutes				Temp: 21.5 °C Pressure: 743 mmHg
HV	1,040V	1,060V				Humidity: 35.5 %
Count time	60 sec	60 sec				** Detector specific parameters must be entered into instrument manually to be used with another 2350-1 **
Saved as Detector #1						
INSTRUMENT INFORMATION						
<u>Model</u>		<u>Serial Number</u>			<u>Calibration Due Date</u>	
2350-1		186177			09/02/16	
USED FOR EFFICIENCY DETERMINATION AND HV PLATEAUING						
I^{129} #040202 at 95,682 DPM Certification Date: 04/13/99						
Background (CPM)	Gross Source Counts (CPM)		Net Source Counts (CPM)		Efficiency in % (Determined on contact)	
3,390	16,588		13,198		13.8 % for I^{129}	
** Gross source counts taken from an average of three one minute counts from the Heel, Middle, and Toe of Detector **						
COMMENTS						
** Detectors set up with a 2350-1 may be used with any 2350-1 provided that the setup parameters are scanned into the 2350-1 prior to use with that specific detector and the threshold ratio is 100 = 10 mV on the instrument **						
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: <i>Mik Young</i>		Reviewed By: <i>J. Dickinson</i>		Date: 9/2/15		
Calibration Date: 09/02/2015		Calibration Due: 09/02/2016				

9/13/15

NE Technology GP13A HIGH VOLTAGE PLATEAU DATA SHEET

Serial Number: 362

[illegible]

Plateau performed with I^{129} Source # 040202 at 95,682 dpm at center of detector

Performed By: Mike Young Date: 9-2-15

Philotechnics Analytical Worksheet
US Department of Health and Human Services
Centers for Disease Control and Prevention
4770 Buford Highway, Chamblee, GA, 30341

Appended
Appendix D

Minimum Detectable Concentration (MDC) Static Count

Calculations for Liquid Scintillation Counter

(95% confidence level via NUREG 1507 method)

$$MDC (dpm/100cm^2) = \frac{3 + 3.29\sqrt{(R_b)(T_{s+b})(1 + T_{s+b}/T_b)}}{(Eff.)(T_{s+b})} \quad (Eq. 1)$$

Where:

Eff. = LSC total efficiency, Counter cpm/NIST Standard dpm
 R_b = LSC background rate (cpm)
 T_{s+b} = Sample count time (minutes)
 T_b = Background count time (minutes)

Static Count MDC Calculations					
Nuclide	Eff.	R_b	T_{s+b}	T_b	MDC (Static)
H-3	69.9%	11.5	1	1	26.9 dpm/100 cm ²
C-14	62.5%	11.5	1	1	30.0 dpm/100 cm ²
I-125	50.0%	11.5	1	1	37.6 dpm/100 cm ²

Minimum Detectable Concentration (MDC) Static Count

Calculations for Planchet Counter

(95% confidence level via NUREG 1507 method)

$$MDC (dpm/100cm^2) = \frac{3 + 3.29\sqrt{(R_b)(T_{s+b})(1 + T_{s+b}/T_b)}}{(Eff.)(T_{s+b})} \quad (Eq. 1)$$

Where:

Eff. = Planchet total efficiency {4 π efficiency}
 R_b = Planchet background rate (cpm)
 T_{s+b} = Sample count time (minutes)
 T_b = Background count time (minutes)

Static Count MDC Calculations						
PIC ASC #0713821						
Meter	Nuclide	Total Eff.	R_b	T_{s+b}	T_b	MDC (Static)
Protean	Th-230	15.27%	0.1	15	60	3.4 dpm/100 cm ²
Protean	Tc-99	11.82%	66.7	15	60	67.3 dpm/100 cm ²

Philotechnics Analytical Worksheet
US Department of Health and Human Services
Centers for Disease Control and Prevention
4770 Buford Highway, Chamblee, GA, 30341

Appended
Appendix D

Minimum Detectable Concentration (MDC) Static Count

Calculations for Hand-Held Monitors

(95% confidence level via NUREG 1507 method)

$$MDC (dpm/100cm^2) = \frac{3 + 3.29\sqrt{(R_b)(T_{s+b})(1 + T_{s+b}/T_b)}}{(Eff.)(T_{s+b})(probeareacm^2/100cm^2)} \quad (Eq. 2)$$

Where:

Total Eff. = Total Efficiency (2pi efficiency * 0.25 per ISO 7503-1)

R_b = Average background rate (cpm)

T_{s+b} = Sample count time (minutes)

T_b = Background count time (minutes)

P = Probe area (cm²)

Static Count MDC Calculations

Meter: 187286 (Hand Held)

Nuclide	Total Eff.	R_b	T_{s+b}	T_b	P	MDC (Static)
Tc-99	7.51%	468.4	1	1	100	1381 dpm/100 cm ²

Meter: 187286 (Hand Held)

Nuclide	Total Eff.	R_b	T_{s+b}	T_b	P	MDC (Static)
Th-230	10.32%	3.0	3	3	100	55 dpm/100 cm ²

Meter: 212234 (Hand Held)

Nuclide	Total Eff.	R_b	T_{s+b}	T_b	P	MDC (Static)
I-129	7.07%	9008.7	1	1	100	6289 dpm/100 cm ²

Philotechnics Analytical Worksheet
US Department of Health and Human Services
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Appended
Appendix D

Scan Minimum Detectable Concentration (MDC)

Calculations for Hand-Held Monitors

(Scan MDA per NUREG-1575, NUREG-1507 methodology)

$$Scan\ MDC = \frac{MDCR}{\sqrt{p} (\epsilon_i)(\epsilon_s) \left(\frac{A}{100\text{cm}^2} \right)} \quad (\text{Eq. 3})$$

Where:

p = surveyor efficiency, per NUREG 1507 (0.5)
 ϵ_i = total efficiency (2π geometry)
 ϵ_s = surface efficiency, 0.5 for gammas and high energy betas >1 MeV Emax
 (e.g. P-32, Cl-36, S/Y-90, etc.), 0.25 for low energy betas
 (e.g. C-14, P-33, S-35, Tc-99, Ca-45, etc.)
 A = probe active area (cm^2)

And,

$$MDCR = S_i (60 \text{ sec /min}) / i \text{ sec} \quad (\text{Eq. 4})$$

Where:

MDCR = Minimum detectable count rate (cpm)
 S_i = source counts in time interval, i

And,

$$S_i = d \sqrt{B_i} \quad (\text{Eq. 5})$$

Where:

d' = 1.38 for 95% true positive scan detection rate,
 per, NUREG 1507, Table 6.1
 B_i = Background counts in interval, i

And,

$$B_i = (P_b)(i)(1 \text{ min} / 60 \text{ sec}) \quad (\text{Eq. 6})$$

Where:

P_b = probe background count rate (cpm)
 i = observation interval

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Appendix D

Scan Minimum Detectable Concentration (MDC)

Calculations for Hand-Held Monitors

(Scan MDA per NUREG-1575, NUREG-1507 methodology)

Specific Scan MDC calculation results:

#352912	Ambient	
$P_b =$	1534.0	cpm
$i =$	1.25	sec
$B_i =$	31.96	counts
$d' =$	1.38	
$S_i =$	7.80	counts
MDCR =	374.5	cpm

#212234	Ambient	
$P_b =$	9008.7	cpm
$i =$	1.25	sec
$B_i =$	187.68	counts
$d' =$	1.38	
$S_i =$	18.91	counts
MDCR =	907.5	cpm

#352912	Ambient	
$P_b =$	23.2	cpm
$i =$	3.975	sec
$B_i =$	1.54	counts
$d' =$	1.38	
$S_i =$	1.71	counts
MDCR =	25.8	cpm

Scan MDC Calculations			
Meter: 352912 Large Area Probe (Hand Held)			
Nuclide	Total Efficiency	Area	MDC (Scan)
Tc-99	9.76%	821	660.7 dpm/100 cm ²

Ambient

Meter: 212234 (Hand Held)			
Nuclide	Total Efficiency	Area	MDC (Scan)
I-129	7.07%	100	18152.1 dpm/100 cm ²

Ambient

**Philotechnics Analytical Worksheet
US Department of Health and Human Services
Centers for Disease Control and Prevention
4770 Buford Highway, Chamblee, GA, 30341**

Appended
Appendix D

Alpha Scan MDC IAW Appendix J

Calculation provided in Section 8.3.3.2 - Count Probability 821 cm² Probe in the Final Status Survey Report

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Appended
Appendix G - Resurvey Data

Survey Unit 4	Instrument				
	Protean		LSC - 7065636		
	Alpha	Beta	Chan A	Chan B	I-125
Background (CPM)	0.1	66.7	11.5	11.5	10.9
MDC Value	3.4	67.3	26.9	30.0	37.6
Meter Efficiency	15.3%	11.8%	61.1%	96.2%	50.0%

Survey Unit 4 - Incinerator Room

Sample	Gross CPM / 100 cm ²					Quench & Efficiency		Net DPM / 100 cm ²					Comment
	Alpha Planchet	Beta Planchet	Chan A Scint	Chan B Scint	Chan C Scint	H-3 Eff.	C-14 Eff.	Alpha Planchet	Beta Planchet	H-3	C-14/S-35	I-125	
1	0	55	7	12	4	61.1%	96.2%	-0.8	-98.7	-7.4	0.5	-7.8	<DCGL
1a	1	73	9	12	4	61.1%	96.2%	5.8	53.6	-4.1	0.5	-3.8	<DCGL
1b	0	51	12	10	6	61.1%	96.2%	-0.8	-132.6	0.8	-1.6	2.2	<DCGL
1c	0	65	5	9	7	61.1%	96.2%	-0.8	-14.1	-10.6	-2.6	-11.8	<DCGL

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Survey Unit 5	Instrument				
	Protean		LSC - 7065636		
	Alpha	Beta	Chan A	Chan B	I-125
Background (CPM)	0.1	66.7	11.5	11.5	10.9
MDC Value	3.4	67.3	26.9	30.0	37.6
Meter Efficiency	15.3%	11.8%	61.1%	96.2%	50.0%

Survey Unit 5 - Crawlspace

Sample	Gross CPM / 100 cm ²					Quench & Efficiency		Net DPM / 100 cm ²					Comment
	Alpha Planchet	Beta Planchet	Chan A Scint	Chan B Scint	Chan C Scint	H-3 Eff.	C-14 Eff.	Alpha Planchet	Beta Planchet	H-3	C-14/S-35	I-125	
Resurvey 3	1	79	7	15	7	61.1%	96.2%	5.8	104.4	-7.4	3.6	-7.8	<DCGL
3a	0	73	5	16	11	61.1%	96.2%	-0.8	53.6	-10.6	4.7	-11.8	<DCGL
3b	0	55	11	10	10	61.1%	96.2%	-0.8	-98.7	-0.8	-1.6	0.2	<DCGL
3c	0	71	11	10	10	61.1%	96.2%	-0.8	36.7	-0.8	-1.6	0.2	<DCGL
Resurvey 4	0	61	12	12	5	61.1%	96.2%	-0.8	-48.0	0.8	0.5	2.2	<DCGL
4a	0	49	14	15	14	61.1%	96.2%	-0.8	-149.5	4.1	3.6	6.2	<DCGL
4b	0	58	8	10	8	61.1%	96.2%	-0.8	-73.4	-5.7	-1.6	-5.8	<DCGL
4c	0	64	18	15	8	61.1%	96.2%	-0.8	-22.6	10.6	3.6	14.2	<DCGL
Resurvey 5	0	51	5	9	5	61.1%	96.2%	-0.8	-132.6	-10.6	-2.6	-11.8	<DCGL
5a	0	69	8	10	6	61.1%	96.2%	-0.8	19.7	-5.7	-1.6	-5.8	<DCGL
5b	0	52	11	9	10	61.1%	96.2%	-0.8	-124.1	-0.8	-2.6	0.2	<DCGL
5c	0	59	7	12	7	61.1%	96.2%	-0.8	-64.9	-7.4	0.5	-7.8	<DCGL
Resurvey 6	1	60	14	12	6	61.1%	96.2%	5.8	-56.4	4.1	0.5	6.2	<DCGL
6a	0	67	6	14	10	61.1%	96.2%	-0.8	2.8	-9.0	2.6	-9.8	<DCGL
6b	0	65	12	7	10	61.1%	96.2%	-0.8	-14.1	0.8	-4.7	2.2	<DCGL
6c	0	47	15	14	7	61.1%	96.2%	-0.8	-166.5	5.7	2.6	8.2	<DCGL
Resurvey 12	0	66	11	16	11	61.1%	96.2%	-0.8	-5.6	-0.8	4.7	0.2	<DCGL
12a	0	57	15	16	10	61.1%	96.2%	-0.8	-81.8	5.7	4.7	8.2	<DCGL
12b	0	59	10	15	12	61.1%	96.2%	-0.8	-64.9	-2.5	3.6	-1.8	<DCGL
12c	1	69	15	9	8	61.1%	96.2%	5.8	19.7	5.7	-2.6	8.2	<DCGL
Resurvey 15	0	41	14	10	11	61.1%	96.2%	-0.8	-217.2	4.1	-1.6	6.2	<DCGL
15a	0	61	10	13	11	61.1%	96.2%	-0.8	-48.0	-2.5	1.6	-1.8	<DCGL
15b	0	64	13	11	13	61.1%	96.2%	-0.8	-22.6	2.5	-0.5	4.2	<DCGL
15c	0	59	13	12	11	61.1%	96.2%	-0.8	-64.9	2.5	0.5	4.2	<DCGL