

Memorandum

DATE 22 September 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 588982591780 *amy*

10-06772-01
03004001

1. The submitted information associated with instrument calibration appears to be incomplete or not relevant to the requested release. Please submit the current calibration records for all survey instruments and detectors used during this release survey along with efficiency information. You provided the following calibration information: Instrument 2350-1 #186177, calibration performed October 5, 2015, which did not appear to be used in this survey; Instrument 2224-1 #187286 with 43-93, PR2994119, calibration performed April 27, 2015, which would appear to be beyond the calibration due date during the survey; Probe 43-37-1 #PR352912 attached to 2350-1 #186177, which does not appear to have been used in the survey; and Instrument 2350-01 #212234 with probe GP13A #360, calibration done July 31, 2015, which also does not appear to be used in the survey. Instrument calibration for Ludlum 2350-1 #186180 and GP13A probe, Ludlum 2224 with 43-93 probe, Ludlum 2350-1 #203439 with BP19DD detector; Ludlum 2350-1 #203447 with GP13A detector which was stated was used in the survey did not appear to have calibration information presented.

Response:

The calibration certificates for the actual survey instruments used in the final status survey, along with their description and serial numbers are provided.

2. In section 8.3.3.1 of your report, you state: "The probability of detecting a single count while passing over the contaminated area for 100 cm² probe was not possible due to the limitations on probe size, background and detector efficiency; therefore, only the larger (821 cm²) gas-proportional detectors was used for alpha scans." However, in section 17.6 you do not present that you scanned with anything larger than a 100cm² detector. Additionally, you present MDC scan using the beta scan methodology calculation in Appendix D of your worksheet instead of the methodology presented in the report under section 8.3.3.2. Please restate how you performed alpha scans, present probability of detection for the instruments used, and present any additional results that was done for suspect areas that surveys needed to stop and perform specific fixed point surveys due to the result being higher than the MDC in a clear and comprehensive

REC'D IN LAT. *9/28/16*

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NMCS/RGNI MATERIALS-002

Response:

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 using moving at a scan rate of 2.5 in/sec for large area probe alpha scans and 5 in/sec 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 addition, the Ludlum 2350-1 with a 43-37-1 was added to the list of instruments for the scan surveys.

8.3.3.2 Count Detection Probability 821 cm² Probe

The larger (821 cm²) gas-proportional detectors had alpha background count rates on the order of 20 cpm, and a single count would not cause a surveyor to investigate further. A counting period long enough to establish that a single count indicated elevated contamination level would be prohibitively inefficient. For these types of instruments, the surveyor needed to get at least two counts while passing over the source area before stopping for further investigation, and therefore the probability of getting two or more counts was calculated using the following equation in

Equation Error! No text of specified style in document.-1 – Count Detection Probability Two or More Counts Equation below.

Equation Error! No text of specified style in document.-1 – Count Detection Probability Two or More Counts Equation Example

$$\begin{aligned} P(n \geq 2) &= 1 - P(n = 0) - P(n = 1) \\ &= 1 - \left(1 + \frac{(GE + B)d}{60v} \right) \left(e^{-\frac{(GE+B)d}{60v}} \right) \\ &= 1 - \left(1 + \frac{(GE + B)t}{60} \right) \left(e^{-\frac{(GE+B)t}{60}} \right) \end{aligned}$$

Where:

- $P(n \geq 2)$ = Probability of observing at least 2 counts
- C = Contamination Guideline in dpm/100 cm²,
- A = Physical probe area (cm²)
- G = Contamination activity (dpm), 75 dpm/100 cm² (50% of DCGL to meet DQOs) adjusted for detector at 100 cm² from 821 cm² is 615.75

- E = Detector efficiency (4π) including ISO 7503 surface efficiency of 0.25 for alphas = 10.90%
 B = Background in dpm/100cm² = 9.5
 t = D/v, dwell time over the source (15.9 cm / 4 cm/sec) = ~4 sec
 v = Scan speed (cm/s) = 4 cm/sec or ~1.5 inches/sec
 D = Width of detector in direction of scan (cm)

$$\begin{aligned}
 G &= C \cdot A / 100 \\
 G &= (75 \cdot 821) / 100 \\
 G &= 615.75
 \end{aligned}$$

$$P(n \geq 2) = 1 - \left(1 + \frac{(615.75 \cdot .109 + 23)15.9}{60 \cdot 4} \right) \left(e^{-\frac{(615.75 \cdot .109 + 23)15.9}{60 \cdot 4}} \right)$$

$$P(n \geq 2) = 1 - (1 + 5.970235)(e^{-5.970235})$$

$$P(n \geq 2) = 1 - (6.970235)(.0025536)$$

$$P(n \geq 2) = 1 - (.017799)$$

$$P(n \geq 2) = 98\%$$

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. Two or more counts were detected six times. Upon detection of two or more counts, timed counts (60 seconds for beta and 180 seconds for alpha) were conducted. All results were <MDC.

Surface Scans

Scanning was used to identify locations within the survey unit that exceeded the DCGL. These locations were marked and receive additional investigations to determine the concentration, area, and extent of the contamination. None were identified with the exception of the Scoping survey effort identification. For Class 1 areas, scanning surveys were designed to detect small areas of elevated activity that were not detected by the measurements using the systematic pattern. The percentage of actual accessible building structural surfaces to be scanned compared to MARSSIM recommendations are presented in **Table Error! No text of specified style in document.-1 - Scan Survey Coverage**.

Table Error! No text of specified style in document.-1 - Scan Survey Coverage

| Classification | Percentage of Surface Area Requiring Scan Coverage (MARSSIM) | CDC's Surface Area Scan Coverage |
|----------------|--|---|
| 1 | 100% | 100% of all accessible areas (holders/casing for the instrument detectors normally prevent direct scans along the intersection) |

| | | |
|---|------------------------|--------------------------------|
| | | of walls, floors and ceiling) |
| 2 | 10 – 100% (Judgmental) | 50% of all accessible areas |
| 3 | Judgmental | 25% of all accessible areas |

The scan survey percentage was chosen in order to provide a comprehensive survey of the impacted areas and provided confidence there was no contamination present above the DCGLs. In the event of any elevated activity noted from the survey, the location would have been marked, additional measurements taken to quantify the activity, and any decontamination determined to be appropriate conducted prior to a re-survey. The probe was maintained at a constant distance of approximately 1/8-1/4" (ensuring < 1 cm or 0.4 inches) above the surface using moving at a scan rate of 2.5 in/sec for large area, **821 cm²**, probe alpha scans and 5 in/sec for large area, **821 cm²**, probe beta/gamma scans. Survey instrumentation detectors, both small and large area probes were designed to float across all surfaces (floors, walls, structures) on state of the art Ultra-Wear-Resistant PTFE-Filled Delrin® Acetal Resin Teflon slides to maintain a constant 1/8-1/4" (ensuring < 1 cm or 0.4 inches) detector distance, as the detector was independent of the normal cart system associated with large area probe monitoring systems, which by design encompasses a fulcrum point, causing fluctuations in distance of the detector. The design was also not dependent on the technician attempting to hold the detector at a predetermined distance, while cautiously ensuring they did not damage the sensitive mylar by allowing the detector to creep to close to the surface or an uneven surface.

In addition, total activity measurements were collected in a random-systematic grid in accordance with the MARSSIM approach. Removable contamination measurements were performed at each total activity measurement location.

The floor, the louvers and the ventilation of the room and all other surfaces and structures were scanned using a Ludlum 2350-1 (serial# 186180) with a GP13A (100 cm² Gamma probe), a Ludlum 2224 (serial# 187286) with a 43-93 (100 cm² Alpha/Beta probe), and a **Ludlum 2350-1 (Serial #186177) with a 43-37-1 (821 cm² Alpha/Beta probe PR352912)**. Our data shows that **all scan surveys were below the established DCGL_w**.

3. Sample 1 of Survey Unit 4 survey results for loose surface contamination results are 23.8 dpm/100 cm² alpha which is above the DCGL for alpha per License Condition 20. No discussion or follow up of the survey was presented, nor was it noted as being above the DCGL. Please re-perform surveys in this area to determine size of the contamination and if the area can be cleaned up. Please present further documentation to why this area may be released.

Response:

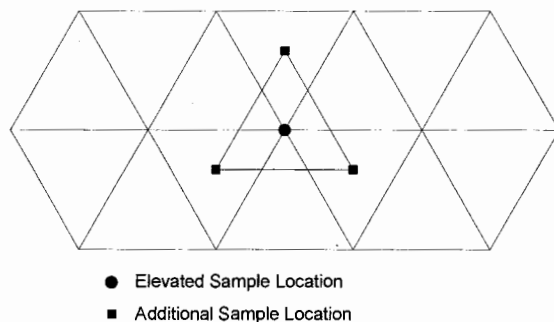
We believe the results provided were converted incorrectly. The original removable results were calculated from the straight 4-pi efficiency of the Protean instrument utilized. To use the ISO-7503-1 Standard from an instrument calibrated with 4-pi efficiency, the efficiency must be doubled to simulate the 2-pi efficiency normally utilized in the ISO-7503-1 Standard, prior to the application of the surface efficiency of 25%. Therefore, using this methodology, actual results are half of those presented and are now accurately presented in Appendix G as 11.9 dpm/100 cm², and not 23.8 dpm/100 cm² originally reported. Longer count times, although not required to meet the DQOs, may have eliminated the problem, as the removable DCGL was at the lower

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limits of detection for most all instruments produced, presenting its own technical challenges, an issue known to the NRC. As such, normal background variations and radon complicate the measurement process.

In addition, all total activity (fixed plus removable) results were less than 15 dpm/100 cm², indicating the removable results were not actually the 23.8 dpm/100 cm² and were likely statistical noise from acquiring 2 counts on the Protean while running the removable smears. As such, all total activity results were less than ten percent of the total activity DCGL for all alpha measurements; therefore, removable activity measurements were likely not even required.

However, in the interest of providing the requested documentation, all survey locations provided in the original FSSR with results in excess of the DCGL were investigated. Additional samples collected for investigation purposes were collected at locations that support the original random-systematic pattern used in the original survey design. For any original sample location where original activity was reported in excess of the DCGL, in addition to resample of the original location, an additional three samples were collected. A triangular grid, using the same sample spacing as the original survey was superimposed using the location of the elevated activity as the center. The additional samples were collected at the corners of the grid and were analyzed using the same instrument as the original samples. An example of sample design is provided below.



Maximum removable activity was 5.6 dpm/100 cm².

4. The static measurements displayed in the spreadsheets of appendix F show that the beta meter efficiency is 7.51% and alpha efficiency of 10.32 %. The appendix D Analytical Worksheets show that the beta total efficiency is 10.32% and the alpha total efficiency is 7.51%. Please resubmit whichever is incorrect.

Response:

The error was on Appendix D analytical worksheet, the corrected Appendix D analytical sheet is provided.

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,
0.9.2342.19200300.1001.1=1000906652,
cn=Narvaez L. Stinson -S
Date: 2016.09.22 12:44:49 -0400

Narvaez L. Stinson, MHS, CEM
Radiation Safety Officer
Office of the Associate Director for Laboratory Science and Safety



GRIFFIN INSTRUMENTS



CALIBRATION CERTIFICATE FOR 43-93 PROBE # PR294133

Owner: PHILOTECHNICS

DATE: 12/03/15

LOCATION: Griffin Inst

TECH: D.Steime

DATE LAST CAL EXPIRES:

12/16/15

REASON FOR CALIBRATION:

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

CABLE LENGTH: 39"

INPUT SENSITIVITY: DUAL

NIST TRACEABLE EQUIPMENT AND STANDARDS USED DURING CALIBRATION

MODEL: 2224 SERIAL #: 133876 CAL. DUE: 12/03/16

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 ☐ Unsat

Pu: 23.24% Th: 17.94% Sr: 34.50%

Tc ss: 16.43% 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. |
| 650 V / N/A | | | | 3946 | 532 | 21.32% | 1 | 249 | 2 | 3092 | 16.43% |

| | |
|---------------------------|----------------------|
| Net A to B Xtalk: <10% | B to A Xtalk: <1% |
| 6.7% | <1% |

| | Pu239 | Tc99 Ni | Tc99 ss | Th-230 | Sr90 | C-14 |
|--------------|--------|---------|---------|--------|--------|------|
| AF CPM: | 3946 | | 3092 | 2809 | 3026 | |
| AF 4 pi eff: | 21.32% | | 16.43% | 16.84% | 33.26% | |
| AF 2 pi eff: | 42.10% | | 26.32% | 38.81% | 47.57% | |

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 #: PR294133

Date: 12/03/15

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. | | |
| N/A | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |

| Alpha / Beta Bkg (cpm) | | 1 | 249 | | | | |
|------------------------|-----------|----------|----------|--------|------|--------|--|
| HV / Vernier | Pu-239 | Tc-99 NI | Tc-99 SS | Th-230 | C-14 | Sr-90 | |
| 650 V / N/A | CPM: 3946 | | 3092 | 2809 | | 3026 | |
| 4 pi AL Efficiencies: | 21.32% | | 16.43% | 16.84% | | 33.26% | |
| 2 pi AL Efficiencies: | 42.10% | | 26.32% | 36.61% | | 47.57% | |

REMARKS: Replaced mylar due to lacquer. Repaired scint due to glue on scint.

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

Date Instrument is Due For Next Calibration: 12/03/16

INSTRUMENT MARRIED WITH 2224 # 133676

Performed/Reviewed by:

Date: 12/3/2015

Entered by: Initials

2 pi efficiencies denoted in italics.

Calibrations performed to ANSI N321A-1997 standards.





GRIFFIN INSTRUMENTS



CALIBRATION CERTIFICATE FOR

2224-1

SERIAL#

187286

Owner: PHILOTECHNICS

DATE: 03/16/16

LOCATION:

Griffin Inst

TECH: E.M. Glenn

DATE LAST CAL EXPIRES:

04/27/16

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 #: 114512

CAL DUE: 10/19/16

☒ 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 | A.F. |
| 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

| | | | | | | | | |
|---------------|------|-------|------|------|---------------|--|--|--|
| x1 or x1 | 200 | 200 | 0.0% | A.F. | 501 0.2% A.F. | | | |
| | 500 | 500 | 0.0% | A.F. | | | | |
| | 800 | 800 | 0.0% | A.F. | | | | |
| x1 or x10 | 2000 | 2000 | 0.0% | A.F. | | | | |
| | 5000 | 5000 | 0.0% | A.F. | | | | |
| | 8000 | 8000 | 0.0% | A.F. | | | | |
| x10 or x100 | 20K | 20 K | 0.0% | A.F. | | | | |
| | 50K | 50 K | 0.0% | A.F. | | | | |
| | 80K | 80 K | 0.0% | A.F. | | | | |
| x100 or x1000 | 200K | 200 K | 0.0% | A.F. | | | | |
| | 500K | 500 K | 0.0% | A.F. | | | | |
| | 800K | 800 K | 0.0% | A.F. | | | | |

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

☒ Yes ☐ No

Overload Light:

☒ Adjusted / Verified ☐ Not Adj.

REMARKS:

Does Instrument Meet Final Acceptance Criteria?:

☒ Yes ☐ No

Calibration Sticker Attached?:

☒ Yes ☐ No

Date Instrument is Due For Next Calibration:

03/16/17

INSTRUMENT MARKED WITH

43-93

#PR294119

Performed/Reviewed by:

E.M. Glenn

Date: 3/16/2016.

Entered by: *ELG* Initials



GRIFFIN INSTRUMENTS



CALIBRATION CERTIFICATE FOR 43-93 PROBE # PR294119

Owner: PHILOTECHNICS

DATE: 03/16/16

LOCATION: Griffin Inst

TECH: E.M. Glenn

DATE LAST CAL EXPIRES:

04/27/16

REASON FOR CALIBRATION:

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

CABLE LENGTH: 39"

INPUT SENSITIVITY: DUAL

NIST TRACEABLE EQUIPMENT AND STANDARDS USED DURING CALIBRATION

MODEL: 2224-1

SERIAL #: 187286

CAL. DUE:

03/16/17

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: 17.37% Sr: 31.75%Tc ss: 16.56% 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. |
| 650 / N/A | | | | 4235 | 434 | 22.89% | 0 | 194 | 1 | 3341 | 18.19% |

| | |
|---------------------------|----------------------|
| Net A to B Xtalk: <10% | B to A Xtalk: <1% |
| 5.4% | <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: | 4235 | | 3341 | 2985 | 2807 | |
| AF 4 pi eff: | 22.89% | | 18.19% | 17.90% | 31.48% | |
| AF 2 pi eff: | 45.20% | | 29.14% | 38.91% | 45.03% | |

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 #: PR294119

Date: 03/16/16

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. | | |
| 575 | 1 | 1255 | 6.9% | 3593 | 238 | 19.4% | 0 | 58 | 4.8% | <1% |
| 600 | 1 | 2046 | 11.2% | 4021 | 199 | 21.7% | 0 | 104 | 2.3% | <1% |
| 625 | 1 | 2735 | 14.9% | 4167 | 267 | 22.5% | 1 | 158 | 2.5% | <1% |
| 650 | 1 | 3154 | 17.2% | 4279 | 331 | 23.1% | 0 | 175 | 3.5% | <1% |
| 675 | 1 | 3461 | 18.6% | 4358 | 489 | 23.6% | 1 | 240 | 5.4% | <1% |
| 700 | | | | 4288 | 1255 | 23.2% | 1 | 261 | 18.8% | |

| Alpha / Beta Bkg (cpm) | | 0 | 231 | | | |
|------------------------|-----------|----------|----------|--------|------|--------|
| HV / Vernier | Pu-238 | Tc-99 Ni | Tc-99 SS | Th-230 | C-14 | Sr-90 |
| 675 / N/A | CPM: 4312 | | 3474 | 3167 | | 2895 |
| 4 pi AL Efficiencies: | 23.31% | | 18.75% | 19.00% | | 32.10% |
| 2 pi AL Efficiencies: | 46.02% | | 30.03% | 41.29% | | 45.91% |

REMARKS:

Does Instrument Meet Final Acceptance Criteria? ☒ Yes ☐ NoCalibration Sticker Attached? ☒ Yes ☐ No

Date Instrument is Due For Next Calibration: 03/16/17

INSTRUMENT MARKED WITH 2224-1 #187288

Performed/Reviewed by: E. M. Glenn

Date: 3/16/2016

Entered by: EC Initials

2 pi efficiencies denoted in italics.

Calibrations performed to ANSI N323A-1997 standards.





GRIFFIN INSTRUMENTS



CALIBRATION CERTIFICATE FOR 43-37-1 PROBE # PR352912

Owner: PHILOTECHNICS

DATE: 10/05/15

LOCATION: Griffin Inst

TECH: E.M. Glenn

DATE LAST CAL EXPIRES:

REASON FOR CALIBRATION:

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

CABLE LENGTH: 6'

INPUT SENSITIVITY: 4mV

NIST TRACEABLE EQUIPMENT AND STANDARDS USED DURING CALIBRATION

MODEL: 2350-1 SERIAL #: 186177 CAL. DUE: 09/02/16

NIST TRACEABLE SOURCES USED

| Source Number | Isotope | 4 pi Activity | Assay Date | 2 pi Activity |
|---------------|---------|---------------|------------|---------------|
| L7-434 | Pu239 | 18,084 dpm | 09/01/14 | 9,131 cpm |
| 94TH470-1593 | Th230 | 16,672 dpm | 05/27/14 | 7,671 cpm |
| 00TC470-0654 | Tc99 SS | 17,300 dpm | 06/15/09 | 10,800 cpm |
| 2697-00 | Sr90 | 12,200 dpm | 03/01/00 | 8,530 cpm |
| PX-726 | C14 | 48,780 dpm | 01/21/08 | 18,660 cpm |

Efficiencies from last cal.:

Condition: ☒ Sat ☐ UnsatPu: Th: Sr: Tc ss: 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. |
| N/A | | | | | | | | | | | |

| | |
|---------------------------|----------------------|
| Net A to B Xtalk: <10% | B to A Xtalk: <1% |
| | |

| | Pu239 | Tc99 Ni | Tc99 ss | Th-230 | Sr90 | C-14 |
|--------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
| AF CPM: | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> |
| AF 4 pi eff: | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> |
| AF 2 pi eff: | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> |

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

☐ Yes ☒ No (See Remarks)

Note: If the as found date 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 #: PR352912

Date: 10/05/15

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. | | |
| 1600 | | 2235 | 12.1% | | | | | 137 | | |
| 1650 | | 3307 | 17.4% | | | | | 298 | | |
| 1700 | | 4603 | 23.5% | | | | | 545 | | |
| 1750 | | 5602 | 26.8% | | | | | 968 | | |
| 1800 | | 6134 | 27.0% | | | | | 1463 | | |
| 1850 | | 6423 | 28.4% | | | | | 1509 | | |

| Alpha / Beta Bkg (cpm) | | 1449 | | | | | |
|------------------------|-----------------------|--------|----------|----------|--------|--------|--------|
| HV / Vernier | | Pu-239 | Tc-99 Ni | Tc-99 SS | Th-230 | C-14 | Sr-90 |
| 1800 b | CPM: | | | 6262 | | 8736 | 4751 |
| | 4 pi AL Efficiencies: | | | 27.82% | | 14.94% | 39.38% |
| | 2 pi AL Efficiencies: | | | 44.56% | | 39.05% | 58.34% |

PROBE #: PR352912

Date: 10/05/15

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. | | |
| 1100 | | | | 2647 | | 14.3% | 1 | | | |
| 1150 | | | | 4016 | | 21.7% | 5 | | | |
| 1200 | | | | 4097 | | 22.1% | 3 | | | |
| 1250 | | | | 4241 | | 22.9% | 7 | | | |
| 1300 | | | | 4326 | | 23.3% | 7 | | | |
| 1350 | | | | 4370 | | 23.6% | 9 | | | |

| Alpha / Beta Bkg (cpm) | | 6 | | | | | |
|------------------------|-----------------------|--------|----------|----------|--------|------|-------|
| HV / Vernier | | Pu-239 | Tc-99 Ni | Tc-99 SS | Th-230 | C-14 | Sr-90 |
| 1275 a | CPM: | 4237 | | | 3460 | | |
| | 4 pi AL Efficiencies: | 23.40% | | | 20.72% | | |
| | 2 pi AL Efficiencies: | 46.34% | | | 45.03% | | |





GRIFFIN INSTRUMENTS



REMARKS: No previous cal data. Det 02 - alpha. Det 03 - beta. Cal due 09/02/16 to match the meter.

Does Instrument Meet Final Acceptance Criteria? ☒ Yes ☐ No

Calibration Sticker Attached? ☒ Yes ☐ No

Date Instrument Is Due For Next Calibration: 09/02/16

INSTRUMENT MARRIED WITH 2350-1 #186177

Performed/Reviewed by:

E. M. Glenn

Date: 10/5/2015

Entered by: *EL* Initials

2 pi efficiencies denoted in italics.

Calibrations performed to ANSI N323A-1997 standards.




**CALIBRATION
CERTIFICATE**

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

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

| CUSTOMER INFORMATION | | INSTRUMENT INFORMATION | | |
|--|---|--|-----------------------|---|
| Customer Name: Griffin Instruments | | Manufacturer: Ludlum | | |
| Address: 131 Gallaher Road, Kingston, TN 37763 | | Model: 2350-1 | Serial Number: 212234 | |
| Contact Name: Joanne Glenn | | Probe: N/A | Serial Number: N/A | |
| Customer Purchase Order Number: N/A | Work Order Number: 2015-14329 | 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) | 494 | 498 | |
| 1,500 | (1,498 - 1,502) | 1,488 | 1,500 | |
| 2,000 | (1,940 - 2,060) | 1,982 | 1,998 | Temp: 21.0 °C Pressure: 741 mmHg Humidity: 34.3 % |
| Parameter | Tolerance ($\pm 10\%$) | As Found | As Left | |
| Threshold T = 100 | 10 \pm (9 to 11) mVDC | 9.3 | 10.0 | Geotrolism: SAT ACK/Scroll: SAT |
| Threshold T = 500 | 50 \pm (45 to 55) mVDC | 46.5 | 50.0 | BAT >4.5V: SAT Volume: SAT |
| Threshold T = 1000 | 100 \pm (90 to 110) mVDC | 95 | 102 | Count: SAT Audio Divide: SAT |
| Window Width W = 100 | 10 \pm (9 to 11) mVDC | 9.1 | 9.9 | 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 Jones</i> | | Reviewed By: <i>J. J. Dubinso</i> | | Date: 7/31/15 |
| Calibration Date: 07/31/2015 | | Certification Due (12 mo.): 07/31/2016 | | |

7/4/15


**CALIBRATION
CERTIFICATE**

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

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

| CUSTOMER INFORMATION | | | DETECTOR INFORMATION | | | |
|--|---------------------------|-------------------------------|-----------------------------|---|--------------------|--|
| Customer Name: Griffin Instruments | | | Manufacturer: NE Technology | | | |
| Address: 131 Gallaher Road, Kingston, TN 37763 | | | Model: GP13A | | Serial Number: 360 | |
| Contact Name: Joanne Glenn | | | Calibration Method: | | | |
| Contract Purchase Order Number: Credit Card | | Work Order Number: 2015-14329 | 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: 741 mmHg |
| HV | 780V | 800V | | | | Humidity: 34.3 % |
| Count time | 30 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 | | | | | | |
| Model | | Serial Number | | Calibration Due Date | | |
| 2350-1 | | 212234 | | 07/31/16 | | |
| USED FOR EFFICIENCY DETERMINATION AND HV PLATEAUIING | | | | | | |
| 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) | | |
| 3,519 | 17,284 | 13,765 | | 14.4 % 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 | | Reviewed By: | | Date: | | |
| Calibrated By: <i>Mike Jones</i> | | <i>Jeff Robinson</i> | | 7/31/15 | | |
| Calibration Date: 07/31/2015 | | Calibration Due: 07/31/2016 | | | | |

8/4/15

NE Technology GP13A HIGH VOLTAGE PLATEAU DATA SHEET

Serial Number: 360

[illegible]

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

Performed By: Mike Young

Date: 7-31-15

Philotechnics Analytical Worksheet

Appendix C

**Centers For Disease Control
Instrument Operational Check
6/23/2016**

Counting Data:

| Standard | CPM |
|----------|---------|
| H-3 | 143,300 |
| C-14 | 81,150 |
| Blank | 27 |

Nuclide Information:

Analytical Sampling Date: 6/22/2016

| Nuclide | Initial Activity (DPM) | Count Date | Current Activity (CPM) |
|---------|------------------------|------------|------------------------|
| H-3 | 293,900 | 2/5/2010 | 205,133 |
| C-14 | 129,900 | 2/5/2010 | 129,800 |

Efficiency Calculations Unquenched:

| Nuclide | CPM | Corrected DPM | Efficiency |
|------------|---------|---------------|------------|
| H-3 | 143,300 | 205,133 | 69.86% |
| C-14 | 81,150 | 129,800 | 62.52% |
| Gross Beta | 224,450 | 334,933 | 67.01% |

Efficiency Used Based on Quench Curve:

| H-3 Quench | |
|------------|--------|
| LSR | EFF |
| 0.1 | 61.20% |
| 39.8 | 55.95% |
| 94.1 | 42.34% |
| 132.4 | 33.29% |
| 165.7 | 25.65% |
| 202.8 | 18.25% |
| 231.6 | 13.55% |
| 253.5 | 10.52% |
| 280.6 | 7.49% |

| C-14 Quench | |
|-------------|--------|
| LSR | EFF |
| 0.1 | 95.64% |
| 46.9 | 94.75% |
| 95.2 | 92.78% |
| 124.4 | 91.27% |
| 159.7 | 88.63% |
| 204.2 | 84.76% |
| 224.2 | 82.04% |
| 263.1 | 76.05% |
| 284.5 | 72.26% |



GRIFFIN INSTRUMENTS



CALIBRATION CERTIFICATE FOR

2224

SERIAL# 133676

Owner: PHILOTECHNICS

DATE: 12/03/15

LOCATION: Griffin Inst

TECH: D.Steinel

DATE LAST CAL EXPIRES:

12/16/15

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 | A.F. |
| 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. |

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. | | 248 | 0.8% | A.F. | |
| | 260 | 245 | 2.0% | A.F. | | | | | |
| | 400 | 395 | 1.3% | A.F. | | | | | |
| x1 or x10 | 1000 | 1000 | 0.0% | A.F. | | | | | |
| | 2500 | 2450 | 2.0% | A.F. | | | | | |
| | 4000 | 4000 | 0.0% | A.F. | | | | | |
| x10 or x100 | 10K | 10 K | 0.0% | A.F. | | | | | |
| | 25K | 24.5 K | 2.0% | A.F. | | | | | |
| | 40K | 40 K | 0.0% | A.F. | | | | | |
| x100 or x1000 | 100K | 100 K | 0.0% | A.F. | | | | | |
| | 250K | 245 K | 2.0% | A.F. | | | | | |
| | 400K | 400 K | 0.0% | A.F. | | | | | |

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

☒ Yes ☐ No

Overload Light:

☒ Adjusted / Verified ☐ Not Adj.

REMARKS:

Does Instrument Meet Final Acceptance Criteria?:

☒ Yes ☐ No

Calibration Sticker Attached?:

☒ Yes ☐ No

Date Instrument Is Due For Next Calibration:

12/03/16

INSTRUMENT MARRIED WITH

43-93

PR294133

Performed/Reviewed by:

D. Steinel

Date: 12/3/2015

Entered by: J.S. Initials




**CALIBRATION
CERTIFICATE**

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

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

| CUSTOMER INFORMATION | | INSTRUMENT INFORMATION | | |
|--|--|--|-----------------------|---|
| Customer Name: Griffin Instruments | | Manufacturer: Ludlum | | |
| Address: 131 Gallaher Road, Kingston, TN 37763 | | Model: 2350-1 | Serial Number: 186180 | |
| Contact Name: Joanne Glenn | | Probe: N/A | Serial Number: N/A | |
| Customer Purchase Order Number: N/A | Work Order Number: 2015-14329 | 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 | 39,886 | 39,886 | Humidity: 958670 Cal Due: 01/30/16 |
| 400,000 | 400,000 | 398,848 | 398,848 | 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) | 494 | 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: 741 mmHg Humidity: 34.3 % |
| Parameter | Tolerance ($\pm 10\%$) | As Found | As Left | |
| Threshold T = 100 | 10 \pm (9 to 11) mVDC | 9.7 | 10.0 | Geotropism: SAT ACK/Scroll: SAT |
| Threshold T = 500 | 50 \pm (45 to 55) mVDC | 48.4 | 50.0 | BAT >4.5V: SAT Volume: SAT |
| Threshold T = 1000 | 100 \pm (90 to 110) mVDC | 98 | 101 | Count: SAT Audio Divide: SAT |
| Window Width W = 100 | 10 \pm (9 to 11) mVDC | 9.2 | 9.5 | 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 Younce</i> | | Reviewed By: <i>Jeff Dubeinso</i> | | Date: 7/31/15 |
| Calibration Date: 07/31/2015 | | Certification Due (12 mo.): 07/31/2016 | | |

8/14/15



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 | | | DETECTOR INFORMATION | | | |
|--|---------------------------|-------------------------------|---|-----------------------------|--------------------|--|
| Customer Name: Griffin Instruments | | | Manufacturer: NE Technology | | | |
| Address: 131 Gallaher Road, Kingston, TN 37763 | | | Model: GP13A | | Serial Number: 361 | |
| Contact Name: Joanne Glenn | | | Calibration Method: | | | |
| Contract Purchase Order Number: Credit Card | | Work Order Number: 2015-14329 | 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: 741 mmHg |
| HV | 820V | 860V | | | | Humidity: 34.3 % |
| 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 | | 186180 | | 07/31/16 | | |
| USED FOR EFFICIENCY DETERMINATION AND HV PLATEAUGING | | | | | | |
| 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) | | | |
| 3,203 | 16,417 | 13,214 | 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 | | Reviewed By: | | Date: | | |
| Calibrated By: <i>Mike Yoner</i> | | <i>Jeff Dubois</i> | | 7/31/15 | | |
| Calibration Date: 07/31/2015 | | Calibration Due: 07/31/2016 | | | | |

8/4/15



GRIFFIN INSTRUMENTS



CALIBRATION CERTIFICATE FOR

2350-1

SERIAL# 203439

Owner: PHILOTECHNICS

DATE: 08/15/15

LOCATION: Griffin Inst

TECH: E.M. Glenn

DATE LAST CAL EXPIRES:

08/20/15

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 #: 114512

CAL. DUE: 10/15/15

MODEL:

SERIAL #:

CAL DUE:

☒ Audio Response

CABLE LENGTH 5'

CONDITION: Sat

NEW BATTERIES: ☐ Yes ☒ No

BATTERY CHECK: 5.6V

HV (+/-10%)

AS FOUND HV

AS LEFT HV

500 V:

500

A.F.

1250 V:

1250

A.F.

2000 V:

2000

A.F.

AF Threshold: 350

AL Threshold: A.F.

RATE CPM AS FOUND % ERROR AS LEFT % ERROR

| | | | | |
|------|-----------|------|------|--|
| 250 | 250 | 0.0% | A.F. | |
| 2500 | 2499 | 0.0% | A.F. | |
| 25K | 24.996 K | 0.0% | A.F. | |
| 250K | 249.963 K | 0.0% | A.F. | |

Is the As Found Data Within 2% of the Set Point?:

☒ Yes ☐ No

| | AF | AL |
|--------------------|--------|------|
| Detector #: | 00 | A.F. |
| Detector Serial #: | 351 | A.F. |
| Model #: | BP19DD | A.F. |
| U: | 7 | A.F. |
| M: | 0 | A.F. |
| TB: | 1 | A.F. |

| | AF | AL |
|----------------------|-----|------|
| HV: | 925 | A.F. |
| Window: | Off | A.F. |
| Count Time (sec): | 30 | 60 |
| Threshold: | 350 | A.F. |
| Correction Constant: | 1 | A.F. |
| Dead Time (uSec): | 0.0 | A.F. |

REMARKS:

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

Date Instrument is Due For Next Calibration: 08/15/16

INSTRUMENT MARKED WITH

BP19DD

#361

Performed/Reviewed by:

E.M. Glenn

Date: 8/15/2015

Entered by: *elt* Initials



GRIFFIN INSTRUMENTS



CALIBRATION CERTIFICATE FOR BP19DD PROBE # 351

Owner: PHILOTECHNICS

DATE: 08/15/15
TECH: E.M. GlennLOCATION: Griffin Inst
DATE LAST CAL EXPIRES: 08/20/15

REASON FOR CALIBRATION:

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

CABLE LENGTH: 5'

INPUT SENSITIVITY: 35mV

NIST TRACEABLE EQUIPMENT AND STANDARDS USED DURING CALIBRATION

MODEL: 2350-1 SERIAL #: 203439 CAL. DUE: 08/15/16

NIST TRACEABLE SOURCES USED

| Source Number | Isotops | 4 pi Activity | Assay Date | 2 pi Activity |
|---------------|---------|---------------|------------|---------------|
| 007C470-0654 | Tc99 SS | 17,300 dpm | 06/15/09 | 10,800 cpm |
| 2697-00 | Sr90 | 12,200 dpm | 03/01/00 | 8,530 cpm |
| PX-726 | C14 | 48,780 dpm | 01/21/08 | 18,660 cpm |

Efficiencies from last cal.:

Condition: ☒ Sat ☐ UnsatPu: Th: Sr: 35.67%Tc SS: 20.86% C14: 8.26% 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. |
| 925 / N/A | | | | | | | | 371 | | 3981 | 20.87% |

| | |
|---------------------------|----------------------|
| Net A to B Xtalk: <10% | B to A Xtalk: <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: | | | 3981 | | 3532 | 4416 |
| AF 4 pi eff: | | | 20.87% | | 37.58% | 8.29% |
| AF 2 pi eff: | | | 33.43% | | 53.71% | 27.68% |

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 #: 351

Date: 08/15/15

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. | | |
| N/A | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |

| Alpha / Beta Bkg (cpm) | | 371 | | | | | |
|------------------------|-----------------------|----------|----------|--------|--------|--------|--|
| HV / Vernier | Pu-239 | Tc-99 Ni | Tc-99 SS | Th-230 | C-14 | Sr-90 | |
| 925 / N/A | CPM: | | 3981 | | 4416 | 3532 | |
| | 4 pi AL Efficiencies: | | 20.67% | | 8.20% | 37.56% | |
| | 2 pi AL Efficiencies: | | 33.43% | | 21.68% | 53.71% | |

REMARKS:

Does Instrument Meet Final Acceptance Criteria? ☒ Yes ☐ NoCalibration Sticker Attached? ☒ Yes ☐ No

Date Instrument is Due For Next Calibration: 08/15/16

INSTRUMENT MARRIED WITH 2350-1 #203439

Performed/Reviewed by:

G.M. Glenn

Date: 8/15/2015

Entered by: Initials

2 pi efficiencies denoted in italics.

Calibrations performed to ANSI N323A-1997 standards.




**CALIBRATION
CERTIFICATE**

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

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

| CUSTOMER INFORMATION | | INSTRUMENT INFORMATION | | |
|--|---|--|---------------------------------------|---|
| Customer Name: Griffin Instruments | | Manufacturer: Ludlum | | |
| Address: 131 Gallaher Road, Kingston, TN 37763 | | Model: 2350-1 | Serial Number: 203447 | |
| Contact Name: Joanne Glenn | | Probe: N/A | Serial Number: N/A | |
| Customer Purchase Order Number: N/A | Work Order Number: 2015-14312 | Calibration Method: Electronic | | |
| INSTRUMENT CALIBRATION INFORMATION | | | | |
| Instrument Range (CPM) | Calibration Standard Value (CPM) | Instrument Response (CPM) (Tolerance $\pm 10\%$) | | Comments |
| | | Before Calibration | After Calibration | |
| 400 | 400 | 399 | 399 | DVM: 88020324 Cal Due: 03/27/16 |
| 4,000 | 4,000 | 3,990 | 3,990 | Temp/Press: 3076 Cal Due: 01/06/16 |
| 40,000 | 40,000 | 39,901 | 39,901 | Humidity: 958670 Cal Due: 01/30/16 |
| 400,000 | 400,000 | 399,005 | 399,005 | 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) | 495 | 499 | |
| 1,500 | (1,498 - 1,502) | 1,488 | 1,500 | |
| 2,000 | (1,940 - 2,060) | 1,982 | 1,996 | Temp: 20.8 °C Pressure: 744 mmHg Humidity: 37.6 % |
| Parameter | Tolerance ($\pm 10\%$) | As Found | As Left | |
| Threshold T = 100 | 10 \pm (9 to 11) mVDC | 9.2 | 10.0 | Geotroplism: SAT ACK/Scroll: SAT |
| Threshold T = 500 | 50 \pm (45 to 55) mVDC | 45.4 | 49.6 | BAT >4.5V: SAT Volume: SAT |
| Threshold T = 1000 | 100 \pm (90 to 110) mVDC | 93 | 101 | Count: SAT Audio Divide: SAT |
| Window Width W = 100 | 10 \pm (9 to 11) mVDC | 8.1 | 9.0 | 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 Yancey</i> | | Reviewed By: <i>Jeff Dickerson</i> | Date: 7/10/15 | |
| Calibration Date: 07/10/2015 | | Certification Due (12 mo.): 07/10/2016 | | |

| | | |
|-----------------|----------|--------|
| Serial # | 203447 | |
| Detector # | 00 | 01 |
| Det Ser # | PR029733 | 333 |
| Model | 43-5 | GP13A |
| U | 7 | 7 |
| M | 0 | 0 |
| TB | 1 | 1 |
| HV | 750 | 920 |
| W (Window) | Off | Off |
| CT (Count Time) | 60 sec | 60 sec |
| T (Threshold) | 350 | 350 |
| CC | 1 | 1 |
| DT | 0.0 usec | 4 usec |


**CALIBRATION
CERTIFICATE**

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

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

| CUSTOMER INFORMATION | | | DETECTOR INFORMATION | | | |
|--|---------------------------|-------------------------------|-----------------------------------|---|--------------------|--|
| Customer Name: Griffin Instruments | | | Manufacturer: NE Technology | | | |
| Address: 131 Gallaher Road, Kingston, TN 37763 | | | Model: GP13A | | Serial Number: 333 | |
| Contact Name: Joanne Glenn | | | Calibration Method: | | | |
| Contract Purchase Order Number: Credit Card | | Work Order Number: 2015-14312 | | Source | | |
| DETECTOR PARAMETER SETUPS | | | | | | |
| Parameter | As Found | As Left | Parameter | As Found | As Left | Comments |
| Model | GP13A | GP13A | CC | 1.0 | 1.0 | DVM: 89020324 Cal Due: 03/27/16 |
| S/N | 333 | 333 | 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: 20.8 °C Pressure: 744 mmHg |
| HV | 940V | 920V | | | | Humidity: 37.6 % |
| Count time | 30 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 | | | | | | |
| Model | | Serial Number | | Calibration Due Date | | |
| 2350-1 | | 203447 | | 07/10/16 | | |
| 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) | | |
| 3,329 | 17,206 | 13,877 | | 14.5 % 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>W. J. Dinkins</i> | | Date: 7/10/15 | |
| Calibration Date: 07/10/2015 | | | Calibration Due: 07/10/2016 | | | |

NE Technology GP13A HIGH VOLTAGE PLATEAU DATA SHEET**Serial Number: 333**

| HIGH VOLTAGE | BACKGROUND (CPM) | SOURCE (CPM) |
|------------------|------------------|---------------|
| 800 | 3,036 | 9,839 |
| 820 | 3,086 | 14,419 |
| 840 | 3,135 | 16,225 |
| 860 | 3,175 | 16,605 |
| 880 | 3,235 | 16,853 |
| 900 | 3,247 | 17,134 |
| 920 (SET) | 3,302 | 17,133 |
| 940 | 3,348 | 17,355 |
| 960 | 3,534 | 17,619 |
| 980 | 3,776 | 18,112 |
| N/A | N/A | N/A |
| N/A | N/A | N/A |
| N/A | N/A | N/A |
| N/A | N/A | N/A |
| N/A | N/A | N/A |
| N/A | N/A | N/A |
| N/A | N/A | N/A |
| N/A | N/A | N/A |
| N/A | N/A | N/A |
| N/A | N/A | N/A |
| N/A | N/A | N/A |
| N/A | N/A | N/A |
| N/A | N/A | N/A |
| N/A | N/A | N/A |
| N/A | N/A | N/A |
| N/A | N/A | N/A |

Plateau performed with I¹²⁹ Source #040202 at 95,682 dpm at center of detectorPerformed By: Mike YonaDate: 7-10-15



GRIFFIN INSTRUMENTS



CALIBRATION CERTIFICATE FOR 43-5 PROBE # PR029733

Owner: PHILOTECHNICS

DATE: 07/13/15

LOCATION:

Griffin Inst.

TECH: E.M. Glenn

DATE LAST CAL EXPIRES:

05/09/14

☒ Due For Calibration☐ Other (See Remarks)

CABLE LENGTH: 3'

☐ Repair (See Remarks)☐ Due and Repair

I.S.: 35mV

NIST TRACEABLE STANDARDS AND EQUIPMENT USED DURING CALIBRATION

| Source Number | Isotope | 4 pi Activity | Assay Date | 2 pi Activity |
|---------------|---------|---------------|------------|---------------|
| 94TH470-1593 | Th230 | 16,672 dpm | 05/27/14 | 7,871 cpm |

MODEL: 2350-1

SERIAL #: 203447

CAL. DUE: 07/10/16

AS FOUND DATA

Physical Condition: SAT

Efficiency from Last Cal.: 12.50%

HV From Last Cal.: 775 V

| HV | Resp - Heel | Resp - Center | Resp - Toe | Uniformity: | 4pi Eff.: |
|-------|-------------|---------------|------------|-------------|------------------|
| 775 V | 1961 | 1954 | 2061 | 3.46% | 11.95% |
| | | | | Bkg. CPM: 0 | 2pi Eff.: 25.97% |
| | | | | Uniformity: | 4pi Eff.: |
| | | | | Bkg. CPM: | 2pi Eff.: |

Is the As Found Efficiency within 20% of the efficiency from the last cal.?

☒

Yes

☐

No *See Remarks

*If As Found Efficiency is within 10% of the last calibration and uniformity is <10%, the technician may N/A the Plateau Section

PLATEAU AND SET POINT DATA

High Voltage:

Source Response (CPM):

Background (CPM):

| |
|-----|
| 675 |
| 700 |
| 725 |
| 750 |
| 775 |
| 800 |
| 825 |
| |
| |

| |
|------|
| 1773 |
| 1953 |
| 2012 |
| 1911 |
| 1827 |
| 1882 |
| 1967 |
| |
| |

| |
|---|
| 0 |
| 0 |
| 0 |
| 0 |
| 0 |
| 0 |
| 0 |
| |
| |

| HV | RESP - HEEL | RESP - CTR | RESP - TOE | Bkg.: | AL 4pi Eff.: |
|-------|-------------|------------|------------|-------------------|---------------------|
| 750 V | 1899 | 1995 | 1945 | 0 | 11.67% |
| | | | | Uniformity: 2.50% | AL 2pi Eff.: 25.37% |

REMARKS: Det 00. Replaced mylar due to no response to source outside. Cal due 07/10/16 to match meter.

Does Instrument Meet Final Acceptance Criteria?:

☒

Yes

☐

No

Calibration Sticker Attached?:

☒

Yes

☐

No

Date Instrument is Due For Next Calibration:

07/10/16

INSTRUMENT MARKED WITH

2350-1

203447

Performed/Reviewed by:

E.M. Glenn

Date: 7/13/2015

Entered by: *etc* Initials

Geometry: Flat Surface. 2 pi efficiencies: 11.67% 25.37%

Calibrations performed to ANSI N323A-1997 standards

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

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 {4π 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 | 7.90% | 0.1 | 15 | 60 | 6.6 dpm/100 cm ² |
| Protean | Tc-99 | 6.14% | 61.5 | 15 | 60 | 124.5 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

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 | 10.32% | 468.4 | 1 | 1 | 100 | 1005 dpm/100 cm ² |

Meter: 187286 (Hand Held)

| Nuclide | Total Eff. | R_b | T_{s+b} | T_b | P | MDC (Static) |
|---------|------------|-------|-----------|-------|-----|----------------------------|
| Th-230 | 7.51% | 3.0 | 3 | 3 | 100 | 75 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 |

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

Appendix D

Scan Minimum Detectable Concentration (MDC)

Calculations for Hand-Held Monitors

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

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

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

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

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

Appendix D

Alpha Scan MDC IAW Appendix J

G = (release level in 100cm² adjusted for detector at 100cm²)

E - Total 4pi efficiency

B= 23 cpm

d = Detector width for 43-37-1 is 15.9 cm

v = Scan Speed is 4 cm/sec

| Variable | Symbol | Value |
|--------------------|--------|-------|
| dpm | G | 100 |
| total efficiency | E | 0.21 |
| background cpm | B | 9.5 |
| detector width, cm | d | 15.9 |
| scan speed, cm/s | v | 1.7 |

| |
|--------------------------------|
| $(GE+B)t/60$ |
| 4.754411765 |

| |
|-------------------------------------|
| $P(n=0)$ |
| $P(n=0) = \text{EXP}(-4.754411765)$ |
| $P(n=0) = 0.0086136$ |

| |
|--|
| $P(n=1)$ |
| $P(n=1) = 4.75441765 * \text{EXP}(-4.754411765)$ |
| $P(n=1) = 0.0409526$ |

| |
|----------------------------|
| $P(n=0)$ |
| $P(n=0) = 0.0086136$ |

| |
|--|
| $P(n \geq 1) = 99\%$ |
| $P(n \geq 1) = 1 - P(n=0)$ |
| $P(n \geq 1) = 0.9913864$ |

| |
|---|
| $P(n \geq 2) = 95\%$ |
| $P(n \geq 2) = (1 - P(n=0) * (1 + (GE+B)t/60))$ |
| $P(n \geq 2) = 0.9504337$ |

Philotechnics Analytical Worksheet
US Department of Health and Human Services
Centers for Disease Control and Prevention

Appendix G

| Survey Unit 1 | Instrument | | | | |
|------------------|-----------------|-------|---------------|--------|-------|
| | Protean-0713821 | | LSC - 7065636 | | |
| | Alpha | Beta | Chan A | Chan B | I-125 |
| Background (CPM) | 0.1 | 61.5 | 11.5 | 11.5 | 10.9 |
| MDC Value | 3.3 | 62.3 | 26.9 | 30.0 | 37.6 |
| Meter Efficiency | 15.8% | 12.3% | 61.1% | 96.2% | 50.0% |

Survey Unit 1 - Floor and Lower Walls

| 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 | 15 | 13 | 12 | 61.1% | 96.2% | -0.7 | -52.8 | 5.7 | 1.6 | 8.2 | <DCGL |
| 2 | 0 | 72 | 5 | 16 | 15 | 61.1% | 96.2% | -0.7 | 85.6 | -10.6 | 4.7 | -11.8 | <DCGL |
| 3 | 1 | 70 | 8 | 12 | 8 | 61.1% | 96.2% | 5.6 | 69.4 | -5.7 | 0.5 | -5.8 | <DCGL |
| 4 | 0 | 56 | 11 | 11 | 14 | 61.1% | 96.2% | -0.7 | -44.7 | -0.8 | -0.5 | 0.2 | <DCGL |
| 5 | 1 | 70 | 12 | 16 | 5 | 61.1% | 96.2% | 5.6 | 69.4 | 0.8 | 4.7 | 2.2 | <DCGL |
| 6 | 0 | 77 | 9 | 9 | 9 | 61.1% | 96.2% | -0.7 | 126.4 | -4.1 | -2.6 | -3.8 | <DCGL |
| 7 | 1 | 76 | 5 | 15 | 14 | 61.1% | 96.2% | 5.6 | 118.2 | -10.6 | 3.6 | -11.8 | <DCGL |
| 8 | 0 | 57 | 5 | 14 | 8 | 61.1% | 96.2% | -0.7 | -36.5 | -10.6 | 2.6 | -11.8 | <DCGL |
| 9 | 1 | 75 | 11 | 9 | 4 | 61.1% | 96.2% | 5.6 | 110.1 | -0.8 | -2.6 | 0.2 | <DCGL |
| 10 | 1 | 63 | 10 | 16 | 5 | 61.1% | 96.2% | 5.6 | 12.4 | -2.5 | 4.7 | -1.8 | <DCGL |
| 11 | 0 | 59 | 9 | 16 | 10 | 61.1% | 96.2% | -0.7 | -20.2 | -4.1 | 4.7 | -3.8 | <DCGL |
| 12 | 1 | 60 | 11 | 8 | 9 | 61.1% | 96.2% | 5.6 | -12.1 | -0.8 | -3.6 | 0.2 | <DCGL |
| 13 | 1 | 62 | 11 | 8 | 11 | 61.1% | 96.2% | 5.6 | 4.2 | -0.8 | -3.6 | 0.2 | <DCGL |
| 14 | 1 | 56 | 11 | 10 | 14 | 61.1% | 96.2% | 5.6 | -44.7 | -0.8 | -1.6 | 0.2 | <DCGL |
| 15 | 0 | 56 | 12 | 9 | 14 | 61.1% | 96.2% | -0.7 | -44.7 | 0.8 | -2.6 | 2.2 | <DCGL |
| 16 | 0 | 69 | 4 | 16 | 8 | 61.1% | 96.2% | -0.7 | 61.2 | -12.3 | 4.7 | -13.8 | <DCGL |
| 17 | 0 | 73 | 10 | 10 | 5 | 61.1% | 96.2% | -0.7 | 93.8 | -2.5 | -1.6 | -1.8 | <DCGL |
| 18 | 1 | 76 | 12 | 15 | 10 | 61.1% | 96.2% | 5.6 | 118.2 | 0.8 | 3.6 | 2.2 | <DCGL |
| 19 | 0 | 67 | 8 | 13 | 4 | 61.1% | 96.2% | -0.7 | 44.9 | -5.7 | 1.6 | -5.8 | <DCGL |
| 20 | 1 | 57 | 8 | 10 | 8 | 61.1% | 96.2% | 5.6 | -36.5 | -5.7 | -1.6 | -5.8 | <DCGL |
| 21 | 1 | 78 | 6 | 15 | 13 | 61.1% | 96.2% | 5.6 | 134.5 | -9.0 | 3.6 | -9.8 | <DCGL |
| 22 | 1 | 57 | 7 | 15 | 15 | 61.1% | 96.2% | 5.6 | -36.5 | -7.4 | 3.6 | -7.8 | <DCGL |
| 23 | 0 | 63 | 15 | 14 | 8 | 61.1% | 96.2% | -0.7 | 12.4 | 5.7 | 2.6 | 8.2 | <DCGL |
| 24 | 0 | 79 | 7 | 10 | 11 | 61.1% | 96.2% | -0.7 | 142.6 | -7.4 | -1.6 | -7.8 | <DCGL |
| 25 | 0 | 70 | 10 | 14 | 9 | 61.1% | 96.2% | -0.7 | 69.4 | -2.5 | 2.6 | -1.8 | <DCGL |
| 26 | 1 | 64 | 4 | 15 | 12 | 61.1% | 96.2% | 5.6 | 20.5 | -12.3 | 3.6 | -13.8 | <DCGL |
| 27 | 0 | 67 | 15 | 9 | 14 | 61.1% | 96.2% | -0.7 | 44.9 | 5.7 | -2.6 | 8.2 | <DCGL |
| 28 | 1 | 72 | 8 | 14 | 5 | 61.1% | 96.2% | 5.6 | 85.6 | -5.7 | 2.6 | -5.8 | <DCGL |
| 29 | 1 | 71 | 8 | 13 | 6 | 61.1% | 96.2% | 5.6 | 77.5 | -5.7 | 1.6 | -5.8 | <DCGL |
| 30 | 0 | 68 | 14 | 14 | 14 | 61.1% | 96.2% | -0.7 | 53.1 | 4.1 | 2.6 | 6.2 | <DCGL |
| 31 | 1 | 77 | 7 | 9 | 15 | 61.1% | 96.2% | 5.6 | 126.4 | -7.4 | -2.6 | -7.8 | <DCGL |
| 32 | 1 | 74 | 11 | 11 | 11 | 61.1% | 96.2% | 5.6 | 101.9 | -0.8 | -0.5 | 0.2 | <DCGL |
| 33 | 1 | 56 | 9 | 12 | 8 | 61.1% | 96.2% | 5.6 | -44.7 | -4.1 | 0.5 | -3.8 | <DCGL |
| 34 | 0 | 60 | 9 | 15 | 14 | 61.1% | 96.2% | -0.7 | -12.1 | -4.1 | 3.6 | -3.8 | <DCGL |
| 35 | 1 | 79 | 7 | 13 | 5 | 61.1% | 96.2% | 5.6 | 142.6 | -7.4 | 1.6 | -7.8 | <DCGL |
| 36 | 0 | 57 | 13 | 8 | 8 | 61.1% | 96.2% | -0.7 | -36.5 | 2.5 | -3.6 | 4.2 | <DCGL |
| 37 | 1 | 70 | 15 | 11 | 10 | 61.1% | 96.2% | 5.6 | 69.4 | 5.7 | -0.5 | 8.2 | <DCGL |
| 38 | 0 | 55 | 13 | 13 | 14 | 61.1% | 96.2% | -0.7 | -52.8 | 2.5 | 1.6 | 4.2 | <DCGL |
| 39 | 1 | 58 | 8 | 12 | 7 | 61.1% | 96.2% | 5.6 | -28.4 | -5.7 | 0.5 | -5.8 | <DCGL |
| 40 | 0 | 79 | 9 | 15 | 5 | 61.1% | 96.2% | -0.7 | 142.6 | -4.1 | 3.6 | -3.8 | <DCGL |
| 41 | 0 | 62 | 4 | 16 | 9 | 61.1% | 96.2% | -0.7 | 4.2 | -12.3 | 4.7 | -13.8 | <DCGL |

Philotechnics Analytical Worksheet
US Department of Health and Human Services
Centers for Disease Control and Prevention

Appendix G

| Survey Unit 2 | Instrument | | | | |
|------------------|------------|-------|---------------|--------|-------|
| | Protean | | LSC - 7065636 | | |
| | Alpha | Beta | Chan A | Chan B | I-125 |
| Background (CPM) | 0.1 | 61.5 | 11.5 | 11.5 | 10.9 |
| MDC Value | 3.3 | 62.3 | 26.9 | 30.0 | 37.6 |
| Meter Efficiency | 15.8% | 12.3% | 61.1% | 96.2% | 50.0% |

Survey Unit 2 - Ceiling and Upper Walls

| 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 | 1 | 69 | 14 | 16 | 14 | 61.1% | 96.2% | 5.6 | 61.2 | 4.1 | 4.7 | 6.2 | <DCGL |
| 2 | 0 | 59 | 5 | 8 | 9 | 61.1% | 96.2% | -0.7 | -20.2 | -10.6 | -3.6 | -11.8 | <DCGL |
| 3 | 0 | 64 | 7 | 14 | 11 | 61.1% | 96.2% | -0.7 | 20.5 | -7.4 | 2.6 | -7.8 | <DCGL |
| 4 | 0 | 70 | 12 | 13 | 10 | 61.1% | 96.2% | -0.7 | 69.4 | 0.8 | 1.6 | 2.2 | <DCGL |
| 5 | 1 | 61 | 6 | 15 | 5 | 61.1% | 96.2% | 5.6 | -3.9 | -9.0 | 3.6 | -9.8 | <DCGL |
| 6 | 0 | 60 | 11 | 16 | 6 | 61.1% | 96.2% | -0.7 | -12.1 | -0.8 | 4.7 | 0.2 | <DCGL |
| 7 | 1 | 75 | 15 | 10 | 8 | 61.1% | 96.2% | 5.6 | 110.1 | 5.7 | -1.6 | 8.2 | <DCGL |
| 8 | 0 | 71 | 15 | 14 | 7 | 61.1% | 96.2% | -0.7 | 77.5 | 5.7 | 2.6 | 8.2 | <DCGL |
| 9 | 1 | 78 | 8 | 10 | 4 | 61.1% | 96.2% | 5.6 | 134.5 | -5.7 | -1.6 | -5.8 | <DCGL |
| 10 | 1 | 70 | 15 | 11 | 14 | 61.1% | 96.2% | 5.6 | 69.4 | 5.7 | -0.5 | 8.2 | <DCGL |
| 11 | 0 | 69 | 4 | 12 | 7 | 61.1% | 96.2% | -0.7 | 61.2 | -12.3 | 0.5 | -13.8 | <DCGL |
| 12 | 1 | 63 | 13 | 12 | 5 | 61.1% | 96.2% | 5.6 | 12.4 | 2.5 | 0.5 | 4.2 | <DCGL |
| 13 | 1 | 66 | 5 | 8 | 11 | 61.1% | 96.2% | 5.6 | 36.8 | -10.6 | -3.6 | -11.8 | <DCGL |
| 14 | 0 | 60 | 10 | 16 | 13 | 61.1% | 96.2% | -0.7 | -12.1 | -2.5 | 4.7 | -1.8 | <DCGL |
| 15 | 1 | 56 | 11 | 9 | 5 | 61.1% | 96.2% | 5.6 | -44.7 | -0.8 | -2.6 | 0.2 | <DCGL |
| 16 | 0 | 70 | 13 | 12 | 7 | 61.1% | 96.2% | -0.7 | 69.4 | 2.5 | 0.5 | 4.2 | <DCGL |
| 17 | 1 | 71 | 8 | 8 | 13 | 61.1% | 96.2% | 5.6 | 77.5 | -5.7 | -3.6 | -5.8 | <DCGL |
| 18 | 0 | 76 | 7 | 14 | 13 | 61.1% | 96.2% | -0.7 | 118.2 | -7.4 | 2.6 | -7.8 | <DCGL |
| 19 | 0 | 71 | 9 | 16 | 9 | 61.1% | 96.2% | -0.7 | 77.5 | -4.1 | 4.7 | -3.8 | <DCGL |
| 20 | 1 | 75 | 5 | 15 | 6 | 61.1% | 96.2% | 5.6 | 110.1 | -10.6 | 3.6 | -11.8 | <DCGL |
| 21 | 0 | 67 | 9 | 16 | 13 | 61.1% | 96.2% | -0.7 | 44.9 | -4.1 | 4.7 | -3.8 | <DCGL |
| 22 | 1 | 64 | 11 | 13 | 10 | 61.1% | 96.2% | 5.6 | 20.5 | -0.8 | 1.6 | 0.2 | <DCGL |
| 23 | 1 | 67 | 12 | 11 | 6 | 61.1% | 96.2% | 5.6 | 44.9 | 0.8 | -0.5 | 2.2 | <DCGL |
| 24 | 1 | 75 | 11 | 13 | 14 | 61.1% | 96.2% | 5.6 | 110.1 | -0.8 | 1.6 | 0.2 | <DCGL |
| 25 | 0 | 78 | 6 | 15 | 14 | 61.1% | 96.2% | -0.7 | 134.5 | -9.0 | 3.6 | -9.8 | <DCGL |
| 26 | 0 | 64 | 7 | 13 | 4 | 61.1% | 96.2% | -0.7 | 20.5 | -7.4 | 1.6 | -7.8 | <DCGL |
| 27 | 1 | 77 | 12 | 9 | 13 | 61.1% | 96.2% | 5.6 | 126.4 | 0.8 | -2.6 | 2.2 | <DCGL |
| 28 | 1 | 74 | 10 | 11 | 11 | 61.1% | 96.2% | 5.6 | 101.9 | -2.5 | -0.5 | -1.8 | <DCGL |
| 29 | 1 | 69 | 11 | 11 | 4 | 61.1% | 96.2% | 5.6 | 61.2 | -0.8 | -0.5 | 0.2 | <DCGL |
| 30 | 0 | 72 | 9 | 13 | 15 | 61.1% | 96.2% | -0.7 | 85.6 | -4.1 | 1.6 | -3.8 | <DCGL |
| 31 | 0 | 69 | 14 | 10 | 15 | 61.1% | 96.2% | -0.7 | 61.2 | 4.1 | -1.6 | 6.2 | <DCGL |
| 32 | 1 | 68 | 11 | 9 | 12 | 61.1% | 96.2% | 5.6 | 53.1 | -0.8 | -2.6 | 0.2 | <DCGL |
| 33 | 1 | 70 | 13 | 16 | 11 | 61.1% | 96.2% | 5.6 | 69.4 | 2.5 | 4.7 | 4.2 | <DCGL |
| 34 | 1 | 75 | 14 | 10 | 13 | 61.1% | 96.2% | 5.6 | 110.1 | 4.1 | -1.6 | 6.2 | <DCGL |
| 35 | 1 | 77 | 15 | 13 | 5 | 61.1% | 96.2% | 5.6 | 126.4 | 5.7 | 1.6 | 8.2 | <DCGL |
| 36 | 1 | 55 | 8 | 12 | 13 | 61.1% | 96.2% | 5.6 | -52.8 | -5.7 | 0.5 | -5.8 | <DCGL |
| 37 | 0 | 73 | 5 | 10 | 7 | 61.1% | 96.2% | -0.7 | 93.8 | -10.6 | -1.6 | -11.8 | <DCGL |
| 38 | 0 | 75 | 8 | 8 | 9 | 61.1% | 96.2% | -0.7 | 110.1 | -5.7 | -3.6 | -5.8 | <DCGL |
| 39 | 1 | 77 | 8 | 14 | 7 | 61.1% | 96.2% | 5.6 | 126.4 | -5.7 | 2.6 | -5.8 | <DCGL |
| 40 | 1 | 71 | 15 | 12 | 14 | 61.1% | 96.2% | 5.6 | 77.5 | 5.7 | 0.5 | 8.2 | <DCGL |
| 41 | 0 | 63 | 14 | 15 | 5 | 61.1% | 96.2% | -0.7 | 12.4 | 4.1 | 3.6 | 6.2 | <DCGL |
| 42 | 1 | 65 | 6 | 8 | 4 | 61.1% | 96.2% | 5.6 | 28.6 | -9.0 | -3.6 | -9.8 | <DCGL |
| 43 | 1 | 60 | 5 | 8 | 14 | 61.1% | 96.2% | 5.6 | -12.1 | -10.6 | -3.6 | -11.8 | <DCGL |
| 44 | 1 | 61 | 13 | 14 | 5 | 61.1% | 96.2% | 5.6 | -3.9 | 2.5 | 2.6 | 4.2 | <DCGL |
| 45 | 1 | 61 | 4 | 11 | 5 | 61.1% | 96.2% | 5.6 | -3.9 | -12.3 | -0.5 | -13.8 | <DCGL |
| 46 | 0 | 70 | 4 | 8 | 12 | 61.1% | 96.2% | -0.7 | 69.4 | -12.3 | -3.6 | -13.8 | <DCGL |
| 47 | 1 | 66 | 10 | 10 | 8 | 61.1% | 96.2% | 5.6 | 36.8 | -2.5 | -1.6 | -1.8 | <DCGL |

Philotechnics Analytical Worksheet
US Department of Health and Human Services
Centers for Disease Control and Prevention

Appendix G

| Survey Unit 3 | Instrument | | | | |
|------------------|------------|-------|---------------|--------|-------|
| | Protean | | LSC - 7065636 | | |
| | Alpha | Beta | Chan A | Chan B | I-125 |
| Background (CPM) | 0.1 | 61.5 | 11.5 | 11.5 | 10.9 |
| MDC Value | 3.3 | 62.3 | 26.9 | 30.0 | 37.6 |
| Meter Efficiency | 15.8% | 12.3% | 61.1% | 96.2% | 50.0% |

Survey Unit 3 - Loading Dock

| 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 | 58 | 8 | 16 | 6 | 61.1% | 96.2% | -0.7 | -28.4 | -5.7 | 4.7 | -5.8 | <DCGL |
| 2 | 1 | 56 | 6 | 15 | 10 | 61.1% | 96.2% | 5.6 | -44.7 | -9.0 | 3.6 | -9.8 | <DCGL |
| 3 | 0 | 78 | 10 | 11 | 9 | 61.1% | 96.2% | -0.7 | 134.5 | -2.5 | -0.5 | -1.8 | <DCGL |
| 4 | 1 | 78 | 10 | 9 | 12 | 61.1% | 96.2% | 5.6 | 134.5 | -2.5 | -2.6 | -1.8 | <DCGL |
| 5 | 1 | 72 | 13 | 11 | 4 | 61.1% | 96.2% | 5.6 | 85.6 | 2.5 | -0.5 | 4.2 | <DCGL |
| 6 | 0 | 67 | 15 | 16 | 15 | 61.1% | 96.2% | -0.7 | 44.9 | 5.7 | 4.7 | 8.2 | <DCGL |
| 7 | 0 | 57 | 7 | 8 | 9 | 61.1% | 96.2% | -0.7 | -36.5 | -7.4 | -3.6 | -7.8 | <DCGL |
| 8 | 1 | 60 | 17 | 13 | 6 | 61.1% | 96.2% | 5.6 | -12.1 | 9.0 | 1.6 | 12.2 | <DCGL |
| 9 | 0 | 58 | 6 | 11 | 4 | 61.1% | 96.2% | -0.7 | -28.4 | -9.0 | -0.5 | -9.8 | <DCGL |
| 10 | 1 | 56 | 9 | 12 | 4 | 61.1% | 96.2% | 5.6 | -44.7 | -4.1 | 0.5 | -3.8 | <DCGL |
| 11 | 0 | 64 | 12 | 8 | 11 | 61.1% | 96.2% | -0.7 | 20.5 | 0.8 | -3.6 | 2.2 | <DCGL |
| 12 | 1 | 66 | 6 | 11 | 6 | 61.1% | 96.2% | 5.6 | 36.8 | -9.0 | -0.5 | -9.8 | <DCGL |
| 13 | 0 | 67 | 13 | 14 | 4 | 61.1% | 96.2% | -0.7 | 44.9 | 2.5 | 2.6 | 4.2 | <DCGL |
| 14 | 0 | 61 | 7 | 13 | 11 | 61.1% | 96.2% | -0.7 | -3.9 | -7.4 | 1.6 | -7.8 | <DCGL |
| 15 | 0 | 65 | 13 | 9 | 9 | 61.1% | 96.2% | -0.7 | 28.6 | 2.5 | -2.6 | 4.2 | <DCGL |

Philotechnics Analytical Worksheet
US Department of Health and Human Services
Centers for Disease Control and Prevention

Appendix G

| Survey Unit 4 | Instrument | | | | |
|------------------|------------|-------|---------------|--------|-------|
| | Protean | | LSC - 7065636 | | |
| | Alpha | Beta | Chan A | Chan B | I-125 |
| Background (CPM) | 0.1 | 61.5 | 11.5 | 11.5 | 10.9 |
| MDC Value | 3.3 | 62.3 | 26.9 | 30.0 | 37.6 |
| Meter Efficiency | 15.8% | 12.3% | 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 | 2 | 69 | 6 | 14 | 8 | 61.1% | 96.2% | 11.9 | 61.2 | -9.0 | 2.6 | -9.8 | <DCGL |
| 2 | 1 | 77 | 10 | 10 | 5 | 61.1% | 96.2% | 5.6 | 126.4 | -2.5 | -1.6 | -1.8 | <DCGL |
| 3 | 1 | 71 | 11 | 8 | 4 | 61.1% | 96.2% | 5.6 | 77.5 | -0.8 | -3.6 | 0.2 | <DCGL |
| 4 | 0 | 73 | 9 | 16 | 4 | 61.1% | 96.2% | -0.7 | 93.8 | -4.1 | 4.7 | -3.8 | <DCGL |
| 5 | 0 | 61 | 12 | 13 | 6 | 61.1% | 96.2% | -0.7 | -3.9 | 0.8 | 1.6 | 2.2 | <DCGL |
| 6 | 1 | 77 | 9 | 15 | 10 | 61.1% | 96.2% | 5.6 | 126.4 | -4.1 | 3.6 | -3.8 | <DCGL |
| 7 | 0 | 59 | 17 | 12 | 15 | 61.1% | 96.2% | -0.7 | -20.2 | 9.0 | 0.5 | 12.2 | <DCGL |
| 8 | 1 | 71 | 7 | 14 | 11 | 61.1% | 96.2% | 5.6 | 77.5 | -7.4 | 2.6 | -7.8 | <DCGL |
| 9 | 0 | 75 | 10 | 10 | 4 | 61.1% | 96.2% | -0.7 | 110.1 | -2.5 | -1.6 | -1.8 | <DCGL |
| 10 | 0 | 73 | 9 | 13 | 8 | 61.1% | 96.2% | -0.7 | 93.8 | -4.1 | 1.6 | -3.8 | <DCGL |
| 11 | 0 | 59 | 13 | 14 | 7 | 61.1% | 96.2% | -0.7 | -20.2 | 2.5 | 2.6 | 4.2 | <DCGL |
| 12 | 0 | 57 | 8 | 12 | 6 | 61.1% | 96.2% | -0.7 | -36.5 | -5.7 | 0.5 | -5.8 | <DCGL |
| 13 | 1 | 61 | 11 | 15 | 4 | 61.1% | 96.2% | 5.6 | -3.9 | -0.8 | 3.6 | 0.2 | <DCGL |
| 14 | 0 | 68 | 6 | 8 | 12 | 61.1% | 96.2% | -0.7 | 53.1 | -9.0 | -3.6 | -9.8 | <DCGL |
| 15 | 1 | 60 | 16 | 11 | 7 | 61.1% | 96.2% | 5.6 | -12.1 | 7.4 | -0.5 | 10.2 | <DCGL |

Philotechnics Analytical Worksheet
US Department of Health and Human Services
Centers for Disease Control and Prevention

Appendix G

| Survey Unit 5 | Instrument | | | | |
|------------------|------------|-------|---------------|--------|-------|
| | Protean | | LSC - 7065636 | | |
| | Alpha | Beta | Chan A | Chan B | I-125 |
| Background (CPM) | 0.1 | 61.5 | 11.5 | 11.5 | 10.9 |
| MDC Value | 3.3 | 62.3 | 26.9 | 30.0 | 37.6 |
| Meter Efficiency | 15.8% | 12.3% | 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 | |
| | | | | | | | | | | | | | |
| 1 | 1 | 69 | 17 | 15 | 7 | 61.1% | 96.2% | 5.6 | 61.2 | 9.0 | 3.6 | 12.2 | <DCGL |
| 2 | 1 | 67 | 9 | 17 | 13 | 61.1% | 96.2% | 5.6 | 44.9 | -4.1 | 5.7 | -3.8 | <DCGL |
| 3 | 2 | 77 | 16 | 14 | 9 | 61.1% | 96.2% | 11.9 | 126.4 | 7.4 | 2.6 | 10.2 | <DCGL |
| 4 | 2 | 75 | 11 | 17 | 14 | 61.1% | 96.2% | 11.9 | 110.1 | -0.8 | 5.7 | 0.2 | <DCGL |
| 5 | 0 | 72 | 13 | 8 | 6 | 61.1% | 96.2% | -0.7 | 85.6 | 2.5 | -3.6 | 4.2 | <DCGL |
| 6 | 0 | 68 | 16 | 9 | 13 | 61.1% | 96.2% | -0.7 | 53.1 | 7.4 | -2.6 | 10.2 | <DCGL |
| 7 | 0 | 70 | 8 | 15 | 9 | 61.1% | 96.2% | -0.7 | 69.4 | -5.7 | 3.6 | -5.8 | <DCGL |
| 8 | 2 | 64 | 14 | 13 | 15 | 61.1% | 96.2% | 11.9 | 20.5 | 4.1 | 1.6 | 6.2 | <DCGL |
| 9 | 2 | 65 | 10 | 14 | 9 | 61.1% | 96.2% | 11.9 | 28.6 | -2.5 | 2.6 | -1.8 | <DCGL |
| 10 | 1 | 62 | 12 | 16 | 8 | 61.1% | 96.2% | 5.6 | 4.2 | 0.8 | 4.7 | 2.2 | <DCGL |
| 11 | 0 | 74 | 10 | 14 | 8 | 61.1% | 96.2% | -0.7 | 101.9 | -2.5 | 2.6 | -1.8 | <DCGL |
| 12 | 2 | 61 | 15 | 17 | 14 | 61.1% | 96.2% | 11.9 | -3.9 | 5.7 | 5.7 | 8.2 | <DCGL |
| 13 | 1 | 76 | 17 | 16 | 5 | 61.1% | 96.2% | 5.6 | 118.2 | 9.0 | 4.7 | 12.2 | <DCGL |
| 14 | 0 | 78 | 7 | 15 | 16 | 61.1% | 96.2% | -0.7 | 134.5 | -7.4 | 3.6 | -7.8 | <DCGL |
| 15 | 2 | 74 | 13 | 11 | 9 | 61.1% | 96.2% | 11.9 | 101.9 | 2.5 | -0.5 | 4.2 | <DCGL |

| Survey Unit QA | Instrument | | | | |
|------------------|------------|-------|---------------|--------|-------|
| | Protean | | LSC - 7065636 | | |
| | Alpha | Beta | Chan A | Chan B | I-125 |
| Background (CPM) | 0.1 | 61.5 | 11.5 | 11.5 | 10.9 |
| MDC Value | 3.3 | 62.3 | 26.9 | 30.0 | 37.6 |
| Meter Efficiency | 15.8% | 12.3% | 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 | |
| | | | | | | | | | | | | | |
| 1 | 1 | 69 | 17 | 15 | 7 | 61.1% | 96.2% | 5.6 | 61.2 | 9.0 | 3.6 | 12.2 | <DCGL |
| 2 | 1 | 67 | 9 | 17 | 13 | 61.1% | 96.2% | 5.6 | 44.9 | -4.1 | 5.7 | -3.8 | <DCGL |
| 3 | 1 | 77 | 16 | 14 | 9 | 61.1% | 96.2% | 5.6 | 126.4 | 7.4 | 2.6 | 10.2 | <DCGL |
| 4 | 1 | 75 | 11 | 17 | 14 | 61.1% | 96.2% | 5.6 | 110.1 | -0.8 | 5.7 | 0.2 | <DCGL |
| 5 | 0 | 72 | 13 | 8 | 6 | 61.1% | 96.2% | -0.7 | 85.6 | 2.5 | -3.6 | 4.2 | <DCGL |
| 6 | 0 | 68 | 16 | 9 | 13 | 61.1% | 96.2% | -0.7 | 53.1 | 7.4 | -2.6 | 10.2 | <DCGL |
| 7 | 0 | 70 | 8 | 15 | 9 | 61.1% | 96.2% | -0.7 | 69.4 | -5.7 | 3.6 | -5.8 | <DCGL |
| 8 | 1 | 64 | 14 | 13 | 15 | 61.1% | 96.2% | 5.6 | 20.5 | 4.1 | 1.6 | 6.2 | <DCGL |
| 9 | 1 | 65 | 10 | 14 | 9 | 61.1% | 96.2% | 5.6 | 28.6 | -2.5 | 2.6 | -1.8 | <DCGL |
| 10 | 1 | 62 | 12 | 16 | 8 | 61.1% | 96.2% | 5.6 | 4.2 | 0.8 | 4.7 | 2.2 | <DCGL |
| 11 | 0 | 74 | 10 | 14 | 8 | 61.1% | 96.2% | -0.7 | 101.9 | -2.5 | 2.6 | -1.8 | <DCGL |
| 12 | 1 | 61 | 15 | 17 | 14 | 61.1% | 96.2% | 5.6 | -3.9 | 5.7 | 5.7 | 8.2 | <DCGL |
| 13 | 1 | 76 | 17 | 16 | 5 | 61.1% | 96.2% | 5.6 | 118.2 | 9.0 | 4.7 | 12.2 | <DCGL |
| 14 | 0 | 78 | 7 | 15 | 16 | 61.1% | 96.2% | -0.7 | 134.5 | -7.4 | 3.6 | -7.8 | <DCGL |
| 15 | 1 | 74 | 13 | 11 | 9 | 61.1% | 96.2% | 5.6 | 101.9 | 2.5 | -0.5 | 4.2 | <DCGL |