

LMS/PIQ/42087

Addendum Characterization Survey Report for the Piqua, Ohio, Decommissioned Reactor Site Room B-7

August 2022

Work performed under DOE contract number 89303020DLM000001
for the U.S. Department of Energy Office of Legacy Management.

This document has been designed for online viewing.

Contents

Abbreviations.....	ii
Forms Referenced in This Manual.....	iii
1.0 Introduction.....	1
2.0 Performing the ACS.....	1
2.1 Instrument Minimum Detectable Activity (MDA) Determination	1
2.2 Building- and Material-Specific Radiological Background Determination	2
2.3 Radionuclides of Concern and Action Levels	3
2.4 Measurement Locations.....	3
2.5 Survey Instrumentation	6
2.6 Survey Instrument Operational Checks.....	6
3.0 ACS Results	6
3.1 Alpha and Beta Scans.....	6
3.2 Gamma Area Scans	7
3.3 Alpha and Beta Direct Surveys	7
3.4 Wipe (Smear) Surveys.....	7
3.5 Room B-7 Internal Tank Survey	8
4.0 Review of ACS Results.....	11
5.0 Room B-7 and Tank CS Conclusion.....	11
6.0 References	11

Figures

Figure 1. Instrument and Probe Background Determination Location.....	3
Figure 2. Identified CSPA Room B-7 Wall Measurement Locations	4
Figure 3. Room B-7 Walls Removed, Shaded Areas	4
Figure 4. Rubblized Wall Concrete	5
Figure 5. Survey Location No. 1, Room B-7 Floor	5
Figure 6. Room B-7 Tank, Top Openings	8
Figure 7. Room B-7 Tank, Internals.....	9
Figure 8. Room B-7 Tank, Bottom.....	10

Appendixes

Appendix A	Piqua Room B-7 Radiological Survey Maps
Appendix B	Piqua Room B-7 Radiological Survey Instrument Information

Abbreviations

ACS	addendum characterization survey
CFR	<i>Code of Federal Regulations</i>
cm ²	square centimeters
cpm	counts per minute
CS	characterization survey
CSP	Characterization Survey Plan
CSPA	Characterization Survey Plan Addendum
CSR	characterization survey report
DOE	U.S. Department of Energy
dpm	disintegrations per minute
DQO	data quality objective
LM	Office of Legacy Management
LMS	Legacy Management Support
MARSSIM	<i>Multi-Agency Radiological Survey and Site Investigation Manual (MARSSIM)</i>
MDA	minimum detectable activity
NaI(Tl)	thallium-doped sodium iodide
NV5	NV5 Global, Inc.
RCT	radiological control technician

Forms Referenced in This Manual

LMS forms are accessible on the **Document Management** homepage > **LMS Forms**.

<i>After-Calibration Source Response Checks Data Sheet</i>	LMS 1974
<i>Daily Instrument Response</i>	LMS 1974a
<i>Radiological Survey Map</i>	LMS 1553
<i>Scaler Chi-Squared (x2) Test Data Sheet</i>	LMS 2020

1.0 Introduction

During summer 2020, NV5 Global, Inc. (NV5), which was a subcontracted firm to Woolpert as a subcontractor to the U.S. Army Corps of Engineers, performed a radiological characterization survey (CS) of the U.S. Department of Energy (DOE) Office of Legacy Management (LM) Piqua, Ohio, Decommissioned Reactor Site. The CS was conducted in accordance with the reviewed and approved *Characterization Survey Plan, Piqua Nuclear Power Facility* (NV5 2020), also called the original CSP. The original CSP was developed and written to provide appropriate and confident radiological survey data from which to establish the radiological status of the Piqua site and be able to make confident radiological release decisions.

After completion of the 2020 CS, a characterization survey report (CSR) was written, reviewed, and approved in June 2021 (*Piqua Nuclear Power Facility Characterization Survey Final Report* June 2021, 100552-RPT-20200709, NV5). The CSR concluded that if the facility structures were left as is, then the CS data would be sufficient and appropriate to support an unrestricted release decision of the facilities or an unrestricted release decision of demolished materials from the facilities (if demolished). The unrestricted release decision made by the NV5 health physicist was supported by: (1) the CS data being collected using the *Multi-Agency Radiological Survey and Site Investigation Manual (MARSSIM)* (NRC et al. 2000) survey and sampling methodology and guidance, (2) the final status survey-level data quality objectives (DQOs), and (3) the actual CS results and analysis. The CSR also identified exceptions to the unrestricted release decision for the current Piqua site entombment in the bottom of the Reactor Building, for the inside of Room B-7 in the Auxiliary Building, and for the tank in Room B-7.

The *Piqua, Ohio, Decommissioned Reactor Site Characterization Survey Plan Addendum* (DOE 2022), also called the CSPA, was written as an addendum to the original 2020 CSP. The CSPA provided radiological survey guidance and direction necessary to complete the addendum characterization survey (ACS) of Room B-7 and the tank in Room B-7. Survey guidance and direction in the CSPA came from the original 2020 CSP.

This *Addendum Characterization Survey Report for the Piqua, Ohio, Decommissioned Reactor Site Room B-7* presents the survey information and survey results necessary to demonstrate the successful completion of the original CS for the Piqua site.

2.0 Performing the ACS

Room B-7 ACS measurements were performed in August 2022 by a DOE-qualified Legacy Management Support (LMS) radiological control technician (RCT) in accordance with CSPA, *LMS Radiation Protection Program Plan* (LMS/POL/S04373), *LMS Radiological Control Manual* (LMS/POL/S04322), and LMS Radiological Control organization implementing procedures.

2.1 Instrument Minimum Detectable Activity (MDA) Determination

The LMS Radiological Control organization instruments used to perform the ACS met the MDA limits described in the CSPA. Because the radiological survey instruments used by the LMS RCT performing this ACS were similar or identical to those used by the NV5 survey team,

the LMS radiological instruments were considered acceptable and in compliance with the various MDA and functional requirements. The LMS Radiological Control organization instruments used to perform the ACS also met the critical values required by the LMS *Radiation Protection Program Plan* and the LMS *Radiological Control Manual*. The critical values are identified on each completed *Radiological Survey Map* form (LMS 1553) in Appendix A, "Piqua Room B-7 Radiological Survey Maps."

2.2 Building- and Material-Specific Radiological Background Determination

Building- and material-specific background information was collected for the LMS radiological instrumentation used during the ACS. Figure 1 shows a concrete utility vault with a metal manhole cover that is close to and south of the Piqua site Auxiliary Building. Handheld instrument and probe background determinations were performed there, specifically for the following instruments:

- **Ludlum Model 2221 and 44-10 thallium-doped sodium iodide NaI(Tl) crystal probe for area gamma scan measurements:** A single 10-minute background count was performed with the probe held at the same distance as the survey requirement (i.e., 6 inches above the concrete surface).
- **Ludlum Model 2221 and 43-90 probe for alpha direct and scan measurements:** A single 10-minute background was performed with the probe at the same distance as the survey requirement (i.e., 0.125 inch above the concrete surface).
- **Ludlum Model 26 for beta direct and scan measurements:** Ten 1-minute counts were performed with the probe at the same distance as the survey requirement (i.e., 0.25 inch above the surface). The established background value for the instrument was an average of the 10 1-minute count values.

This background location represents nonradiologically impacted concrete and metal, similar to the items surveyed during the ACS (e.g., the walls, floor, and metal tank).

Background determinations for the Ludlum Model 2929/44-10-1 smear counter (for alpha and beta removable surface contamination surveys) were performed at the LM Fernald Preserve, Ohio, Site. A 20-minute background count was performed on the instrument before counting the smears collected during the Room B-7 surveys.

Radiological instrument background values are identified on the *Radiological Survey Map* form for each individual instrument used (Appendix A).



Figure 1. Instrument and Probe Background Determination Location

2.3 Radionuclides of Concern and Action Levels

The radionuclides of concern, action levels, and guidance for deviations from the sample plan remained unchanged during this ACS.

2.4 Measurement Locations

Radiological measurements were collected in accordance with the March 2022 CSPA (DOE 2022). Three wall measurement locations were moved from the physical wall to the rubblized concrete that represents the wall areas that were removed to access and remove the tank from the room. In accordance with the CSPA:

If Room B-7 presents surveyors with physical access limitations (with regard to an RCT being able to enter the room to perform the ACS), then sections or portions of the room (e.g., walls, removable facility supports or structures, the tank) can be mechanically deconstructed as necessary using appropriate construction equipment and techniques (as permitted by approved project demolition plans) before performing

the ACS. Deconstructed room material shall be made available to the RCT to survey immediately after deconstruction. Deconstructed room material shall remain in close proximity to Room B-7 if physically possible. If not physically possible, then the RCT shall perform the ACS of the relocated deconstructed material once the material is placed in a safe and appropriate survey area.

Figure 2 shows the wall measurement locations as presented in the CSPA, Figure 3 shows the areas of the walls that were deconstructed (shaded portions) in order to remove the tank from the room, Figure 4 shows the rubblized concrete that represents the wall areas that were removed, and Figure 5 shows Survey Location No. 1 on the floor of Room B-7 (as an example).

Three measurement locations (one from the B-7 north wall and two from the B-7 east wall) were displaced from the physical walls and transferred to the rubblized concrete. The radiological survey maps in Appendix A show that measurement locations 11, 12, and 13 were moved from the walls to the rubblized concrete.

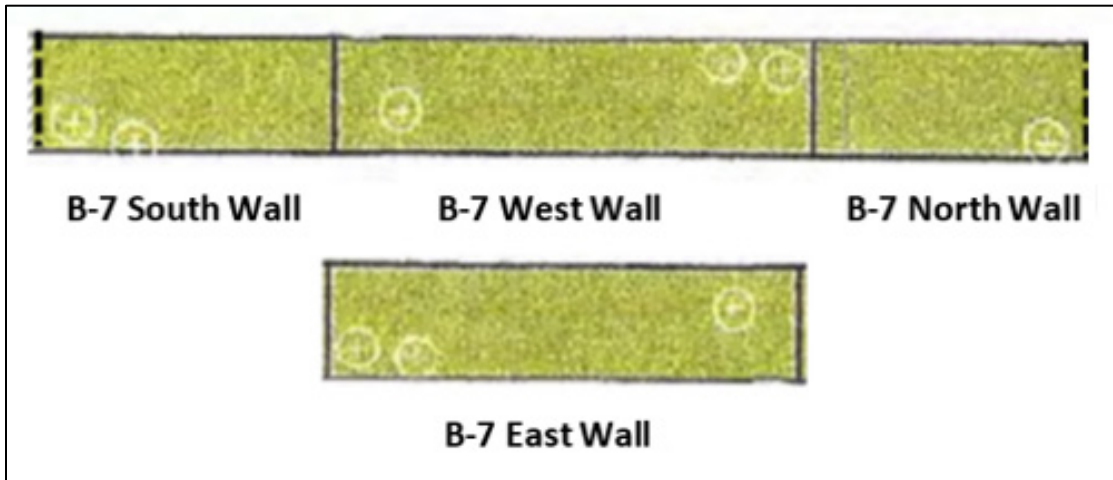


Figure 2. Identified CSPA Room B-7 Wall Measurement Locations

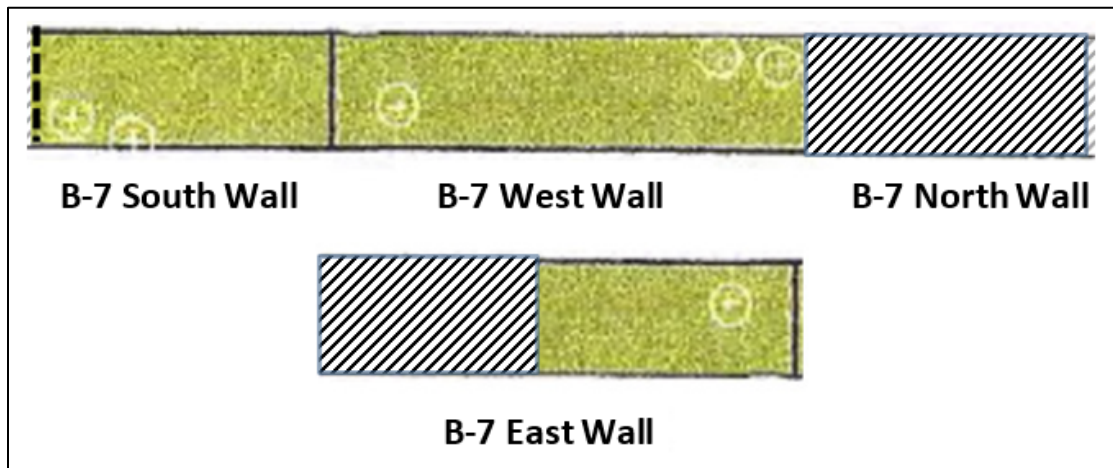


Figure 3. Room B-7 Walls Removed, Shaded Areas



Figure 4. Rubblized Wall Concrete



Figure 5. Survey Location No. 1, Room B-7 Floor

2.5 Survey Instrumentation

This ACS involved radiological instruments that were identical or similar to the radiological instruments used in the original CS. Instruments used in this ACS included the following:

- A Ludlum Model 2221 instrument with a 43-90 probe that was used for alpha direct and scan measurements on Room B-7 walls and floor and on the B-7 tank
- A Ludlum Model 26 that was used for beta direct and scan measurements on (1) Room B-7 walls and floor and (2) the B-7 tank
- A Ludlum 2221 instrument with a 44-10 probe that was used to perform gamma area scans on (1) Room B-7 walls and floor and (2) the B-7 tank
- A Ludlum Model 2929 with a 43-10-1 probe that was used to analyze wipe or smear samples for alpha and beta removable residual radioactivity

The above radiological instruments and detectors came from the LMS Radiological Control instrument inventory. No radiological instruments used during the ACS were rented from an outside vendor or agency.

2.6 Survey Instrument Operational Checks

LMS radiological instrument performance prerequisites (operational checks) were performed in accordance with LMS Radiological Control implementing procedures and as generally outlined below:

- Verify that the instrument is within the calibration due date.
- Visually verify that the instrument is not damaged and, if it is battery operated, that the battery has an acceptable charge or level.
- Verify that the high voltage is set correctly for the instrument, if that is required for the instrument.
- Perform a source check on the instrument using the correct radiation check source.
- Perform a background level determination for the instrument, if necessary.

Instrument verification and operational checks were recorded on the appropriate LMS Radiological Control instrument forms (e.g., LMS 1974, 1974a and 2020,) and are included in Appendix B, “Piqua Room B-7 Radiological Survey Instrument Information.”

3.0 ACS Results

3.1 Alpha and Beta Scans

Alpha and beta scans were performed using the Ludlum Model 2221 with a 43-90 probe for alpha radiation and the Ludlum Model 26 for beta radiation. Scans were performed at a rate of 4 inches per second with the probe held 0.25 inch from the surface for beta and 0.125 inch for alpha. No alpha or beta scans identified elevated radioactivity (i.e., approximately twice background), so no additional direct (or static) measurements were necessary or performed.

Alpha and beta scan measurement results were recorded on *Radiological Survey Map* forms in Appendix A. The highest alpha scan measurement on the walls, floor, or tank was 2 counts per minute (cpm) with a background instrument value of 2 cpm. The highest beta scan measurement on the walls, floor, or tank was 70 cpm with a background instrument value of 40 cpm.

3.2 Gamma Area Scans

Gamma area scans were performed using the Ludlum 2221 instrument with a 44-10 probe. Gamma area scans were performed at each identified survey point, covering approximately 1 square meter of area within the identified survey location. The 44-10 probe was held approximately 6 inches from the surface and was moved over the surface in a serpentine pattern to survey each 1 square meter area. No gamma area scans identified elevated radioactivity (i.e., approximately twice background), so no additional investigations were necessary or performed. Gamma area scan measurement results were recorded on the *Radiological Survey Map* forms in Appendix A. The highest gamma area scan measurement on the walls and floors was 6700 cpm with a background instrument value of 4495 cpm. The highest gamma area scan measurement on the tank was 2100 cpm with a background instrument value of 1747 cpm.

3.3 Alpha and Beta Direct Surveys

Alpha and beta direct measurements were performed using the Ludlum Model 2221 with a 43-90 probe for alpha radiation and the Ludlum Model 26 for beta radiation. Direct measurements were performed by collecting a 1 minute (or greater) static measurement at the required distance from the surface being measured (e.g., 0.25 inch for beta and 0.125 inch for alpha) for each identified survey location. No alpha or beta direct measurements identified elevated radioactivity (e.g., greater than the action level), so no additional direct measurements were necessary or performed. Alpha and beta direct measurement results were recorded on the *Radiological Survey Map* forms in Appendix A. The highest alpha direct measurement on the walls, floor, or tank was -1 disintegration per minute (dpm)/100 square centimeters (cm²) (i.e., less than the critical value of the instrument) with a background instrument value of 2 dpm/100 cm². The highest beta direct measurement on the walls, floor, or tank was 290 dpm/100 cm² with a background instrument value of 40 dpm/100 cm².

3.4 Wipe (Smear) Surveys

Wipe (smear) surveys were performed by the RCT in accordance with CSPA, LMS *Radiation Protection Program Plan*, LMS *Radiological Control Manual*, and LMS Radiological Control organization implementing procedures. Smear surveys were performed using industry standard smears (i.e., Wipe Test Smears), applying moderate pressure while sampling a surface area of approximately 100 cm². Once collected, the smears were counted on a Ludlum Model 2929 instrument with a 43-10-1 detector counting system. Smear counting results were recorded on the *Radiological Survey Map* forms in Appendix A. The highest alpha smear result on the walls, floor, or tank was 0.7 cpm net (i.e., less than the critical value of the counting instrument) with an alpha background instrument value of 0.3 cpm. The highest beta smear result on the walls, floor, or tank was 11 cpm net (28 dpm/100 cm²) with a background instrument value of 39 cpm. With an action level of 25% of the Title 10 *Code of Federal Regulations* Part 835 (10 CFR 835) release limit (1000 dpm/100 cm²), no smear result was greater than 250 dpm/100 cm² CSPA action level.

3.5 Room B-7 Internal Tank Survey

Radiological surveys and measurements were performed by the RCT on the Room B-7 empty tank (tank) once the tank was removed from the room. Alpha and beta scans, alpha and beta direct measurements, gamma area scans, and smear surveys were performed on the tank. The tank had seven separate openings, which were all on the top of the tank, and most of the radiological surveys performed on the tank were performed in and around the tank's openings (Figure 6). The seven *Radiological Survey Map* forms related to the tank (in Appendix A) describe which radiological surveys and measurements were performed and where they were performed. No radiological measurements were performed deep inside the tank because access into the tank was not available and was not permitted by the CSPA. A visual inspection of the internals of the tank (Figure 7) revealed a clean-looking internal tank surface. A gamma area scan performed on the bottom of the tank (see Radiological Survey Map ID 220723-006 and Figure 8) revealed only background radioactivity levels (i.e., 3600–4200 gross cpm over the tank bottom with an instrument background of 3956 cpm). Had elevated fission product radioactive material been present at the bottom of the tank, the sensitive NaI(Tl) Ludlum 44-10 probe would have likely detected it. During the initial CS performed by the NV5 survey team, they did insert a Ludlum 44-10 probe into the one of the tank openings and did not detect elevated gamma radiation.



Figure 6. Room B-7 Tank, Top Openings



Figure 7. Room B-7 Tank, Internals



Figure 8. Room B-7 Tank, Bottom

Survey results for this report included the following:

- The highest alpha scan measurement of the tank was 2 cpm gross with a background instrument value of 2 cpm
- The highest beta scan measurement on the tank was 55 cpm gross with a background instrument value of 40 cpm
- The highest alpha direct measurement on the tank was 1 cpm gross with a background instrument value of 2 cpm
- The highest beta direct measurement on the tank was 41 cpm gross with a background instrument value of 40 cpm
- The highest gamma area scan measurement on the tank was 2100 cpm gross with a background instrument value of 1747 cpm
- The highest alpha smear result on the tank was 1 cpm gross with an alpha background instrument value of 0.3 cpm
- The highest beta smear result on the tank was 45 cpm gross with a background instrument value of 39 cpm

Radiological measurement results (from both direct and smear measurements) were all below the instrument's critical values and did not have an activity (in dpm/100 cm²) listed on the *Radiological Survey Map* forms (Appendix A).

4.0 Review of ACS Results

Upon completion of the ACS, the project health physicist gathered the completed and reviewed survey results and evaluated them, ensuring that required surveys were collected and performed in accordance with this CSPA and the original CSP. During the evaluation, it was determined that a DOE-qualified RCT performed the surveys, that correct and appropriate instrumentation was used by the RCT, that established DQOs were met, and that identified survey locations, or their alternative locations, were surveyed by the RCT.

5.0 Room B-7 and Tank CS Conclusion

Upon completion of the ACS, radiological survey results were evaluated and identified to be less than the original CSP action levels (i.e., 250 dpm/100 cm² removable, 1250 dpm/100 cm² total, and 3750 dpm/100 cm² for elevated areas of 1 square meter) and less than the established regulatory release limits (i.e., removable contamination 1000 dpm/100 cm², average total contamination 5000 dpm/100 cm², and maximum total activity of 15,000 dpm/100 cm² on any 1 square meter area).

As identified in the original CSP, these criteria are generally acceptable for unrestricted release for DOE Order 458.1 Chg 4 (LtdChg), *Radiation Protection of the Public and the Environment*, facilities or sites, as described in 10 CFR 835 Appendix D, and as presented in the MARSSIM (NRC et al. 2000) for the U.S. Nuclear Regulatory Commission and the State of Ohio.

Given the above information, it is concluded that Room B-7 and the tank that resided in Room B-7 are not radiologically impacted and are acceptable for unrestricted release.

6.0 References

10 CFR 835. "Occupational Radiation Protection," *Code of Federal Regulations*.

DOE (U.S. Department of Energy), 2022. *Piqua, Ohio, Decommissioned Reactor Site Characterization Survey Plan Addendum*, LMS/S38287, Office of Legacy Management, March.

DOE Order 458.1 Chg 4 (LtdChg), *Radiation Protection of the Public and the Environment*, U.S. Department of Energy, September 15, 2020.

NRC (U.S. Nuclear Regulatory Commission), EPA (U.S. Environmental Protection Agency), and DOE (U.S. Department of Energy), 2000. *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)*, Revision 1, NUREG-1575, EPA 402-R-97-016, DOE/EH-0624, August.

NV5 (NV5 Global, Inc.), 2020. *Characterization Survey Plan, Piqua Nuclear Power Facility*, DMA-TR-107, Richland, Washington.

Radiation Protection Program Plan, LMS/POL/S04373, continually updated, prepared by the LMS contractor for the U.S. Department of Energy Office of Legacy Management.

Radiological Control Manual, LMS/POL/S04322, continually updated, prepared by the LMS contractor for the U.S. Department of Energy Office of Legacy Management.

Appendix A

Piqua Room B-7 Radiological Survey Maps

Radiological Survey Map



Radiological Survey Number: 220722-002 Page 1 of 4

Purpose: Characterization Survey of Room B-7 (Alpha Direct) Truck #: N/A Trailer #: N/A

RWP number: N/A Time: 9:30 AM Date: 7/20/2022

Site name: Piqua Location: Room B-7

RCT (printed): Tom Maveal Reviewer signature: _____ Date: _____

Counting Instruments:	Instrument 1	Instrument 2	Instrument 3	Radiation Instruments:	Instrument 4
Instrument/probe model:			Ludlum 2221/43-90	Instrument/probe model:	
Instrument serial number:			75480	Instrument serial number:	
Probe serial number:			107237	Probe serial number:	
Calibration due:			1/20/2023	Calibration due:	
Efficiency:	α β	α β	α 0.18 β	Background (dose rate):	
Background (cpm):	α β	α β	α 2 β	Other info (as needed):	
S _c (dpm/100cm ²):	α β	α β	α 27 β		
Area probe correction factor:			1.0		

Surface Contamination and Radiation Survey Results

Item Surveyed / Map Location	Counting Inst. No. Used	Smear Survey (Instrument 1 or 2)						Direct Survey (Instrument 3)						Exposure Rate Survey
		Gross Counts		Net Counts		Activity		Gross Counts		Net Counts		Activity		
		Alpha cpm	Beta/gamma cpm	Alpha cpm	Beta/gamma cpm	Alpha dpm/100cm ²	Beta/gamma dpm/100cm ²	Alpha cpm	Beta/gamma cpm	Alpha cpm	Beta/gamma cpm	Alpha dpm/100cm ²	Beta/gamma dpm/100cm ²	
Floor #1	3							0		-2.0		< Sc		
Floor #2	3							1		-1.0		< Sc		
Floor #3	3							0		-2.0		< Sc		
Floor #4	3							0		-2.0		< Sc		
Floor #5	3							0		-2.0		< Sc		
Wall #6	3							0		-2.0		< Sc		
Wall #7	3							0		-2.0		< Sc		
Wall #8	3							0		-2.0		< Sc		
Wall #9	3							1		-1.0		< Sc		
Wall #10	3							1		-1.0		< Sc		
Wall #11	3							0		-2.0		< Sc		
Wall #12	3							0		-2.0		< Sc		
Wall #13	3							0		-2.0		< Sc		
Wall #14	3							0		-2.0		< Sc		

RCT signature: _____

Radiological Survey Map

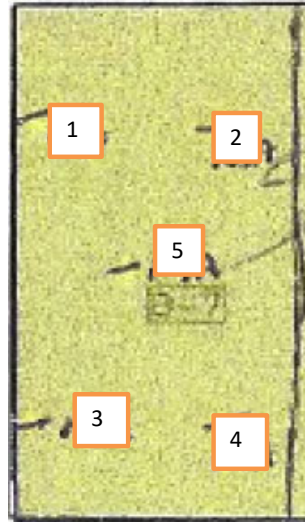
Surface Contamination and Radiation Survey Results														
Item Surveyed / Map Location	Counting Inst. No. Used	Smear Survey (Instrument 1 or 2)						Direct Survey (Instrument 3)						Exposure Rate Survey
		Gross Counts		Net Counts		Activity		Gross Counts		Net Counts		Activity		
		Alpha cpm	Beta/gamma cpm	Alpha cpm	Beta/gamma cpm	Alpha dpm/100cm ²	Beta/gamma dpm/100cm ²	Alpha cpm	Beta/gamma cpm	Alpha cpm	Beta/gamma cpm	Alpha dpm/100cm ²	Beta/gamma dpm/100cm ²	
Applicable Surface Contamination Limits							Activity Equation					APCE		
Check one for alpha, one for beta. Alpha (removable/total) <input checked="" type="checkbox"/> 1000/5000 <input type="checkbox"/> 200/1000 <input type="checkbox"/> 20/500 Beta (removable/total) <input type="checkbox"/> 1000/5000 <input type="checkbox"/> 200/1000							Gross count minus BKGD count = Net count Net count/Eff = dpm Dpm x Area Probe Correction Factor (APCF) = dpm/100cm ²					44-9 = 6.5 FHZ 732 (GM) = 6.5 43-10-1 = 1		
Remarks:														
10 minute background performed on Ludlum 2221 (SN#75480) and 43-90 Probe (SN#107237) Alpha background = 2 CPM														

Contamination and Radiation Survey Figure

Standardized Map Symbols

- = Smear/wipe (no. inside)
- △ = Air sample (no. inside)
- 6.3 = General area exposure rate (result in $\mu\text{R/hr}$)
- * = Contact exposure rate (result beside, in $\mu\text{R/hr}$)
- # = Direct frisk (count rate) (result beside)
- ☆ = Direct gamma (count rate) (e.g., 2"x2" NaI) (result beside)

Note: Note units used if not identified above.



B-7 Floor



B-7 South Wall

B-7 West Wall

B-7 North Wall



B-7 East Wall



Rubblized Concrete Survey Locations

(Place figure in this area.)

Remarks:

Direct Measurement Location = number in orange box

Direct Measurement Area = 100 square centimeter

Direct Measurement Method = taken with 100 square centimeter alpha probe held at a distance of 1/8 inch from the surface for 1 minute

Diagonal Line Area = rubblized wall area (to remove tank). Measurements performed on rubblized concrete wall pieces at survey locations shown

Figures above are not to scale, but are representative of the floor and wall areas surveyed

Radiological Survey Map

Radiological Survey Number: 220720-005 Page 1 of 4

Purpose: Characterization Survey of Room B-7 (Alpha Scan) Truck #: N/A Trailer #: N/A

RWP number: N/A Time: 9:15 AM Date: 7/20/2022

Site name: Piqua Location: Room B-7

RCT (printed): Tom Maveal Reviewer signature: Date:

Counting Instruments:		Instrument 1		Instrument 2		Instrument 3		Radiation Instruments:		Instrument 4	
Instrument/probe model:						Ludlum 2221/43-90		Instrument/probe model:			
Instrument serial number:						75480		Instrument serial number:			
Probe serial number:						107237		Probe serial number:			
Calibration due:						1/20/2023		Calibration due:			
Efficiency:		α	β	α	β	α	β	Background (dose rate):			
Background (cpm):		α	β	α	β	α	2	β	Other info (as needed):		
S _c (dpm/100cm ²):		α	β	α	β	α		β			
Area probe correction factor:											

Surface Contamination and Radiation Survey Results

Item Surveyed / Map Location	Counting Inst. No. Used	Smear Survey (Instrument 1 or 2)						Direct Survey (Instrument 3)						Exposure Rate Survey
		Gross Counts		Net Counts		Activity		Gross Counts		Net Counts		Activity		
		Alpha cpm	Beta/gamma cpm	Alpha cpm	Beta/gamma cpm	Alpha dpm/100cm ²	Beta/gamma dpm/100cm ²	Alpha cpm	Beta/gamma cpm	Alpha cpm	Beta/gamma cpm	Alpha dpm/100cm ²	Beta/gamma dpm/100cm ²	
See Page 3	3													

RCT signature: _____

Radiological Survey Map



Radiological Survey Number: 220720-005

Page 2 of 4

Surface Contamination and Radiation Survey Results														
Item Surveyed / Map Location	Counting Inst. No. Used	Smear Survey (Instrument 1 or 2)						Direct Survey (Instrument 3)						Exposure Rate Survey
		Gross Counts		Net Counts		Activity		Gross Counts		Net Counts		Activity		
		Alpha cpm	Beta/gamma cpm	Alpha cpm	Beta/gamma cpm	Alpha dpm/100cm ²	Beta/gamma dpm/100cm ²	Alpha cpm	Beta/gamma cpm	Alpha cpm	Beta/gamma cpm	Alpha dpm/100cm ²	Beta/gamma dpm/100cm ²	

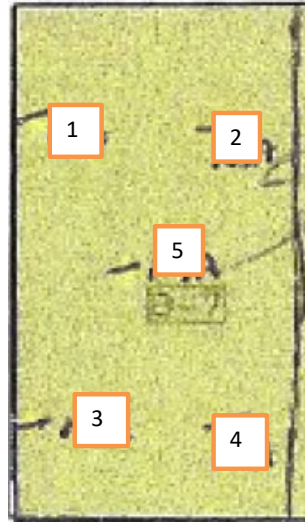
Applicable Surface Contamination Limits Check one for alpha, one for beta. Alpha (removable/total) <input type="checkbox"/> 1000/5000 <input type="checkbox"/> 200/1000 <input type="checkbox"/> 20/500 Beta (removable/total) <input type="checkbox"/> 1000/5000 <input type="checkbox"/> 200/1000	Activity Equation Gross count minus BKGD count = Net count Net count/Eff = dpm Dpm x Area Probe Correction Factor (APCF) = dpm/100cm ²	APCE 44-9 = 6.5 FHZ 732 (GM) = 6.5 43-10-1 = 1
Remarks: 10 minute background performed on Ludlum 2221 (SN#75480) and 43-90 Probe (SN#107237) Alpha Background = 2 CPM		

Contamination and Radiation Survey Figure

Standardized Map Symbols

- = Smear/wipe (no. inside)
- △ = Air sample (no. inside)
- 6.3 = General area exposure rate (result in $\mu\text{R/hr}$)
- * = Contact exposure rate (result beside, in $\mu\text{R/hr}$)
- # = Direct frisk (count rate) (result beside)
- ☆ = Direct gamma (count rate) (e.g., 2"x2" NaI) (result beside)

Note: Note units used if not identified above.



B-7 Floor



B-7 South Wall

B-7 West Wall

B-7 North Wall



B-7 East Wall



Rubblized Concrete Survey Locations

(Place figure in this area.)

Remarks:

Scan Location = number in orange box

Scan Area = 1 square meter (represented by the orange box, not to scale)

Scan Method = surface area was scanned at 4 inches per second with the alpha probe held at a distance of 1/8 inch from the surface

Diagonal Line Area = rubblized wall area (to remove tank). Scans performed on rubblized concrete wall pieces at survey locations shown

Figures above are not to scale, but are representative of the floor and wall areas surveyed

Radiological Survey Map



Radiological Survey Number: 220720-005

Page 4 of 4

Contamination and Radiation Survey Continuation Sheet	
Use this sheet to document or record radiological survey information (in addition to Page 1 of the form)	
Floor Location #1 = 0-2 Gross CPM over 1 meter scan area	
Floor Location #2 = 0-2 Gross CPM over 1 meter scan area	
Floor Location #3 = 0 Gross CPM over 1 meter scan area	
Floor Location #4 = 0 Gross CPM over 1 meter scan area	
Floor Location #5 = 0 Gross CPM over 1 meter scan area	
Wall Location #6 = 0 Gross CPM over 1 meter scan area	
Wall Location #7 = 0 Gross CPM over 1 meter scan area	
Wall Location #8 = 0 Gross CPM over 1 meter scan area	
Wall Location #9 = 0-2 Gross CPM over 1 meter scan area	
Wall Location #10 = 0-2 Gross CPM over 1 meter scan area	
Wall Location #11 = 0 Gross CPM over 1 meter scan area	
Wall Location #12 = 0 Gross CPM over 1 meter scan area	
Wall Location #13 = 0 Gross CPM over 1 meter scan area	
Wall Location #14 = 0 Gross CPM over 1 meter scan area	

Radiological Survey Map



Radiological Survey Number: 220722-003 Page 1 of 4

Purpose: Characterization Survey of Room B-7 (Beta-Gamma Direct) Truck #: N/A Trailer #: N/A

RWP number: N/A Time: 10:00 AM Date: 7/20/2022

Site name: Piqua Location: Room B-7

RCT (printed): Tom Maveal Reviewer signature: _____ Date: _____

Counting Instruments:		Instrument 1		Instrument 2		Instrument 3		Radiation Instruments:		Instrument 4	
Instrument/probe model:						Ludlum 26		Instrument/probe model:			
Instrument serial number:						PF008880		Instrument serial number:			
Probe serial number:						N/A		Probe serial number:			
Calibration due:						1/20/2023		Calibration due:			
Efficiency:		α	β	α	β	α	β	0.38	Background (dose rate):		
Background (cpm):		α	β	α	β	α	β	40	Other info (as needed):		
S _c (dpm/100cm ²):		α	β	α	β	α	β	276			
Area probe correction factor:						6.5					

Surface Contamination and Radiation Survey Results

Item Surveyed / Map Location	Counting Inst. No. Used	Smear Survey (Instrument 1 or 2)						Direct Survey (Instrument 3)						Exposure Rate Survey
		Gross Counts		Net Counts		Activity		Gross Counts		Net Counts		Activity		
		Alpha cpm	Beta/gamma cpm	Alpha cpm	Beta/gamma cpm	Alpha dpm/100cm ²	Beta/gamma dpm/100cm ²	Alpha cpm	Beta/gamma cpm	Alpha cpm	Beta/gamma cpm	Alpha dpm/100cm ²	Beta/gamma dpm/100cm ²	
Floor #1	3								42		2.0		< Sc	
Floor #2	3								38		-2.0		< Sc	
Floor #3	3								36		-4.0		< Sc	
Floor #4	3								47		7.0		< Sc	
Floor #5	3								45		5.0		< Sc	
Wall #6	3								48		8.0		< Sc	
Wall #7	3								56		16.0		< Sc	
Wall #8	3								52		12.0		< Sc	
Wall #9	3								55		15.0		< Sc	
Wall #10	3								50		10.0		< Sc	
Wall #11	3								54		14.0		< Sc	
Wall #12	3								57		17.0		290	
Wall #13	3								45		5.0		< Sc	
Wall #14	3								50		10.0		< Sc	

RCT signature: _____

Radiological Survey Map

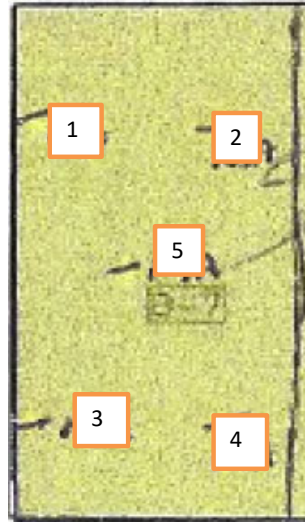
Surface Contamination and Radiation Survey Results														
Item Surveyed / Map Location	Counting Inst. No. Used	Smear Survey (Instrument 1 or 2)						Direct Survey (Instrument 3)						Exposure Rate Survey
		Gross Counts		Net Counts		Activity		Gross Counts		Net Counts		Activity		
		Alpha cpm	Beta/gamma cpm	Alpha cpm	Beta/gamma cpm	Alpha dpm/100cm ²	Beta/gamma dpm/100cm ²	Alpha cpm	Beta/gamma cpm	Alpha cpm	Beta/gamma cpm	Alpha dpm/100cm ²	Beta/gamma dpm/100cm ²	
Applicable Surface Contamination Limits						Activity Equation						APCE		
Check one for alpha, one for beta.						Gross count minus BKGD count = Net count						44-9 = 6.5		
Alpha (removable/total) <input type="checkbox"/> 1000/5000 <input type="checkbox"/> 200/1000 <input type="checkbox"/> 20/500						Net count/Eff = dpm						FHZ 732 (GM) = 6.5		
Beta (removable/total) <input checked="" type="checkbox"/> 1000/5000 <input type="checkbox"/> 200/1000						Dpm x Area Probe Correction Factor (APCF) = dpm/100cm ²						43-10-1 = 1		
Remarks:														
Ten one-minute background counts were performed on Ludlum Model 26. Averaged background = 40 CPM														

Contamination and Radiation Survey Figure

Standardized Map Symbols

- = Smear/wipe (no. inside)
- △ = Air sample (no. inside)
- 6.3 = General area exposure rate (result in $\mu\text{R/hr}$)
- * = Contact exposure rate (result beside, in $\mu\text{R/hr}$)
- # = Direct frisk (count rate) (result beside)
- ☆ = Direct gamma (count rate) (e.g., 2"x2" NaI) (result beside)

Note: Note units used if not identified above.



B-7 Floor



B-7 South Wall

B-7 West Wall

B-7 North Wall



B-7 East Wall



Rubblized Concrete Survey Locations

(Place figure in this area.)

Remarks:

Direct Measurement Location = number in orange box

Direct Measurement Area = 15.5 square centimeters (corrected to 100 square centimeters)

Direct Measurement Method = taken with 15.5 square centimeter beta/gamma probe held at a distance of 1/4 inch from the surface for 1 minute

Diagonal Line Area = rubblized wall area (to remove tank). Measurements performed on rubblized concrete wall pieces at survey locations shown

Figures above are not to scale, but are representative of the floor and wall areas surveyed

Radiological Survey Map



Radiological Survey Number: 220720-006 Page 1 of 4

Purpose: Characterization Survey of Room B-7 (Beta-Gamma Scan) Truck #: N/A Trailer #: N/A

RWP number: N/A Time: 9:00 AM Date: 7/20/2022

Site name: Piqua Location: Room B-7

RCT (printed): Tom Maveal Reviewer signature: Date:

Counting Instruments:		Instrument 1		Instrument 2		Instrument 3		Radiation Instruments:		Instrument 4	
Instrument/probe model:						Ludlum 26		Instrument/probe model:			
Instrument serial number:						PF008880		Instrument serial number:			
Probe serial number:						N/A		Probe serial number:			
Calibration due:						1/20/2023		Calibration due:			
Efficiency:		α	β	α	β	α	β	Background (dose rate):			
Background (cpm):		α	β	α	β	α	β	40	Other info (as needed):		
S _c (dpm/100cm ²):		α	β	α	β	α	β				
Area probe correction factor:											

Surface Contamination and Radiation Survey Results

Item Surveyed / Map Location	Counting Inst. No. Used	Smear Survey (Instrument 1 or 2)						Direct Survey (Instrument 3)						Exposure Rate Survey
		Gross Counts		Net Counts		Activity		Gross Counts		Net Counts		Activity		
		Alpha cpm	Beta/gamma cpm	Alpha cpm	Beta/gamma cpm	Alpha dpm/100cm ²	Beta/gamma dpm/100cm ²	Alpha cpm	Beta/gamma cpm	Alpha cpm	Beta/gamma cpm	Alpha dpm/100cm ²	Beta/gamma dpm/100cm ²	
See Page 3	3													

RCT signature: _____

Radiological Survey Map



Radiological Survey Number: 220720-006

Page 2 of 4

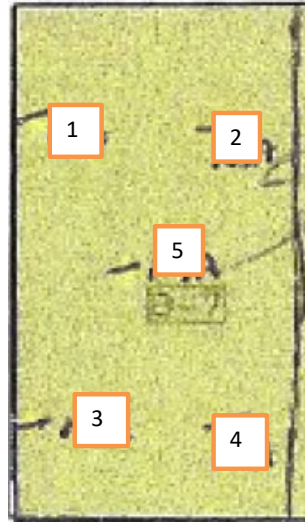
Surface Contamination and Radiation Survey Results														
Item Surveyed / Map Location	Counting Inst. No. Used	Smear Survey (Instrument 1 or 2)						Direct Survey (Instrument 3)						Exposure Rate Survey
		Gross Counts		Net Counts		Activity		Gross Counts		Net Counts		Activity		
		Alpha cpm	Beta/gamma cpm	Alpha cpm	Beta/gamma cpm	Alpha dpm/100cm ²	Beta/gamma dpm/100cm ²	Alpha cpm	Beta/gamma cpm	Alpha cpm	Beta/gamma cpm	Alpha dpm/100cm ²	Beta/gamma dpm/100cm ²	
Applicable Surface Contamination Limits						Activity Equation						APCE		
Check one for alpha, one for beta.						Gross count minus BKGD count = Net count						44-9 = 6.5		
Alpha (removable/total) <input type="checkbox"/> 1000/5000 <input type="checkbox"/> 200/1000 <input type="checkbox"/> 20/500						Net count/Eff = dpm						FHZ 732 (GM) = 6.5		
Beta (removable/total) <input type="checkbox"/> 1000/5000 <input type="checkbox"/> 200/1000						Dpm x Area Probe Correction Factor (APCF) = dpm/100cm ²						43-10-1 = 1		
Remarks:														
Ten one-minute background counts were performed on Ludlum Model 26. Averaged background = 40 CPM														

Contamination and Radiation Survey Figure

Standardized Map Symbols

- = Smear/wipe (no. inside)
- △ = Air sample (no. inside)
- 6.3 = General area exposure rate (result in $\mu\text{R/hr}$)
- * = Contact exposure rate (result beside, in $\mu\text{R/hr}$)
- # = Direct frisk (count rate) (result beside)
- ☆ = Direct gamma (count rate) (e.g., 2"x2" NaI) (result beside)

Note: Note units used if not identified above.



B-7 Floor



B-7 South Wall

B-7 West Wall

B-7 North Wall



B-7 East Wall



Rubblized Concrete Survey Locations

(Place figure in this area.)

Remarks:

Scan Location = number in orange box

Scan Area = 1 square meter (represented by the orange box, not to scale).

Scan Method = surface area was scanned at 4 inches per second with the beta-gamma probe held at a distance of 1/4 inch from the surface

Diagonal Line Area = rubblized wall area (to remove tank). Scans performed on rubblized concrete wall pieces at survey locations shown

Figures above are not to scale, but are representative of the floor and wall areas surveyed

Radiological Survey Map

Radiological Survey Number: 220720-007 **Page** 1 **of** 4

Purpose: Characterization Survey of Room B-7 (NaI Gamma Scan) Truck #: N/A Trailer #: N/A

RWP number: N/A Time: 8:00 AM Date: 7/20/2022

Site name: Piqua Location: Room B-7

RCT (printed): Tom Maveal Reviewer signature: _____ Date: _____

Counting Instruments:		Instrument 1		Instrument 2		Instrument 3		Radiation Instruments:		Instrument 4	
Instrument/probe model:						Ludlum 2221/44-10		Instrument/probe model:			
Instrument serial number:						313959		Instrument serial number:			
Probe serial number:						PR357774		Probe serial number:			
Calibration due:						11/28/2022		Calibration due:			
Efficiency:		α	β	α	β	α	β	Background (dose rate):			
Background (cpm):		α	β	α	β	α	β	4495	Other info (as needed):		
S_c (dpm/100cm ²):		α	β	α	β	α	β				
Area probe correction factor:											

Surface Contamination and Radiation Survey Results

Item Surveyed / Map Location	Counting Inst. No. Used	Smear Survey (Instrument 1 or 2)						Direct Survey (Instrument 3)						Exposure Rate Survey
		Gross Counts		Net Counts		Activity		Gross Counts		Net Counts		Activity		
		Alpha cpm	Beta/gamma cpm	Alpha cpm	Beta/gamma cpm	Alpha dpm/100cm ²	Beta/gamma dpm/100cm ²	Alpha cpm	Beta/gamma cpm	Alpha cpm	Beta/gamma cpm	Alpha dpm/100cm ²	Beta/gamma dpm/100cm ²	
See Page 3	3													

RCT signature: _____

Radiological Survey Map

Radiological Survey Number: 220720-007

Page 2 of 4

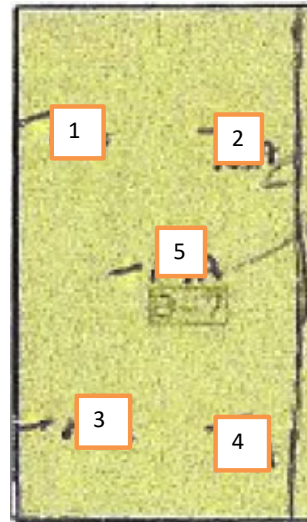
Surface Contamination and Radiation Survey Results														
Item Surveyed / Map Location	Counting Inst. No. Used	Smear Survey (Instrument 1 or 2)						Direct Survey (Instrument 3)						Exposure Rate Survey
		Gross Counts		Net Counts		Activity		Gross Counts		Net Counts		Activity		
		Alpha cpm	Beta/gamma cpm	Alpha cpm	Beta/gamma cpm	Alpha dpm/100cm ²	Beta/gamma dpm/100cm ²	Alpha cpm	Beta/gamma cpm	Alpha cpm	Beta/gamma cpm	Alpha dpm/100cm ²	Beta/gamma dpm/100cm ²	
Applicable Surface Contamination Limits Check one for alpha, one for beta. Alpha (removable/total) <input type="checkbox"/> 1000/5000 <input type="checkbox"/> 200/1000 <input type="checkbox"/> 20/500 Beta (removable/total) <input type="checkbox"/> 1000/5000 <input type="checkbox"/> 200/1000							Activity Equation Gross count minus BKGD count = Net count Net count/Eff = dpm Dpm x Area Probe Correction Factor (APCF) = dpm/100cm ²					APCE 44-9 = 6.5 FHZ 732 (GM) = 6.5 43-10-1 = 1		
Remarks: 10 minute background performed on Ludlum 2221 (SN#313959) and 44-10 Probe (SN#PR357774) Gamma Background = 4495 CPM														

Contamination and Radiation Survey Figure

Standardized Map Symbols

- = Smear/wipe (no. inside)
- △ = Air sample (no. inside)
- 6.3 = General area exposure rate (result in $\mu\text{R/hr}$)
- * = Contact exposure rate (result beside, in $\mu\text{R/hr}$)
- # = Direct frisk (count rate) (result beside)
- ☆ = Direct gamma (count rate) (e.g., 2"x2" NaI) (result beside)

Note: Note units used if not identified above.



B-7 Floor



B-7 South Wall

B-7 West Wall

B-7 North Wall



B-7 East Wall



11



12



13

Rubblized Concrete Survey Locations

(Place figure in this area.)

Remarks:

Scan Location = number in orange box

Scan Area = 1 square meter (represented by the orange box, not to scale).

Scan Method = the area was scanned using a serpentine pattern over the 1 square meter area with the probe held approximately 6 inches from the surface being surveyed (e.g., the floor or wall surface)

Diagonal Line Area = rubblized wall area (to remove tank). Scans performed on rubblized concrete wall pieces at survey locations shown

Figures above are not to scale, but are representative of the floor and wall areas surveyed

Radiological Survey Map



Radiological Survey Number: 220720-007

Page **4** of **4**

Contamination and Radiation Survey Continuation Sheet
Use this sheet to document or record radiological survey information (in addition to Page 1 of the form)
Floor Location #1 = 5100-5500 Gross CPM over 1 meter scan area
Floor Location #2 = 5200-5500 Gross CPM over 1 meter scan area
Floor Location #3 = 5200-5500 Gross CPM over 1 meter scan area
Floor Location #4 = 4700-5000 Gross CPM over 1 meter scan area
Floor Location #5 = 5200-5500 Gross CPM over 1 meter scan area
Wall Location #6 = 5300-5800 Gross CPM over 1 meter scan area
Wall Location #7 = 5200-5600 Gross CPM over 1 meter scan area
Wall Location #8 = 6300-6700 Gross CPM over 1 meter scan area
Wall Location #9 = 5700-5900 Gross CPM over 1 meter scan area
Wall Location #10 = 5400-5600 Gross CPM over 1 meter scan area
Wall Location #11 = 4600-4900 Gross CPM over 1 meter scan area
Wall Location #12 = 4800-5100 Gross CPM over 1 meter scan area
Wall Location #13 = 4500-4800 Gross CPM over 1 meter scan area
Wall Location #14 = 4900-5500 Gross CPM over 1 meter scan area

Radiological Survey Map



Radiological Survey Number: 220720-003 Page 1 of 4

Purpose: Characterization Survey of Room B-7 (Smears) Truck #: N/A Trailer #: N/A

RWP number: N/A Time: 7:40 AM Date: 7/20/2022

Site name: Piqua Location: Room B-7

RCT (printed): Tom Maveal Reviewer signature: _____ Date: _____

Counting Instruments:	Instrument 1	Instrument 2	Instrument 3	Radiation Instruments:	Instrument 4
Instrument/probe model:	Lud-2929/43-10-1			Instrument/probe model:	
Instrument serial number:	329909			Instrument serial number:	
Probe serial number:	PR362456			Probe serial number:	
Calibration due:	7/6/2023			Calibration due:	
Efficiency:	α 0.32 β 0.39	α β	α β	Background (dose rate):	
Background (cpm):	α 0.30 β 39	α β	α β	Other info (as needed):	
S _c (dpm/100cm ²):	α 3 β 27	α β	α β		
Area probe correction factor:	1.0				

Surface Contamination and Radiation Survey Results

Item Surveyed / Map Location	Counting Inst. No. Used	Smear Survey (Instrument 1 or 2)						Direct Survey (Instrument 3)						Exposure Rate Survey
		Gross Counts		Net Counts		Activity		Gross Counts		Net Counts		Activity		
		Alpha cpm	Beta/gamma cpm	Alpha cpm	Beta/gamma cpm	Alpha dpm/100cm ²	Beta/gamma dpm/100cm ²	Alpha cpm	Beta/gamma cpm	Alpha cpm	Beta/gamma cpm	Alpha dpm/100cm ²	Beta/gamma dpm/100cm ²	
Floor #1	1	0	38	-0.3	-1.0	< Sc	< Sc							
Floor #2	1	0	41	-0.3	2.0	< Sc	< Sc							
Floor #3	1	0	34	-0.3	-5.0	< Sc	< Sc							
Floor #4	1	0	36	-0.3	-3.0	< Sc	< Sc							
Floor #5	1	1	33	0.7	-6.0	< Sc	< Sc							
Wall #6	1	1	39	0.7	0.0	< Sc	< Sc							
Wall #7	1	0	23	-0.3	-16.0	< Sc	< Sc							
Wall #8	1	0	29	-0.3	-10.0	< Sc	< Sc							
Wall #9	1	0	34	-0.3	-5.0	< Sc	< Sc							
Wall #10	1	0	33	-0.3	-6.0	< Sc	< Sc							
Wall #11	1	1	38	0.7	-1.0	< Sc	< Sc							
Wall #12	1	1	50	0.7	11.0	< Sc	28							
Wall #13	1	1	45	0.7	6.0	< Sc	< Sc							
Wall #14	1	0	37	-0.3	-2.0	< Sc	< Sc							

RCT signature: _____

Radiological Survey Map



Radiological Survey Number: 220720-003

Page 2 of 4

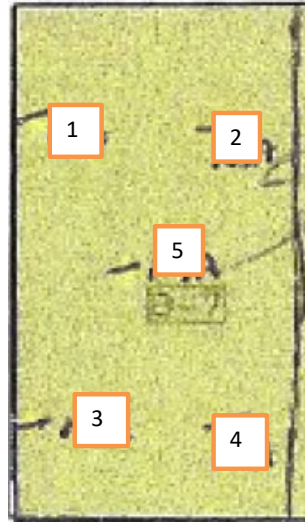
Surface Contamination and Radiation Survey Results														
Item Surveyed / Map Location	Counting Inst. No. Used	Smear Survey (Instrument 1 or 2)						Direct Survey (Instrument 3)						Exposure Rate Survey
		Gross Counts		Net Counts		Activity		Gross Counts		Net Counts		Activity		
		Alpha cpm	Beta/gamma cpm	Alpha cpm	Beta/gamma cpm	Alpha dpm/100cm ²	Beta/gamma dpm/100cm ²	Alpha cpm	Beta/gamma cpm	Alpha cpm	Beta/gamma cpm	Alpha dpm/100cm ²	Beta/gamma dpm/100cm ²	
Applicable Surface Contamination Limits							Activity Equation					APCE		
Check one for alpha, one for beta.							Gross count minus BKGD count = Net count					44-9 = 6.5		
Alpha (removable/total) <input checked="" type="checkbox"/> 1000/5000 <input type="checkbox"/> 200/1000 <input type="checkbox"/> 20/500							Net count/Eff = dpm					FHZ 732 (GM) = 6.5		
Beta (removable/total) <input checked="" type="checkbox"/> 1000/5000 <input type="checkbox"/> 200/1000							Dpm x Area Probe Correction Factor (APCF) = dpm/100cm ²					43-10-1 = 1		
							Remarks:							
Smears counted for 1 minute. Background count time = 20 minutes.														

Contamination and Radiation Survey Figure

Standardized Map Symbols

- = Smear/wipe (no. inside)
- △ = Air sample (no. inside)
- 6.3 = General area exposure rate (result in $\mu\text{R/hr}$)
- * = Contact exposure rate (result beside, in $\mu\text{R/hr}$)
- # = Direct frisk (count rate) (result beside)
- ☆ = Direct gamma (count rate) (e.g., 2"x2" NaI) (result beside)

Note: Note units used if not identified above.



B-7 Floor



B-7 South Wall

B-7 West Wall

B-7 North Wall



B-7 East Wall



Rubblized Concrete Survey Locations

(Place figure in this area.)

Remarks:

Smear Location = number in orange box

Smear Area = 100 square centimeters (represented by the orange box, not to scale)

Smear Method = taken using industry standard smears (Wipe Test Smears) using moderate pressure

Diagonal Line Area = Rubblized wall area (to remove tank). Smears taken on rubblized concrete wall pieces at survey locations shown

Figures above are not to scale, but are representative of the floor and wall areas surveyed

Radiological Survey Map



Radiological Survey Number: 220723-006 **Page** 1 **of** 4

Purpose: Characterization Survey of Room B-7, Tank Exterior (NaI Gamma Scan) **Truck #:** N/A **Trailer #:** N/A

RWP number: N/A **Time:** 11:15 AM **Date:** 7/20/2022

Site name: Piqua **Location:** Tank

RCT (printed): Tom Maveal **Reviewer signature:** **Date:** _____

Counting Instruments:	Instrument 1	Instrument 2	Instrument 3	Radiation Instruments:	Instrument 4
Instrument/probe model:			Ludlum 2221/44-10	Instrument/probe model:	
Instrument serial number:			313959	Instrument serial number:	
Probe serial number:			PR357774	Probe serial number:	
Calibration due:			11/28/2022	Calibration due:	
Efficiency:	α β	α β	α β	Background (dose rate):	
Background (cpm):	α β	α β	α β 3956	Other info (as needed):	
S _c (dpm/100cm ²):	α β	α β	α β		
Area probe correction factor:					

Surface Contamination and Radiation Survey Results

Item Surveyed / Map Location	Counting Inst. No. Used	Smear Survey (Instrument 1 or 2)						Direct Survey (Instrument 3)						Exposure Rate Survey
		Gross Counts		Net Counts		Activity		Gross Counts		Net Counts		Activity		
		Alpha cpm	Beta/gamma cpm	Alpha cpm	Beta/gamma cpm	Alpha dpm/100cm ²	Beta/gamma dpm/100cm ²	Alpha cpm	Beta/gamma cpm	Alpha cpm	Beta/gamma cpm	Alpha dpm/100cm ²	Beta/gamma dpm/100cm ²	
See Page 3	3													

RCT signature: _____

Radiological Survey Map



Radiological Survey Number: 220723-006

Page 2 of 4

Surface Contamination and Radiation Survey Results														
Item Surveyed / Map Location	Counting Inst. No. Used	Smear Survey (Instrument 1 or 2)						Direct Survey (Instrument 3)						Exposure Rate Survey
		Gross Counts		Net Counts		Activity		Gross Counts		Net Counts		Activity		
		Alpha cpm	Beta/gamma cpm	Alpha cpm	Beta/gamma cpm	Alpha dpm/100cm ²	Beta/gamma dpm/100cm ²	Alpha cpm	Beta/gamma cpm	Alpha cpm	Beta/gamma cpm	Alpha dpm/100cm ²	Beta/gamma dpm/100cm ²	
Applicable Surface Contamination Limits							Activity Equation					APCE		
Check one for alpha, one for beta.							Gross count minus BKGD count = Net count					44-9 = 6.5		
Alpha (removable/total) <input type="checkbox"/> 1000/5000 <input type="checkbox"/> 200/1000 <input type="checkbox"/> 20/500							Net count/Eff = dpm					FHZ 732 (GM) = 6.5		
Beta (removable/total) <input type="checkbox"/> 1000/5000 <input type="checkbox"/> 200/1000							Dpm x Area Probe Correction Factor (APCF) = dpm/100cm ²					43-10-1 = 1		
Remarks:														
10 minute background performed near tank on Ludlum 2221 (SN#313959) and 44-10 Probe (SN#PR357774) Gamma Background = 3956 CPM														

Contamination and Radiation Survey Figure

Standardized Map Symbols

- = Smear/wipe (no. inside)
- △ = Air sample (no. inside)
- 6.3 = General area exposure rate (result in $\mu\text{R/hr}$)
- * = Contact exposure rate (result beside, in $\mu\text{R/hr}$)
- # = Direct frisk (count rate) (result beside)
- ☆ = Direct gamma (count rate) (e.g., 2"x2" NaI) (result beside)

Note: Note units used if not identified above.



(Place figure in this area.)

Remarks:

Scan Location = bottom of tank, external

Scan Area = complete bottom of tank

Scan Method = the tank bottom was scanned using a serpentine pattern with the probe held approximately 6 inches from the tank bottom

Figure above is not to scale, but is representative of the tank bottom

Radiological Survey Map



Radiological Survey Number: 220723-002 Page 1 of 4

Purpose: Characterization Survey of Room B-7, Tank Interior (Alpha Direct) Truck #: N/A Trailer #: N/A

RWP number: N/A Time: 10:30 AM Date: 7/20/2022

Site name: Piqua Location: Tank Interior

RCT (printed): Tom Maveal Reviewer signature: _____ Date: _____

Counting Instruments:		Instrument 1		Instrument 2		Instrument 3		Radiation Instruments:		Instrument 4	
Instrument/probe model:						Ludlum 2221/43-90		Instrument/probe model:			
Instrument serial number:						75480		Instrument serial number:			
Probe serial number:						107237		Probe serial number:			
Calibration due:						1/20/2023		Calibration due:			
Efficiency:		α	β	α	β	α	0.18	β	Background (dose rate):		
Background (cpm):		α	β	α	β	α	2	β	Other info (as needed):		
S _c (dpm/100cm ²):		α	β	α	β	α	27	β			
Area probe correction factor:						1.0					

Surface Contamination and Radiation Survey Results

Item Surveyed / Map Location	Counting Inst. No. Used	Smear Survey (Instrument 1 or 2)						Direct Survey (Instrument 3)						Exposure Rate Survey
		Gross Counts		Net Counts		Activity		Gross Counts		Net Counts		Activity		
		Alpha cpm	Beta/gamma cpm	Alpha cpm	Beta/gamma cpm	Alpha dpm/100cm ²	Beta/gamma dpm/100cm ²	Alpha cpm	Beta/gamma cpm	Alpha cpm	Beta/gamma cpm	Alpha dpm/100cm ²	Beta/gamma dpm/100cm ²	
Tank #1	3							0		-2.0		< Sc		
Tank #2	3							1		-1.0		< Sc		
Tank #3	3							0		-2.0		< Sc		
Tank #4	3							0		-2.0		< Sc		
Tank #5	3							0		-2.0		< Sc		
Tank #6	3							1		-1.0		< Sc		
Tank #7	3							0		-2.0		< Sc		

RCT signature: _____

Radiological Survey Map

Radiological Survey Number: 220723-002

Page 2 of 4

Surface Contamination and Radiation Survey Results														
Item Surveyed / Map Location	Counting Inst. No. Used	Smear Survey (Instrument 1 or 2)						Direct Survey (Instrument 3)						Exposure Rate Survey
		Gross Counts		Net Counts		Activity		Gross Counts		Net Counts		Activity		
		Alpha cpm	Beta/gamma cpm	Alpha cpm	Beta/gamma cpm	Alpha dpm/100cm ²	Beta/gamma dpm/100cm ²	Alpha cpm	Beta/gamma cpm	Alpha cpm	Beta/gamma cpm	Alpha dpm/100cm ²	Beta/gamma dpm/100cm ²	
Applicable Surface Contamination Limits							Activity Equation					APCE		
Check one for alpha, one for beta.							Gross count minus BKGD count = Net count					44-9 = 6.5		
Alpha (removable/total) <input checked="" type="checkbox"/> 1000/5000 <input type="checkbox"/> 200/1000 <input type="checkbox"/> 20/500							Net count/Eff = dpm					FHZ 732 (GM) = 6.5		
Beta (removable/total) <input type="checkbox"/> 1000/5000 <input type="checkbox"/> 200/1000							Dpm x Area Probe Correction Factor (APCF) = dpm/100cm ²					43-10-1 = 1		
Remarks:														
10 minute background performed on Ludlum 2221 (SN#75480) and 43-90 Probe (SN#107237) Alpha background = 2 CPM														

Contamination and Radiation Survey Figure

Standardized Map Symbols

- = Smear/wipe (no. inside)
- △ = Air sample (no. inside)
- 6.3 = General area exposure rate (result in $\mu\text{R/hr}$)
- * = Contact exposure rate (result beside, in $\mu\text{R/hr}$)
- # = Direct frisk (count rate) (result beside)
- ☆ = Direct gamma (count rate) (e.g., 2"x2" NaI) (result beside)

Note: Note units used if not identified above.



(Place figure in this area.)

Remarks:

Direct Measurement Location = number in orange circle

Direct Measurement Area = 100 square centimeter, flange area, internal

Direct Measurement Method = taken with 100 square centimeter alpha probe held at a distance of 1/8 inch from the surface for 1 minute

Figure above is not to scale, but is representative of the tank top and openings into the tank

Radiological Survey Map



Radiological Survey Number: 220723-004 **Page** 1 **of** 4

Purpose: Characterization Survey of Room B-7, Tank Interior and Top (Alpha Scan) **Truck #:** N/A **Trailer #:** N/A

RWP number: N/A **Time:** 10:45 AM **Date:** 7/20/2022

Site name: Piqua **Location:** Tank Interior and Top Openings

RCT (printed): Tom Maveal **Reviewer signature:**
 Date:

Counting Instruments:		Instrument 1		Instrument 2		Instrument 3		Radiation Instruments:		Instrument 4	
Instrument/probe model:						Ludlum 2221/43-90		Instrument/probe model:			
Instrument serial number:						75480		Instrument serial number:			
Probe serial number:						107237		Probe serial number:			
Calibration due:						1/20/2023		Calibration due:			
Efficiency:		α	β	α	β	α	β	Background (dose rate):			
Background (cpm):		α	β	α	β	α	2	β	Other info (as needed):		
S _c (dpm/100cm ²):		α	β	α	β	α		β			
Area probe correction factor:											

Surface Contamination and Radiation Survey Results

Item Surveyed / Map Location	Counting Inst. No. Used	Smear Survey (Instrument 1 or 2)						Direct Survey (Instrument 3)						Exposure Rate Survey
		Gross Counts		Net Counts		Activity		Gross Counts		Net Counts		Activity		
		Alpha cpm	Beta/gamma cpm	Alpha cpm	Beta/gamma cpm	Alpha dpm/100cm ²	Beta/gamma dpm/100cm ²	Alpha cpm	Beta/gamma cpm	Alpha cpm	Beta/gamma cpm	Alpha dpm/100cm ²	Beta/gamma dpm/100cm ²	
See Page 3	3													

RCT signature: _____

Radiological Survey Map



Radiological Survey Number: 220723-004

Page 2 of 4

Surface Contamination and Radiation Survey Results														
Item Surveyed / Map Location	Counting Inst. No. Used	Smear Survey (Instrument 1 or 2)						Direct Survey (Instrument 3)						Exposure Rate Survey
		Gross Counts		Net Counts		Activity		Gross Counts		Net Counts		Activity		
		Alpha cpm	Beta/gamma cpm	Alpha cpm	Beta/gamma cpm	Alpha dpm/100cm ²	Beta/gamma dpm/100cm ²	Alpha cpm	Beta/gamma cpm	Alpha cpm	Beta/gamma cpm	Alpha dpm/100cm ²	Beta/gamma dpm/100cm ²	
Applicable Surface Contamination Limits							Activity Equation					APCE		
Check one for alpha, one for beta.							Gross count minus BKGD count = Net count					44-9 = 6.5		
Alpha (removable/total) <input type="checkbox"/> 1000/5000 <input type="checkbox"/> 200/1000 <input type="checkbox"/> 20/500							Net count/Eff = dpm					FHZ 732 (GM) = 6.5		
Beta (removable/total) <input type="checkbox"/> 1000/5000 <input type="checkbox"/> 200/1000							Dpm x Area Probe Correction Factor (APCF) = dpm/100cm ²					43-10-1 = 1		
Remarks:														

Contamination and Radiation Survey Figure

Standardized Map Symbols

- = Smear/wipe (no. inside)
- △ = Air sample (no. inside)
- 6.3 = General area exposure rate (result in $\mu\text{R/hr}$)
- * = Contact exposure rate (result beside, in $\mu\text{R/hr}$)
- # = Direct frisk (count rate) (result beside)
- ☆ = Direct gamma (count rate) (e.g., 2"x2" NaI) (result beside)

Note: Note units used if not identified above.



(Place figure in this area.)

Remarks:

Scan Location = number in orange circle

Scan Area = localized in and around the tank openings

Scan Method = surface area was scanned at 4 inches per second with the alpha probe held at a distance of 1/8 inch from the surface

Figure above is not to scale, but is representative of the tank top and openings into the tank

Contamination and Radiation Survey Continuation Sheet
Use this sheet to document or record radiological survey information (in addition to Page 1 of the form)
Tank Opening Area #1 = 0-1 Gross CPM over scan area
Tank Opening Area #2 = 0 Gross CPM over scan area
Tank Opening Area #3 = 0-2 Gross CPM over scan area
Tank Opening Area #4 = 0 Gross CPM over scan area
Tank Opening Area #5 = 0 Gross CPM over scan area
Tank Opening Area #6 = 0 Gross CPM over scan area
Tank Opening Area #7 = 0 Gross CPM over scan area

Radiological Survey Map



Radiological Survey Number: 220723-003 Page 1 of 4

Purpose: Characterization Survey of Room B-7, Tank Interior (Beta-Gamma Direct) Truck #: N/A Trailer #: N/A

RWP number: N/A Time: 10:45 AM Date: 7/20/2022

Site name: Piqua Location: Tank Interior

RCT (printed): Tom Maveal Reviewer signature: _____ Date: _____

Counting Instruments:		Instrument 1		Instrument 2		Instrument 3		Radiation Instruments:		Instrument 4	
Instrument/probe model:						Ludlum 26		Instrument/probe model:			
Instrument serial number:						PF008880		Instrument serial number:			
Probe serial number:						N/A		Probe serial number:			
Calibration due:						1/20/2023		Calibration due:			
Efficiency:		α	β	α	β	α	β	0.38	Background (dose rate):		
Background (cpm):		α	β	α	β	α	β	40	Other info (as needed):		
S _c (dpm/100cm ²):		α	β	α	β	α	β	276			
Area probe correction factor:						6.5					

Surface Contamination and Radiation Survey Results

Item Surveyed / Map Location	Counting Inst. No. Used	Smear Survey (Instrument 1 or 2)						Direct Survey (Instrument 3)						Exposure Rate Survey
		Gross Counts		Net Counts		Activity		Gross Counts		Net Counts		Activity		
		Alpha cpm	Beta/gamma cpm	Alpha cpm	Beta/gamma cpm	Alpha dpm/100cm ²	Beta/gamma dpm/100cm ²	Alpha cpm	Beta/gamma cpm	Alpha cpm	Beta/gamma cpm	Alpha dpm/100cm ²	Beta/gamma dpm/100cm ²	
Tank #1	3								35		-5.0		< Sc	
Tank #2	3								38		-2.0		< Sc	
Tank #3	3								40		0.0		< Sc	
Tank #4	3								32		-8.0		< Sc	
Tank #5	3								41		1.0		< Sc	
Tank #6	3								38		-2.0		< Sc	
Tank #7	3								37		-3.0		< Sc	

RCT signature: _____

Radiological Survey Map

Surface Contamination and Radiation Survey Results														
Item Surveyed / Map Location	Counting Inst. No. Used	Smear Survey (Instrument 1 or 2)						Direct Survey (Instrument 3)						Exposure Rate Survey
		Gross Counts		Net Counts		Activity		Gross Counts		Net Counts		Activity		
		Alpha cpm	Beta/gamma cpm	Alpha cpm	Beta/gamma cpm	Alpha dpm/100cm ²	Beta/gamma dpm/100cm ²	Alpha cpm	Beta/gamma cpm	Alpha cpm	Beta/gamma cpm	Alpha dpm/100cm ²	Beta/gamma dpm/100cm ²	
Applicable Surface Contamination Limits							Activity Equation					APCE		
Check one for alpha, one for beta.							Gross count minus BKGD count = Net count					44-9 = 6.5		
Alpha (removable/total) <input type="checkbox"/> 1000/5000 <input type="checkbox"/> 200/1000 <input type="checkbox"/> 20/500							Net count/Eff = dpm					FHZ 732 (GM) = 6.5		
Beta (removable/total) <input checked="" type="checkbox"/> 1000/5000 <input type="checkbox"/> 200/1000							Dpm x Area Probe Correction Factor (APCF) = dpm/100cm ²					43-10-1 = 1		
Remarks:														
Ten one minute background counts were performed on Ludlum Model 26. Averaged background = 40 CPM Count Time = 1 Minute														

Contamination and Radiation Survey Figure

Standardized Map Symbols

- = Smear/wipe (no. inside)
- △ = Air sample (no. inside)
- 6.3 = General area exposure rate (result in $\mu\text{R/hr}$)
- * = Contact exposure rate (result beside, in $\mu\text{R/hr}$)
- # = Direct frisk (count rate) (result beside)
- ☆ = Direct gamma (count rate) (e.g., 2"x2" NaI) (result beside)

Note: Note units used if not identified above.



(Place figure in this area.)

Remarks:

Direct Measurement Location = number in orange circle

Direct Measurement Area = 15.5 square centimeters (corrected to 100 square centimeters), flange area, internal

Direct Measurement Method = taken with 15.5 square centimeter beta/gamma probe held at a distance of 1/4 inch from the surface for 1 minute

Figure above is not to scale, but is representative of the tank top and openings into the tank

Radiological Survey Map



Radiological Survey Number: 220723-005 Page 1 of 4

Purpose: Characterization Survey of Room B-7, Tank Interior and Top (Beta-Gamma Scan) Truck #: N/A Trailer #: N/A

RWP number: N/A Time: 11:00 AM Date: 7/20/2022

Site name: Piqua Location: Tank Interior and Top Openings

RCT (printed): Tom Maveal Reviewer signature: _____ Date: _____

Counting Instruments:		Instrument 1		Instrument 2		Instrument 3		Radiation Instruments:		Instrument 4	
Instrument/probe model:						Ludlum 26		Instrument/probe model:			
Instrument serial number:						PF008880		Instrument serial number:			
Probe serial number:						N/A		Probe serial number:			
Calibration due:						1/20/2023		Calibration due:			
Efficiency:		α	β	α	β	α	β	Background (dose rate):			
Background (cpm):		α	β	α	β	α	β 40	Other info (as needed):			
S_c (dpm/100cm ²):		α	β	α	β	α	β				
Area probe correction factor:											

Surface Contamination and Radiation Survey Results

Item Surveyed / Map Location	Counting Inst. No. Used	Smear Survey (Instrument 1 or 2)						Direct Survey (Instrument 3)						Exposure Rate Survey
		Gross Counts		Net Counts		Activity		Gross Counts		Net Counts		Activity		
		Alpha cpm	Beta/gamma cpm	Alpha cpm	Beta/gamma cpm	Alpha dpm/100cm ²	Beta/gamma dpm/100cm ²	Alpha cpm	Beta/gamma cpm	Alpha cpm	Beta/gamma cpm	Alpha dpm/100cm ²	Beta/gamma dpm/100cm ²	
See Page 3	3													

RCT signature: _____

Radiological Survey Map

Radiological Survey Number: 220723-005

Page 2 of 4

Surface Contamination and Radiation Survey Results														
Item Surveyed / Map Location	Counting Inst. No. Used	Smear Survey (Instrument 1 or 2)						Direct Survey (Instrument 3)						Exposure Rate Survey
		Gross Counts		Net Counts		Activity		Gross Counts		Net Counts		Activity		
		Alpha cpm	Beta/gamma cpm	Alpha cpm	Beta/gamma cpm	Alpha dpm/100cm ²	Beta/gamma dpm/100cm ²	Alpha cpm	Beta/gamma cpm	Alpha cpm	Beta/gamma cpm	Alpha dpm/100cm ²	Beta/gamma dpm/100cm ²	
Applicable Surface Contamination Limits							Activity Equation					APCE		
Check one for alpha, one for beta.							Gross count minus BKGD count = Net count					44-9 = 6.5		
Alpha (removable/total) <input type="checkbox"/> 1000/5000 <input type="checkbox"/> 200/1000 <input type="checkbox"/> 20/500							Net count/Eff = dpm					FHZ 732 (GM) = 6.5		
Beta (removable/total) <input type="checkbox"/> 1000/5000 <input type="checkbox"/> 200/1000							Dpm x Area Probe Correction Factor (APCF) = dpm/100cm ²					43-10-1 = 1		
Remarks:														

Contamination and Radiation Survey Figure

Standardized Map Symbols

- = Smear/wipe (no. inside)
- △ = Air sample (no. inside)
- 6.3 = General area exposure rate (result in $\mu\text{R/hr}$)
- * = Contact exposure rate (result beside, in $\mu\text{R/hr}$)
- # = Direct frisk (count rate) (result beside)
- ☆ = Direct gamma (count rate) (e.g., 2"x2" NaI) (result beside)

Note: Note units used if not identified above.



(Place figure in this area.)

Remarks:

Scan Location = number in orange circle

Scan Area = localized in and around the tank openings

Scan Method = surface area was scanned at 4 inches per second with the beta-gamma probe held at a distance of 1/4 inch from the surface

Figure above is not to scale, but is representative of the tank top and openings into the tank

Contamination and Radiation Survey Continuation Sheet

Use this sheet to document or record radiological survey information (in addition to Page 1 of the form)

- Tank Opening Area #1 = 35-45 Gross CPM over 1 meter scan area
- Tank Opening Area #2 = 30-45 Gross CPM over 1 meter scan area
- Tank Opening Area #3 = 30-50 Gross CPM over 1 meter scan area
- Tank Opening Area #4 = 35-50 Gross CPM over 1 meter scan area
- Tank Opening Area #5 = 30-50 Gross CPM over 1 meter scan area
- Tank Opening Area #6 = 35-55 Gross CPM over 1 meter scan area
- Tank Opening Area #7 = 30-55 Gross CPM over 1 meter scan area
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-
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Radiological Survey Map



Radiological Survey Number: 220723-001 Page 1 of 4

Purpose: Characterization Survey of Room B-7, Tank Top and Openings (Nal Scan) Truck #: N/A Trailer #: N/A

RWP number: N/A Time: 10:15 AM Date: 7/20/2022

Site name: Piqua Location: Tank Top and Openings

RCT (printed): Tom Maveal Reviewer signature: _____ Date: _____

Counting Instruments:		Instrument 1		Instrument 2		Instrument 3		Radiation Instruments:		Instrument 4	
Instrument/probe model:						Ludlum 2221/44-10		Instrument/probe model:			
Instrument serial number:						313959		Instrument serial number:			
Probe serial number:						PR 357774		Probe serial number:			
Calibration due:						11/28/2022		Calibration due:			
Efficiency:		α	β	α	β	α	β	Background (dose rate):			
Background (cpm):		α	β	α	β	α	β 1747	Other info (as needed):			
S _C (dpm/100cm ²):		α	β	α	β	α	β				
Area probe correction factor:											

Surface Contamination and Radiation Survey Results														
Item Surveyed / Map Location	Counting Inst. No. Used	Smear Survey (Instrument 1 or 2)						Direct Survey (Instrument 3)						Exposure Rate Survey
		Gross Counts		Net Counts		Activity		Gross Counts		Net Counts		Activity		
		Alpha cpm	Beta/gamma cpm	Alpha cpm	Beta/gamma cpm	Alpha dpm/100cm ²	Beta/gamma dpm/100cm ²	Alpha cpm	Beta/gamma cpm	Alpha cpm	Beta/gamma cpm	Alpha dpm/100cm ²	Beta/gamma dpm/100cm ²	
See Page 3	3													

RCT signature: _____

Radiological Survey Map



Radiological Survey Number: 220723-001

Page **2** of 4

Surface Contamination and Radiation Survey Results														
Item Surveyed / Map Location	Counting Inst. No. Used	Smear Survey (Instrument 1 or 2)						Direct Survey (Instrument 3)						Exposure Rate Survey
		Gross Counts		Net Counts		Activity		Gross Counts		Net Counts		Activity		
		Alpha cpm	Beta/gamma cpm	Alpha cpm	Beta/gamma cpm	Alpha dpm/100cm ²	Beta/gamma dpm/100cm ²	Alpha cpm	Beta/gamma cpm	Alpha cpm	Beta/gamma cpm	Alpha dpm/100cm ²	Beta/gamma dpm/100cm ²	
Applicable Surface Contamination Limits							Activity Equation					APCE		
Check one for alpha, one for beta.							Gross count minus BKGD count = Net count					44-9 = 6.5		
Alpha (removable/total) <input type="checkbox"/> 1000/5000 <input type="checkbox"/> 200/1000 <input type="checkbox"/> 20/500							Net count/Eff = dpm					FHZ 732 (GM) = 6.5		
Beta (removable/total) <input type="checkbox"/> 1000/5000 <input type="checkbox"/> 200/1000							Dpm x Area Probe Correction Factor (APCF) = dpm/100cm ²					43-10-1 = 1		
Remarks:														

Contamination and Radiation Survey Figure

Standardized Map Symbols

- = Smear/wipe (no. inside)
- △ = Air sample (no. inside)
- 6.3 = General area exposure rate (result in $\mu\text{R/hr}$)
- * = Contact exposure rate (result beside, in $\mu\text{R/hr}$)
- # = Direct frisk (count rate) (result beside)
- ☆ = Direct gamma (count rate) (e.g., 2"x2" NaI) (result beside)

Note: Note units used if not identified above.



(Place figure in this area.)

Remarks:

Scan Location = number in orange circle

Scan Area = localized in and around the tank openings and the top of the tank

Scan Method = tank top and openings were scanned with the probe held approximately 6 inches from the surface

Figure above is not to scale, but is representative of the tank top and openings into the tank

Contamination and Radiation Survey Continuation Sheet	
Use this sheet to document or record radiological survey information (in addition to Page 1 of the form)	
Tank Opening Area #1 = 1800-2100 Gross CPM	
Tank Opening Area #2 = 1600-1900 Gross CPM	
Tank Opening Area #3 = 1600-2000 Gross CPM	
Tank Opening Area #4 = 1500-1800 Gross CPM	
Tank Opening Area #5 = 1500-1800 Gross CPM	
Tank Opening Area #6 = 1500-1800 Gross CPM	
Tank Opening Area #7 = 1600-2000 Gross CPM	

Radiological Survey Map



Radiological Survey Number: 220720-004 Page 1 of 4

Purpose: Characterization Survey of Room B-7, Tank Openings (Smears) Truck #: N/A Trailer #: N/A

RWP number: N/A Time: 10:00 AM Date: 7/20/2022

Site name: Piqua Location: Tank Openings and Interior

RCT (printed): Tom Maveal Reviewer signature: Date:

Counting Instruments:	Instrument 1	Instrument 2	Instrument 3	Radiation Instruments:	Instrument 4
Instrument/probe model:	Ludlum 2929/43-10-1			Instrument/probe model:	
Instrument serial number:	329909			Instrument serial number:	
Probe serial number:	PR362456			Probe serial number:	
Calibration due:	7/6/2023			Calibration due:	
Efficiency:	α 0.32 β 0.39	α β	α β	Background (dose rate):	
Background (cpm):	α 0.30 β 39	α β	α β	Other info (as needed):	
S _c (dpm/100cm ²):	α 3 β 27	α β	α β		
Area probe correction factor:	1.0				

Surface Contamination and Radiation Survey Results

Item Surveyed / Map Location	Counting Inst. No. Used	Smear Survey (Instrument 1 or 2)						Direct Survey (Instrument 3)						Exposure Rate Survey
		Gross Counts		Net Counts		Activity		Gross Counts		Net Counts		Activity		
		Alpha cpm	Beta/gamma cpm	Alpha cpm	Beta/gamma cpm	Alpha dpm/100cm ²	Beta/gamma dpm/100cm ²	Alpha cpm	Beta/gamma cpm	Alpha cpm	Beta/gamma cpm	Alpha dpm/100cm ²	Beta/gamma dpm/100cm ²	
Tank #1	1	1	39	0.7	0.0	< Sc	< Sc							
Tank #2	1	0	45	-0.3	6.0	< Sc	< Sc							
Tank #3	1	0	42	-0.3	3.0	< Sc	< Sc							
Tank #4	1	0	31	-0.3	-8.0	< Sc	< Sc							
Tank #5	1	0	45	-0.3	6.0	< Sc	< Sc							
Tank #6	1	1	41	0.7	2.0	< Sc	< Sc							
Tank #7	1	0	36	-0.3	-3.0	< Sc	< Sc							

RCT signature: _____

Radiological Survey Map

Radiological Survey Number: 220720-004

Page 2 of 4

Surface Contamination and Radiation Survey Results														
Item Surveyed / Map Location	Counting Inst. No. Used	Smear Survey (Instrument 1 or 2)						Direct Survey (Instrument 3)						Exposure Rate Survey
		Gross Counts		Net Counts		Activity		Gross Counts		Net Counts		Activity		
		Alpha cpm	Beta/gamma cpm	Alpha cpm	Beta/gamma cpm	Alpha dpm/100cm ²	Beta/gamma dpm/100cm ²	Alpha cpm	Beta/gamma cpm	Alpha cpm	Beta/gamma cpm	Alpha dpm/100cm ²	Beta/gamma dpm/100cm ²	
Applicable Surface Contamination Limits Check one for alpha, one for beta. Alpha (removable/total) <input checked="" type="checkbox"/> 1000/5000 <input type="checkbox"/> 200/1000 <input type="checkbox"/> 20/500 Beta (removable/total) <input checked="" type="checkbox"/> 1000/5000 <input type="checkbox"/> 200/1000						Activity Equation Gross count minus BKGD count = Net count Net count/Eff = dpm Dpm x Area Probe Correction Factor (APCF) = dpm/100cm ² Remarks:					APCE 44-9 = 6.5 FHZ 732 (GM) = 6.5 43-10-1 = 1			
Smear count time = 1 minute. Background count time = 20 minutes.														

Contamination and Radiation Survey Figure

Standardized Map Symbols

- = Smear/wipe (no. inside)
- △ = Air sample (no. inside)
- 6.3 = General area exposure rate (result in $\mu\text{R/hr}$)
- * = Contact exposure rate (result beside, in $\mu\text{R/hr}$)
- # = Direct frisk (count rate) (result beside)
- ☆ = Direct gamma (count rate) (e.g., 2"x2" NaI) (result beside)

Note: Note units used if not identified above.



(Place figure in this area.)

Remarks:

Smear Location = number in orange circle, in and around tank openings
 Smear Area = 100 square centimeters (represented by the orange circle) localized in and around the tank openings
 Smear Method = taken using industry standard smears (Wipe Test Smears) using moderate pressure
 Figure above is not to scale, but is representative of the tank top and openings into the tank

Appendix B

Piqua Room B-7 Radiological Survey Instrument Information

After-Calibration Source Response Checks Data Sheet

Location: CAWWT Detector/Probe Data (if applicable)

Month 1 Day 25 Year 2022 Manufacturer Ludlum

Survey Instrument Data

Manufacturer Ludlum Model No. 43-90

Model No. 2221 Serial Number PR107237

Serial Number 75480 Calibration Due Date 1/20/23

Calibration Due Date 1/20/23 **Check Source Data**

Isotope Th-230

Source ID No. KR368

Instrument Scale	Source Detector Distance	Shielding/Geometry	Instrument Response	-20%	+20%	Scale Units
X100	1/8"	N/A	12,573	10,058	15,088	cpm
N						
A						

Comments

eff = .18

L Oeffner Jr. Performed by (print name) [Signature] Performed by (signature) 1/25/22 Date

Reviewed by (print name) Reviewed by (signature) Date

File Index No. _____

Daily Instrument Response

Instrument model: ^{Lvd} 2221 Serial number: 75480 Detector model: ^{Lvd} 43-96 Serial number: PR107237
 Source ID number: KR-368 Isotope: Th-230 Scale units: cpm
 Calibration due date: 1/20/23 Acceptable range ($\pm 20\%$): 10,058 - 15,088
 Month 7 Year 2022

Initial if daily response check is satisfactory										
Day	Response (Scale or Decade)				Battery Check	Physical Inspection	High Voltage	Initials		
	Satisfactory	Unsatisfactory	2 nd Check	Sat/Failed						
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										
16										
17										
18	12,156	✓			✓	✓				LD
19	12,642	✓			✓	✓				LD
20										
21										
22										
23										
24										
25										
26	11,952	✓			✓	✓				LD
27										
28										
29										
30										
31										

Reviewed by the LMS Radiological Control Manager or designee (print and sign)

Date

Post-Calibration Source Response Checks Data Sheet

Location: CAWWT Detector/Probe Data (if applicable)

Month 7 Day 5 Year 22 Manufacturer _____

Survey Instrument Data Model No. N/A

Manufacturer Ludlum Serial Number _____

Model No. 26 Calibration Due Date _____

Serial Number PF008880 **Check Source Data**

Calibration Due Date 1/20/23 Isotope C1-36

Source ID No. D-526

Instrument Scale	Source Detector Distance	Shielding/Geometry	Instrument Response	-20%	+20%	Scale Units
n/A	1/8"	n/A	1829	1463	2195	cpm
		N				
		A				

Comments

eff = .38

L. Oeffner Jr. *[Signature]* 7/5/22
 Performed by (print name) Performed by (signature) Date

_____ _____ _____
 Reviewed by (print name) Reviewed by (signature) Date

Daily Instrument Response

Instrument model: Lvd-26 Serial number: PFC08880 Detector model: N/A Serial number: N/A
 Source ID number: D-526 Isotope: C1-36 Scale units: cpm
 Calibration due date: 1/20/23 Acceptable range ($\pm 20\%$): 1463-2195
 Month July Year 2022

Initial if daily response check is satisfactory

Day	Response (Scale or Decade)				Battery Check	Physical Inspection	High Voltage	Initials
	Satisfactory	Unsatisfactory	2 nd Check	Sat/Failed				
1							N/A	
2								
3								
4								
5								
6	1834	✓			✓	✓		LO
7	1834	✓						
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18	1896	✓			✓	✓		LO
19	1736	✓			✓	✓		LO
20								
21								
22								
23								
24								
25								
26	1812				✓	✓		LO
27								
28								
29								
30								
31								

Reviewed by the LMS Radiological Control Manager or designee (print and sign)

Date

Pre-Calibration Source Response Checks Data Sheet

Location: CAWWT Detector/Probe Data (if applicable)

Month 7 Day 5 Year 22 Manufacturer Ludlum

Survey Instrument Data Model No. 44-10

Manufacturer Ludlum Serial Number PR357774

Model No. 2221 Calibration Due Date 11/29/22

Serial Number 313959 **Check Source Data**

Calibration Due Date 11/29/22 Isotope CS-137

Source ID No. FER-001

Instrument Scale	Source Detector Distance	Shielding/Geometry	Instrument Response	-20%	+20%	Scale Units
1K	1/8"	N/A	107,671	86,137	129,205	cpm
		N				
		A				

Comments

Loeffner Jr. [Signature] 7/5/22
 Performed by (print name) Performed by (signature) Date

 Reviewed by (print name) Reviewed by (signature) Date

Instrument Response

Instrument model: Lud 2221 Serial number: 313959 Detector model: Lud-44-10 Serial number: PR357774
 ID number: FER-001 Isotope: Cs-137 Scale units: cpm
 Calibration due date: 11/29/22 Acceptable range ($\pm 20\%$): 86,137 - 129,205
 Month: 7 Year: 22

Initial if daily response check is satisfactory

Day	Response (Scale or Decade)					Battery Check	Physical Inspection	High Voltage	Initials
	IK	Satisfactory	Unsatisfactory	2 nd Check	Sat/Failed				
1									
2									
3									
4									
5						✓	✓	✓	LO
6	109,186	✓							
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17		✓				✓	✓	✓	LO
18	106,658	✓				✓	✓	✓	LO
19	106,658	✓							
20									
21									
22									
23									
24									
25						✓	✓	✓	LO
26	109,078								
27									
28									
29									
30									
31									

Reviewed by the LMS Radiological Control Manager or designee (print and sign)

Date

CERTIFICATE OF CALIBRATION

(SCALER/RATEMETER)



RSA Laboratories, Inc.

19 Pendleton Drive; P.O. Box 61
Hebron, Connecticut 06248
(860) 228-0721 Fax (860)228-4402

Customer and Contact: **RSI EnTech, Attn: Anthony Martinez (970) 248-6756**
 Customer Address: **2597 Legacy Way, Grand Junction, CO 81503**
 Inst. Mfr. & Model: **Ludlum Model 2221** Inst. Type: **Scaler/Ratemeter** Inst. s/n: **313959**
 Det. Mfr. & Model: **Ludlum 44-10** Det. Type: **Gamma Scintillator** Det. s/n: **357774**
 Calibration Date: **29 November 2021** Due Date: **29 November 2022** Cal Interval: **1 year**

Environmental conditions: Temperature **70°** Relative Humidity **32%** Atmospheric Pressure **29.57 inches Hg**

Pre-calibration Checks:

- | | | | |
|--|---|---|---|
| <input checked="" type="checkbox"/> Calibration survey | <input checked="" type="checkbox"/> Battery check | <input checked="" type="checkbox"/> Slow response check | |
| <input checked="" type="checkbox"/> Mechanical check | <input checked="" type="checkbox"/> Audio check | <input type="checkbox"/> Window Operation | <input checked="" type="checkbox"/> Det. Volts 750 Vdc |
| <input checked="" type="checkbox"/> Meter zero | <input checked="" type="checkbox"/> Reset check | <input type="checkbox"/> Plateau check | |
| <input checked="" type="checkbox"/> Geotropism check | <input checked="" type="checkbox"/> Fast response check | <input type="checkbox"/> Alarm set | <input checked="" type="checkbox"/> Input sens. 10 mV |

- Pulse generator s/n 94926 Oscilloscope s/n 171-04928 Voltmeter s/n 574100002

Comments: **Efficiencies measured on contact, WIN = OUT.**

Precision check source s/n: **47** Isotope: **Am-241** Dedicated Source? Yes No
 Reading #1: **59,334 cpm** Reading #2: **59,142 cpm** Reading #3: **59,393 cpm** Mean: **59,290 cpm**
 Precision: $\pm < 10\%$ $\pm 10-20\%$ Out of tolerance

Range Multiplier	Reference Calibration Point	Instrument Indication "As Found"	Instrument Indication "As Left"
x 1K	400,000 cpm	400,000 cpm	400,000 cpm
x 1K	100,000 cpm	100,000 cpm	100,000 cpm
x 100	40,000 cpm	40,000 cpm	40,000 cpm
x 100	10,000 cpm	10,000 cpm	10,000 cpm
x 10	4,000 cpm	4,000 cpm	4,000 cpm
x 10	1,000 cpm	1,000 cpm	1,000 cpm
x 1	400 cpm	400 cpm	400 cpm
x 1	100 cpm	100 cpm	100 cpm
1 min. count	400,000 cpm	400,022 counts	400,022 counts
1 min. count	100,000 cpm	100,007 counts	100,007 counts

All ranges calibrated electronically.

Local background (cpm) \approx **11,329**

Range Multiplier	Cal. Source Used (isotope and s/n)	Source Activity (dpm)	Instrument Reading (cpm)	4 π Instrument Efficiency (%)
1 min. count	Cs-137 #2886	12,002	12,854	12.71
1 min. count	Cs-137 #2887	88,317	23,210	13.45
1 min. count	Am-241 #47	558,006	59,290	8.60
1 min. count	Ra-226 (watch)	10,338	15,809	43.34

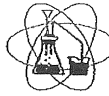
Instrument indicates within $\pm 10\%$ of calibration points unless otherwise indicated. Source-to-detector entry window distance for efficiency determination is 1 cm unless otherwise specified. RSA Laboratories certifies that the above instrument has been calibrated with standards traceable to the national Institute of Standards and Technology, or have been derived from accepted values of natural physical constants, or have been derived by the ratio-type of calibration techniques.

RSA Laboratories ID# **22486**

Calibrated by: **Kurt D. Newton**

Date: **29 November 2021**

CERTIFICATE OF CALIBRATION (COUNT-RATE INSTRUMENT)



RSA Laboratories, Inc.
19 Pendleton Drive, P.O. Box 61
Hebron, Connecticut 06248
(860) 228-0721 Fax (860) 228-4402

Customer and Contact: **RSI Team Fernald Reserve, Attn: Larry Oeffner (513) 686-0564**
 Customer Address: **10995 Hamilton-Cleves Highway, Harrison, OH 45030-9728**
 Inst. Mfr. & Model: **Ludlum Model 26** Inst. Type: **Survey meter** Inst. s/n: **PF008880**
 Det. Mfr. & Model: **not indicated** Det. Type: **G-M Pancake** Det. s/n: **not indicated**
 Calibration Date: **20 January 2022** Due Date: **20 January 2023** Cal Interval: **1 year**

Environmental conditions: Temperature 70°F Relative Humidity 29% Atmospheric Pressure 29.81 inches Hg

Pre-calibration Checks:

- | | | | |
|--|---|--|---|
| <input checked="" type="checkbox"/> Contamination survey | <input checked="" type="checkbox"/> Battery check | <input type="checkbox"/> Slow response check | |
| <input checked="" type="checkbox"/> Mechanical check | <input checked="" type="checkbox"/> Audio check | <input type="checkbox"/> Window Operation | <input type="checkbox"/> Det. Volts Vdc |
| <input type="checkbox"/> Meter zero | <input type="checkbox"/> Reset check | <input type="checkbox"/> Plateau check | |
| <input type="checkbox"/> Geotropism check | <input type="checkbox"/> Fast response check | <input type="checkbox"/> Alarm set | <input type="checkbox"/> Input sens. mV |
- Pulse generator s/n 94926 Oscilloscope s/n 171-04928 Voltmeter s/n 574100020

Comments: All efficiencies measured at near contact.

Precision check source s/n **D700** Isotope **Cl-36** Dedicated Source? Yes No
 Reading #1 **9,210 cpm** Reading #2 **8,710 cpm** Reading #3 **9,180 cpm** Mean **9,033 cpm**
 Precision: $\pm < 10\%$ $\pm 10-20\%$ Out of tolerance

Local background (cpm) \approx 47

Range Multiplier	Cal. Source Used (isotope and s/n)	Source Activity (dpm)	Instrument Reading (cpm)	4 π Instrument Efficiency (%)
1 min. count	C-14 #4456	202,100	10,620	5.23
1 min. count	Pm-147 #1613-32	1,886	283	12.51
1 min. count	Tc-99 #D702	23,064	4830	20.74
1 min. count	Cs-137 #2886	11,956	4460	36.91
1 min. count	Cl-36 #D700	23,598	9033	38.08
1 min. count	Sr/Y-90 #D711	29,283	12,610	42.90
1 min. count	Th-230 #91TH2200210	38,900	4360	11.09

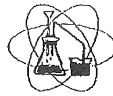
Instrument indicates within $\pm 10\%$ of calibration points unless otherwise indicated. Source-to-detector entry window distance for efficiency determination is 1 cm unless otherwise specified. RSA Laboratories certifies that the above instrument has been calibrated with standards traceable to the National Institute of Standards and Technology, or have been derived from accepted values of natural physical constants, or have been derived by the ratio-type of calibration techniques.

RSA Laboratories ID# **22626**

Calibrated by: **Kurt D. Newton**

Date: **20 January 2022**

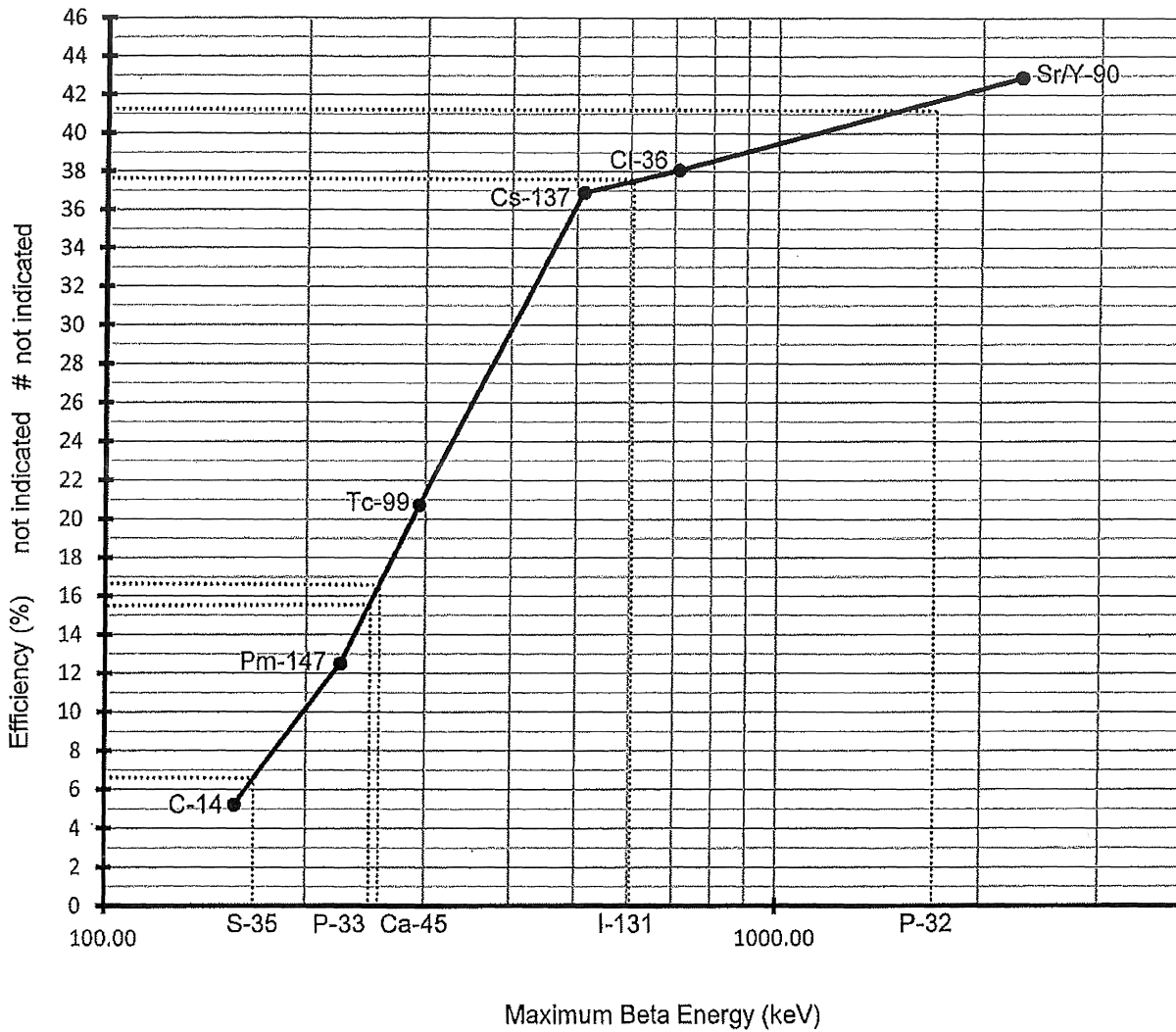
**CERTIFICATE
OF CALIBRATION
(COUNT-RATE INSTRUMENT)**



RSA Laboratories, Inc.
19 Pendleton Drive, P.O. Box 61
Hebron, Connecticut 06248
(860) 228-0721 Fax (860) 228-4402

Interpolated Beta Efficiencies

20 January 2022 Ludlum Model 26 # PF008880

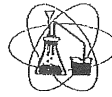


Calibrated by: Kurt D. Newton

Date: 20 January 2022

CERTIFICATE OF CALIBRATION

(SCALER / RATEMETER)



RSA Laboratories, Inc.

19 Pendleton Drive, P.O. Box 61
Hebron, Connecticut 06248
(860) 228-0721 Fax (860) 228-4402

Customer and Contact: **RSI Team Fernald Reserve, Attn: Larry Oeffner (513) 686-0564**
 Customer Address: **10995 Hamilton-Cleves Highway, Harrison, OH 45030-9728**
 Inst. Mfr. & Model: **Ludlum Model 2221** Inst. Type: **Scaler/Ratemeter** Inst. s/n: **75480**
 Det. Mfr. & Model: **Ludlum 43-90** Det. Type: **Alpha Scintillator** Det. s/n: **107237**
 Calibration Date: **20 January 2022** Due Date: **20 January 2023** Cal Interval: **1 year**

Environmental conditions: Temperature 70°F Relative Humidity 29% Atmospheric Pressure 29.81 inches Hg

Pre-calibration Checks:

- Contamination survey
- Battery check
- Slow response check
- Mechanical check
- Audio check
- Window Operation
- Det. Volts 600 Vdc
- Meter zero
- Reset check
- Plateau check
- Alarm set
- Input sens. 21 mV
- Geotropism check
- Fast response check
- Pulse generator s/n 94926
- Oscilloscope s/n 171-04928
- Voltmeter s/n 574100002

Comments: Efficiencies measured on contact.

Precision check source s/n **91TH4700001** Isotope **Th-230** Dedicated Source? Yes No
 Reading #1 **6,028 cpm** Reading #2 **5,966 cpm** Reading #3 **5,968 cpm** Mean **5,987 cpm**
 Precision: ±<10% ±10-20% Out of tolerance

Range Multiplier	Reference Calibration Point	Instrument "As Found"	Instrument "As Left"
x 1000	400,000 cpm	400,000 cpm	400,000 cpm
x 1000	100,000 cpm	100,000 cpm	100,000 cpm
x 100	40,000 cpm	40,000 cpm	40,000 cpm
x 100	10,000 cpm	10,000 cpm	10,000 cpm
x 10	4,000 cpm	4,000 cpm	4,000 cpm
x 10	1,000 cpm	1,000 cpm	1,000 cpm
x 1	400 cpm	400 cpm	400 cpm
x 1	100 cpm	100 cpm	100 cpm

All ranges calibrated electronically.

Range Multiplier	Pulse Rate Indication	Instrument "As Found"	Instrument "As Left"
1 min. count	1 min. x 400,000 cpm	400,039 counts	400,039 counts
1 min. count	1 min. x 100,000 cpm	100,004 counts	100,004 counts
1 min. count	1 min. x 40,000 cpm	40,009 counts	40,009 counts
1 min. count	1 min. x 10,000 cpm	10,001 counts	10,001 counts
1 min. count	1 min. x 4,000 cpm	4,001 counts	4,001 counts
1 min. count	1 min. x 1,000 cpm	1,000 counts	1,000 counts
1 min. count	1 min. x 400 cpm	400 counts	400 counts
1 min. count	1 min. x 100 cpm	100 counts	100 counts

Local background (cpm) ≈ 2 (α)

Range Multiplier	Cal. Source Used (isotope and s/n)	Source Activity (dpm)	Instrument Reading (cpm)	4π Instrument Efficiency (%)
1 min. count	Th-230 #91TH4700001	33,000	5,987 (α)	18.14

Instrument indicates within ±10% of calibration points unless otherwise indicated. Source-to-detector entry window distance for efficiency determination is 1 cm unless otherwise specified. RSA Laboratories certifies that the above instrument has been calibrated with standards traceable to the National Institute of Standards and Technology, or have been derived from accepted values of natural physical constants, or have been derived by the ratio-type of calibration techniques.

RSA Laboratories ID# **22628**

Calibrated by: **Kurt D. Newton**

Date: **20 January 2022**

CERTIFICATE OF CALIBRATION (SCALER INSTRUMENT)



RSA Laboratories, Inc.

19 Pendleton Drive, P.O. Box 61
Hebron, Connecticut 06248
(860) 228-0721 Fax (860) 228-4402

Customer and Contact: **RSI Team Fernald Reserve, Attn: Larry Oeffner (513) 686-0564**
 Customer Address: **10995 Hamilton-Cleves Highway, Harrison, OH 45030-9728**
 Inst. Mfr. & Model: **Ludlum Model 2929** Inst. Type: **Dual Scaler** Inst. s/n: **329909**
 Det. Mfr. & Model: **Ludlum 43-10-1** Det. Type: **Alpha/Beta Scintillator** Det. s/n: **362456**
 Calibration Date: **06 July 2022** Due Date: **06 July 2023** Cal Interval: **1 year**

Environmental conditions: Temperature **72°F** Relative Humidity **51%** Atmospheric Pressure **29.60** inches Hg

Pre-calibration Checks:

<input checked="" type="checkbox"/> Contamination survey	<input type="checkbox"/> Battery check	<input type="checkbox"/> Slow response check
<input checked="" type="checkbox"/> Mechanical check	<input checked="" type="checkbox"/> Audio check	<input checked="" type="checkbox"/> Window Operation
<input checked="" type="checkbox"/> Meter zero	<input checked="" type="checkbox"/> Reset check	<input type="checkbox"/> Plateau check
<input type="checkbox"/> Geotropism check	<input type="checkbox"/> Fast response check	<input type="checkbox"/> Alarm set

Det. Volts **750** Vdc
 Input sens. **see comments**

Pulse generator s/n 94926 Oscilloscope s/n 171-04928 Voltmeter s/n 574100002

Comments: Alpha channel threshold = 180 mV, window = 180 mV to ∞. Beta channel threshold = 4.4 mV, window = 4.4 mV to 50 mV. Calibrated using AC line power. HV potentiometer set to 310.

Precision check source s/n **D700** Isotope **Cl-36** Dedicated Source? Yes No
 Reading #1 **9,145 cpm** Reading #2 **9,208 cpm** Reading #3 **9,087 cpm** Mean **9,147 cpm**
 Precision: ±10% ±10-20% Out of tolerance

Range Multiplier	Reference Calibration Point	Instrument Indication "As Found"	Instrument Indication "As Left"
1 minute	800,000 cpm	800,029 counts	800,015 counts
1 minute	200,000 cpm	199,978 counts	200,003 counts
1 minute	80,000 cpm	80,002 counts	79,997 counts
1 minute	20,000 cpm	20,000 counts	20,001 counts
1 minute	8,000 cpm	8,000 counts	7,999 counts
1 minute	2,000 cpm	2,000 counts	2,000 counts
1 minute	800 cpm	800 counts	800 counts
1 minute	200 cpm	200 counts	200 counts
1 minute	80 cpm	80 counts	80 counts
1 minute	20 cpm	20 counts	20 counts

All ranges calibrated electronically.

Local background (cpm) = **1 (α) 62 (β)**

Range Multiplier	Cal. Source Used (isotope and s/n)	Source Activity (dpm)	Instrument Reading (cpm)	4σ Instrument Efficiency (%)
1 min. count	Tb-230 #91TH4700001	33,000	9,961 (α)	30.18
1 min. count	Cl-36 #D700	23,598	9,147 (β)	38.50

Instrument indicates within ±10% of calibration points unless otherwise indicated. Source-to-detector entry window distance for efficiency determination is 1 cm unless otherwise specified. RSA Laboratories certifies that the above instrument has been calibrated with standards traceable to the National Institute of Standards and Technology, or have been derived from accepted values of natural physical constants, or have been derived by the ratio-type of calibration techniques.

RSA Laboratories ID# **23066**

Calibrated by: **Kurt D. Newton**

Date: **06 July 2022**

Scaler Chi-Squared (x2) Test Data Sheet

Scaler model	Lud-2929	Serial No.	329909	Calibration due date	
Detector model	43-10-1	Serial No.	PR362456		7/6/2023
α Source ID no.	Kr-368	βγ Source ID no.	D-526		
α Source isotope	Th-230	βγ Source isotope	CI-36		
α Source activity	77400	βγ Source activity	5000	dpm	
α Source diameter	47	βγ Source diameter	47	mm	
α Source assay date	5/23/2002	βγ Source assay date	12/11/1995		
Date performed	7/11/2022	Location performed at	CAWWT		

Chi-Squared (χ^2) Test							
Alpha				Beta			
n	x_i	$(x_i) - (\bar{x})$	$[(x_i) - (\bar{x})]^2$	n	x_i	$(x_i) - (\bar{x})$	$[(x_i) - (\bar{x})]^2$
1	24687	6.55	42.9	1	1860	-107.1	11470.4
2	24899	218.55	47764.1	2	1940	-27.1	734.4
3	24533	-147.45	21741.5	3	1938	-29.1	846.8
4	24747	66.55	4428.9	4	2031	63.9	4083.2
5	24644	-36.45	1328.6	5	1995	27.9	778.4
6	24783	102.55	10516.5	6	2025	57.9	3352.4
7	24836	155.55	24195.8	7	1990	22.9	524.4
8	24553	-127.45	16243.5	8	2034	66.9	4475.6
9	24780	99.55	9910.2	9	1942	-25.1	630.0
10	24587	-93.45	8732.9	10	1949	-18.1	327.6
11	24436	-244.45	59755.8	11	1849	-118.1	13947.6
12	24740	59.55	3546.2	12	2018	50.9	2590.8
13	24543	-137.45	18892.5	13	1962	-5.1	26.0
14	24630	-50.45	2545.2	14	1994	26.9	723.6
15	25051	370.55	137307.3	15	1969	1.9	3.6
16	24572	-108.45	11761.4	16	1999	31.9	1017.6
17	24806	125.55	15762.8	17	1961	-6.1	37.2
18	24385	-295.45	87290.7	18	1996	28.9	835.2
19	24704	23.55	554.6	19	1927	-40.1	1608.0
20	24693	12.55	157.5	20	1963	-4.1	16.8
Totals	493609	na	482479.0	Totals	39342	na	48029.8
$\bar{x} =$	24680.5	$\sigma =$	159.4	$\bar{x} =$	1967.1	$\sigma =$	50.3
$2\sigma =$	318.7	$3\sigma =$	478.1	$2\sigma =$	100.6	$3\sigma =$	150.8

Mean	Sigma
$\bar{x} = \frac{\sum x_i}{20}$	$\sigma = \sqrt{\frac{\sum (x_i - \bar{x})^2}{(n-1)}}$
Alpha Values	
mean +2σ =	24999.2
mean -2σ =	24361.7
mean +3σ =	25158.5
mean -3σ =	24202.4
Chi-squared range: 8.91 to 32.85	
$\chi^2 =$	19.5
Test result	Pass

Chi-Squared			
$\chi^2 = \frac{\sum (x_i - \bar{x})^2}{\bar{x}}$			
Beta Values			
mean +2σ =	2067.7	mean -2σ =	1866.5
mean +3σ =	2117.9	mean -3σ =	1816.3
Chi-squared range: 8.91 to 32.85			
$\chi^2 =$	24.4	Test result	Pass

Performed: _____
Printed Name and Signature

Date: _____

Reviewed: _____
Printed Name and Signature

Date: _____

Scaler Post-Calibration Test Data Sheet

Scaler model <u>Lud-2929</u>	Serial No. <u>329909</u>	Calibration due date
Detector model <u>43-10-1</u>	Serial No. <u>PR362456</u>	<u>7/6/2023</u>
α Source ID no. <u>Kr-368</u>	β-γ Source ID no. <u>D-526</u>	
α Source isotope <u>Th-230</u>	β-γ Source isotope <u>Cl-36</u>	
α Source activity <u>77400</u> dpm	β-γ Source activity <u>5000</u> dpm	
α Source diameter <u>47</u> mm	β-γ Source diameter <u>47</u> mm	
α Source assay date <u>5/23/2002</u>	β-γ Source assay date <u>12/11/1995</u>	
Date performed <u>7/11/2022</u>	Location performed at <u>CAWWT</u>	

Background Data

α Background counts <u>6</u> cts (20 min)	β-γ Background counts <u>757</u> cts (20 min)
α Background <u>0.30</u> cpm	β-γ Background <u>37.9</u> cpm

Scaler Efficiency

Alpha	Beta
20 minute source count <u>493609</u> cts	20 minute source count <u>39342</u> cts
Gross count rate <u>24680.5</u> cpm	Gross count rate <u>1967.1</u> cpm
Net count rate <u>24680.2</u> cpm	Net count rate <u>1929.3</u> cpm
Source activity <u>77400</u> dpm	Source activity <u>5000</u> dpm
Efficiency <u>0.32</u> cpm/dpm	Efficiency <u>0.39</u> cpm/dpm

Acceptable Source Range

Alpha	Beta
20 minute count <u>493609</u> cts	20 minute count <u>39342</u> cts
Gross count rate <u>24680.5</u> cpm	Gross count rate <u>1967.1</u> cpm
Net count rate <u>24680.2</u> cpm	Net count rate <u>1929.3</u> cpm

$\sigma = \sqrt{\frac{R_g}{1} + \frac{R_b}{20}}$	where: σ = standard deviation of the net count rate R _g = Gross count rate (cpm) R _b = background count rate (cpm)
--	--

Alpha σ <u>157.10</u> cpm	Beta-Gamma σ <u>44.37</u> cpm
---------------------------	-------------------------------

Alpha Acceptable Source Ranges (cpm)

1σ <u>24523</u>	to	<u>24837</u>
2σ <u>24366</u>	to	<u>24994</u>

Beta Acceptable Source Ranges (cpm)

1σ <u>1885</u>	to	<u>1974</u>
2σ <u>1841</u>	to	<u>2018</u>

Performed: _____
Printed name and signature

Date: _____

Reviewed: _____
Printed name and signature

Date: _____

Alpha Scaler Daily Check Data Sheet

Scaler model Lud-2929
 Detector model 43-10-1
 Month/year performed 7/2022

Serial no. 329909 Calibration due date
 Serial no. PR362456 7/6/2023
 Location performed at CAWWT

α Source ID no. Kr-368
 α Source isotope Th-230
 α Source activity 77400 dpm

Alpha source value (cpm) 24680.2

Alpha Acceptable Source Ranges (cpm)

1σ 24523 to 24837
 2σ 24366 to 24994

Date	Alpha Background Counts	Alpha Background cpm	Alpha Source Counts	Alpha Source cpm	Critical Value (dpm/100cm ²)	Daily Check Sat/Unsat	Initials
7/11/2022	6	0.30	24681	24681	2.9	Sat	LO
7/12/2022	6	0.30	24631	24631	2.9	Sat	LO
7/18/2022	4	0.20	24551	24551	2.4	Sat	LO
7/25/2022	4	0.20	24745	24745	2.4	Sat	LO
7/26/2022	6	0.30	24636	24636	2.9	Sat	LO
7/27/2022	6	0.30	24594	24594	2.9	Sat	LO
7/28/2022	7	0.35	24603	24603	3.1	Sat	LO

Reviewed: _____
Printed name and signature

Date: _____

Beta Scaler Daily Check Data Sheet

Scaler model Lud-2929
 Detector model 43-10-1
 Month/year performed 7/2022
 β-γ Source ID no. D-526
 β-γ Source isotope Cl-36
 β-γ Source activity 5000 dpm

Serial no. 329909 Calibration due date
 Serial no. PR362456 7/6/2023
 Location performed at CAWWT
 Beta source value (cpm) 1929.3
Beta Acceptable Source Ranges (cpm)
 1σ 1885 to 1974
 2σ 1841 to 2018

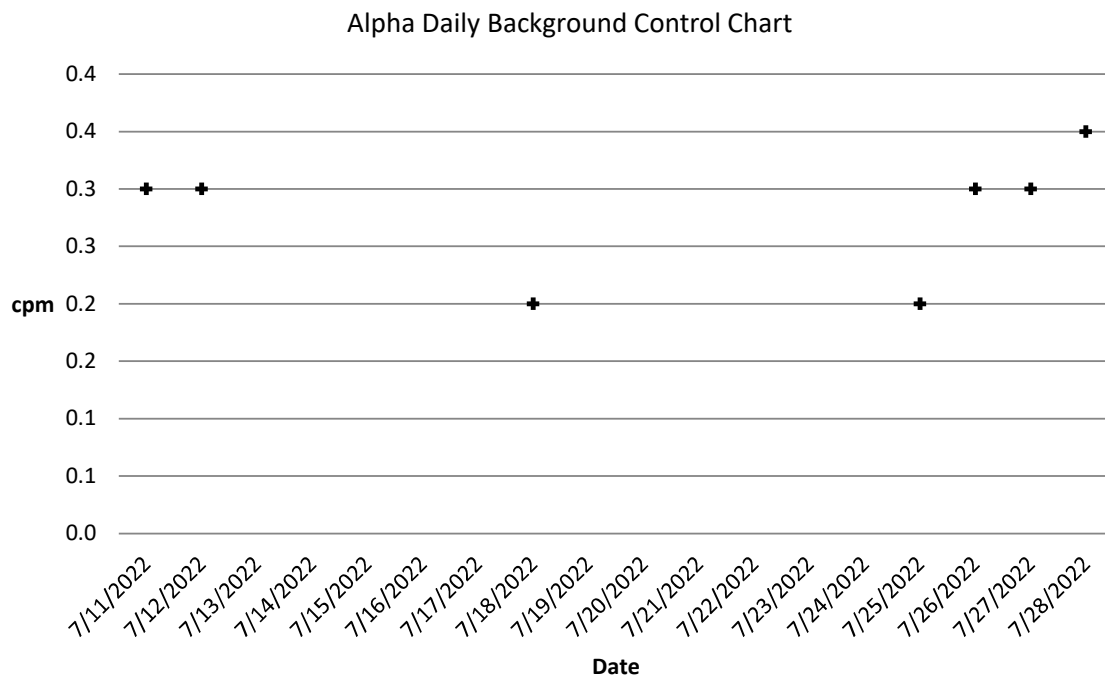
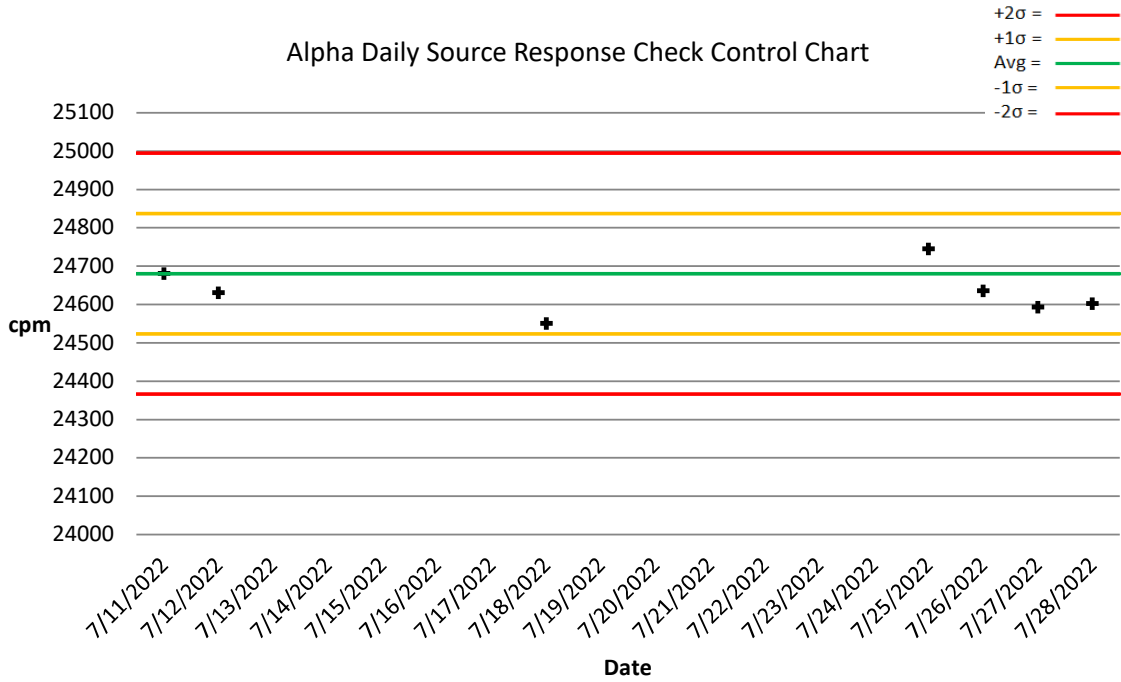
Date	Beta Background Counts	Beta Background cpm	Beta Source Counts	Beta Source cpm	Critical Value (dpm/100cm ²)	Daily Check Sat/Unsat	Initials
7/11/2022	757	38	1967	1929	27	Sat	LO
7/12/2022	773	39	1981	1942	27	Sat	LO
7/18/2022	734	37	1983	1946	26	Sat	LO
7/25/2022	690	35	1952	1918	26	Sat	LO
7/26/2022	787	39	1915	1876	27	Sat	LO
7/27/2022	770	39	1935	1897	27	Sat	LO
7/28/2022	738	37	1954	1917	27	Sat	LO

Reviewed: _____ Date: _____
Printed name and signature

Alpha Daily Source & Background Control Charts

Scaler Model Lud-2929
 Detector Model 43-10-1
 Month and Year 7/2022
 α Source ID No. Kr-368
 α Source Isotope Th-230
 α Source Activity 77400 dpm

Serial No. 329909 Calibration Due Date 7/6/2023
~~PK30243~~
 Serial No. 6
 Alpha Source Value (cpm) 24680.2
 Alpha Acceptable Source Ranges (cpm)
 1 σ 24523 to 24837
 2 σ 24366 to 24994



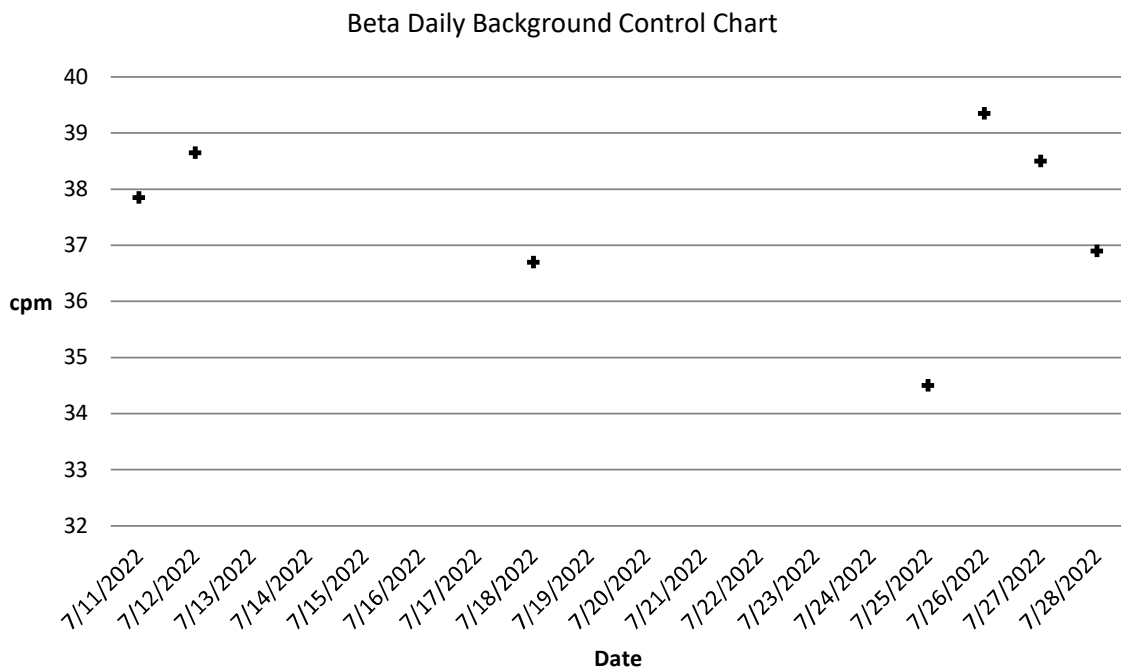
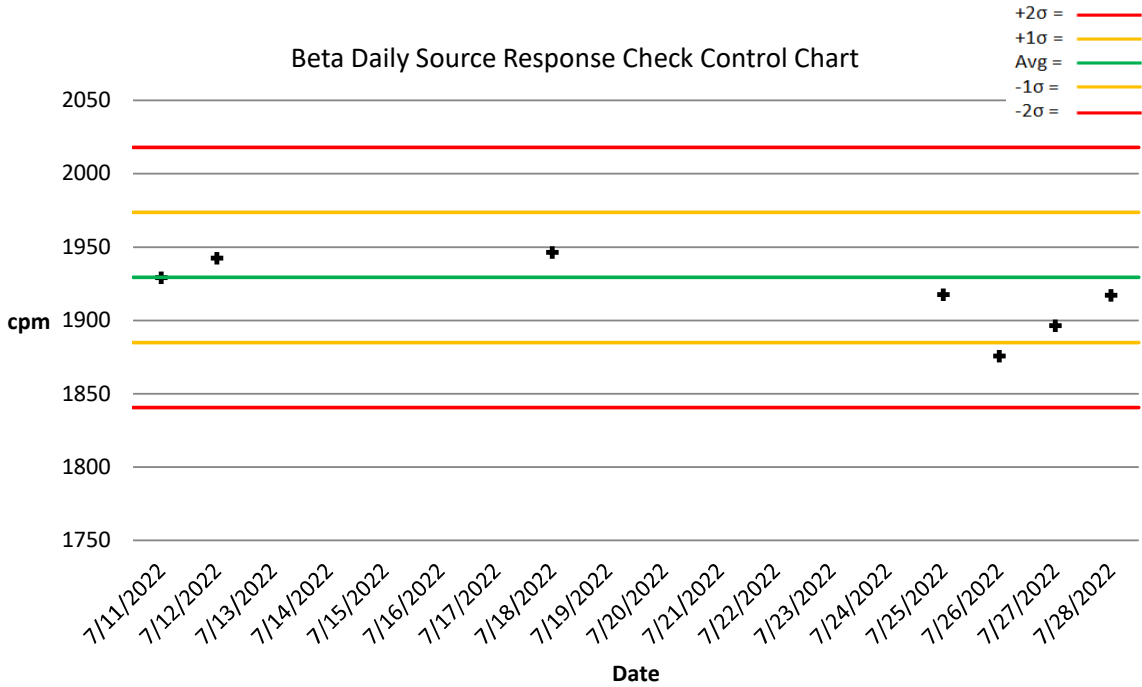
Reviewed: _____
Printed Name and Signature

Date: _____

Beta Daily Source & Background Control Charts

Scaler Model Lud-2929
 Detector Model 43-10-1
 Month and Year 7/2022
 β - γ Source ID No. D-526
 β - γ Source Isotope Cl-36
 β - γ Source Activity 5000 dpm

Serial No. 329909 Calibration Due Date
 Serial No. ~~PK30243~~ 7/6/2023
 Serial No. 6
 Beta Source Value (cpm) 1929.3
 Beta Acceptable Source Ranges (cpm)
 1 σ 1885 to 1974
 2 σ 1841 to 2018



Reviewed: _____
Printed Name and Signature

Date: _____