November 15, 2019

U.S. Nuclear Regulatory Commission
Nuclear Materials Licensing Section
Region III
2443 Warrenville Road
Lisle, IL 60532-4351

RE: Jubilant Draximage Radiopharmacies, Inc. d/b/a Triad Isotopes
RAM License #09-32781-04MD
3101 Terrace St
Kansas City, Missouri, 64111

Dear License Reviewer,

Please amend the above referenced radioactive material license to reflect the following modifications:

1. Please correct the State listed in the address for Condition 10B. The State should be Missouri not Kansas.

2. Please remove Condition 10A from our radioactive material license. We ceased operating a nuclear pharmacy at 712 Westport Rd., Kansas City, Missouri, 64111 on October 11, 2019.

   All of the radioactive materials handled at this facility location were relatively short-lived or extremely short-lived materials that are used in the practice of nuclear medicine. All radioactive materials and decayed waste materials have been removed from this facility location. The biomedical waste was disposed of through Stericycle Inc. All sealed sources were transferred to our 3101 Terrace Street, Kansas City, Missouri location. All nuclear pharmacy operations are now operated out of 3101 Terrace Street, Kansas City, Missouri, 64111.

   Enclosed please find a Final Status Survey Report which discusses the radiological data collected in conjunction with the final status surveys for the Jubilant DraxImage Radiopharmacies Inc. d/b/a Triad Isotopes Nuclear Pharmacy located at 712 Westport Road, Kansas City, MO 64111. Triad Isotopes contracted Ameriphysics, LLC (Ameriphysics) to perform the final status survey activities described in the attached report.

We are requesting an expedited review of this license amendment request so we may exit our lease as soon as possible per landlord request. All other items relating to our radioactive material license and established Radiation Safety Program remain unchanged at this time. We greatly appreciate your attention to this request. Please, forward the amended radioactive materials license to Jubilant Draximage Radiopharmacies Inc. d/b/a Triad Isotopes 790 Township Line Road, Suite 175, Yardley, PA 19067. Should you have specific questions about this amendment request, you may contact me at (407) 257-8998 or by email at craig.kinne@jubl.com

Sincerely,

Craig S. Kinne, CHP, MHP
Jubilant DraxImage Radiopharmacies Inc. d/b/a Jubilant Radiopharma Radiopharmacies Radiation Safety Officer
4205 Vineland Road, Suite L1
Orlando, Florida 32811
(407) 257-8998 (Cell)
(407) 455-6755 (Office)

Attachments

cc: *David Persinger, R.Ph – Staff Pharmacist/RSO*
Debra Rogers, MA - Paralegal, Licensing and Regulatory Coordinator
Jubilant Radiopharma Quality and Safety Department

Final Status Survey Report

1169-PR-001 Rev.0

Prepared for:

US Nuclear Regulatory Commission Radioactive Materials License Number 09-32781-04MD

Triad Isotopes – Kansas City Nuclear Pharmacy

712 Westport Road, Kansas City, MO 64111

November 1, 2019

Prepared by:

AMERIPHYSICS
9111 Cross Park Drive, Suite D200
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800.563.7497

RECORD OF REVISIONS

Change Number	Date	Description of Change	Approval
0	11/5/19	Initial Distribution	TJP

APPROVALS

Prepared By

Timothy Pratt — **Date** 11/5/2019

Review and Approval

Paul A. Jones — **Date** 11/5/2019

Contents

Abbreviations and Acronyms

ALARA	As Low as Reasonably Achievable
Ameriphysics	Ameriphysics, LLC
cpm	counts per minute
DCGL	Derived Concentration Guideline Level
dpm	disintegration per minute
DQO	Data Quality Objective
HSA	Historical Site Assessment
LBGR	Lower Bound of the Gray Region
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
MDC	Minimum Detectable Concentration
NRC	U.S. Nuclear Regulatory Commission
TEDE	Total Effective Dose Equivalent
y	Year

1. EXECUTIVE SUMMARY

The purpose of this Final Status Survey Report is to provide and discuss the radiological data collected in conjunction with the final status surveys for the Jubilant DraxImage d/b/a Triad Isotopes Nuclear Pharmacy located at 712 Westport Road, Kansas City, MO 64111. Triad Isotopes contracted Ameriphysics, LLC (Ameriphysics) to perform the final status survey activities described in this report. All work was accomplished under Triad Isotopes U. S. Nuclear Regulatory Commission (NRC) radioactive material license.

Final Status Surveys were developed using the guidance provided in NUREG-1757, "Consolidated Decommissioning Guidance" and NUREG-1575, "Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)" and provided the approach, methods, and techniques for the radiological surveys of the impacted areas of the facility. These methods ensure technically defensible data are generated to aid in determining compliance with the release criteria specified in Title 10 of the Code of Federal Regulations, Part 20, Subpart E, Radiological Criteria for License Termination, of 25 mrem/year.

Ameriphysics' personnel arrived onsite on October 22, 2019 and began preparing the remaining radioactive material for shipment to Triad Isotopes' new Kansas City pharmacy. The radioactive material was shipped on the morning of October 23, 2019. Following the removal of the radioactive material, Ameriphysics began performing the final status surveys.

This report demonstrates that building structural surfaces included in this report are significantly less than the release criterion of 25 mrem/y and are suitable to release for unrestricted use. Based on the results of the final status surveys, the maximum Total Effective Dose Equivalent (TEDE) to an individual is <0.0074 mrem/y. Final status survey results are described and tabulated more specifically in Section 8 of this report.

2. FACILITY DESCRIPTION

The Kansas City nuclear pharmacy is a single story reinforced concrete structure with concrete masonry block and brick infill.

2.1. Site Location and Facility Description

Figure 2-1 provides a satellite view of the Kansas City nuclear pharmacy location. The map was obtained online from Google. Figure 2-2 provides the floorplan of the Kansas City nuclear pharmacy.

Figure 2-1 – Location of Kansas City Nuclear Pharmacy

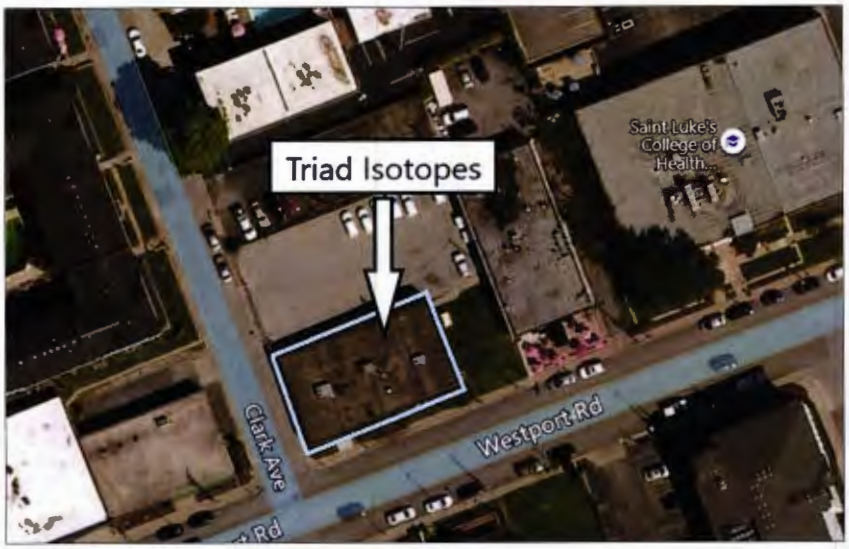
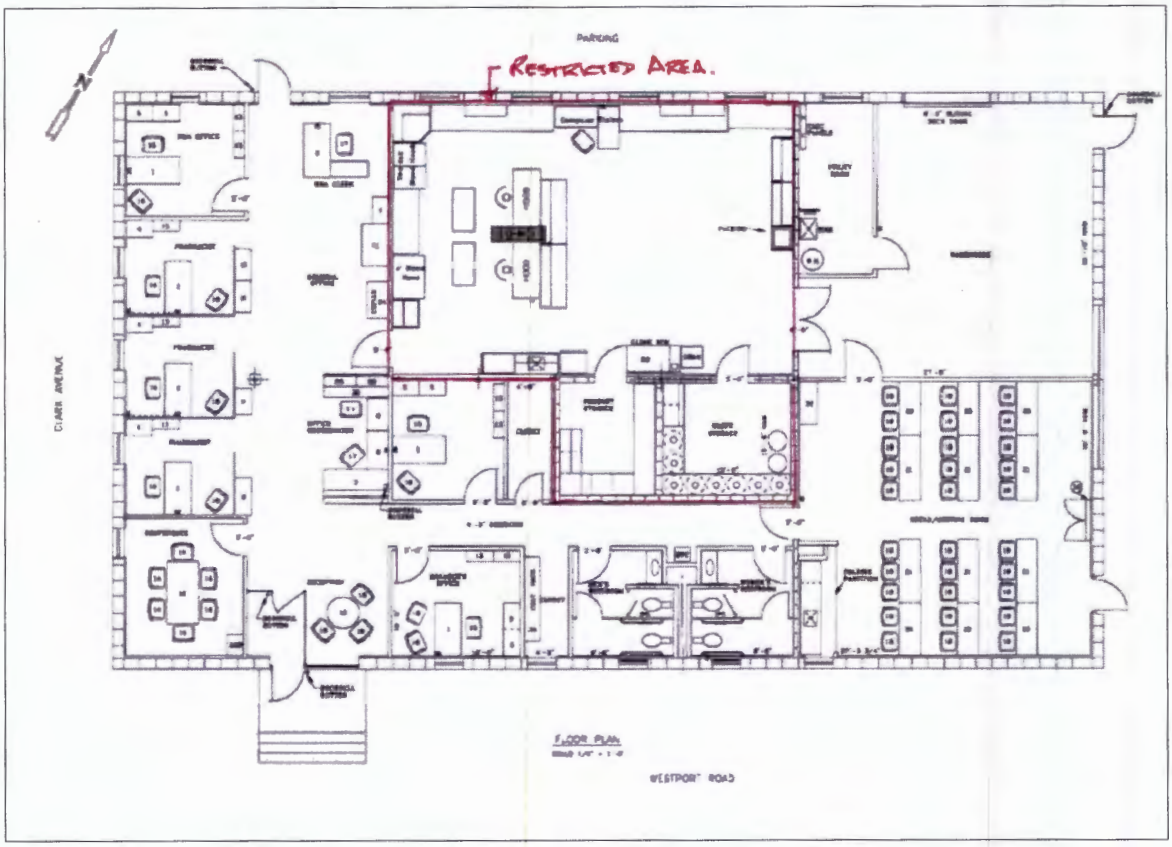


Figure 2-2 – Layout of the Kansas City Nuclear Pharmacy



3. LICENSE REVIEW AND HISTORICAL USE

The pharmacy is approximately 4,600 square feet and is located within a light industrial area in Kansas City, MO.

Radionuclides historically used in the Kansas City facility and their dates of last use are summarized in Table 3-1.

Table 3-1: Restricted and Non-Restricted Area Summary

Radionuclide	Half-Life	Approximate Date of Last use	Form
Cobalt-57[1]	270.9 Days	October 18, 2019	Sealed
Gallium-67	3.261 Days	October 18, 2019	Liquid
Strontium-89[2]	50.55 Days	December 2015	Liquid
Yttrium-90	64.1 Hours	October 18, 2019	Liquid
Molybdenum-99	66.02 Hours	October 18, 2019	Liquid
Technetium-99m	6.02 Hours	October 18, 2019	Liquid
Indium-111	2.83 Days	October 18, 2019	Liquid
Iodine-123	13.13 Hours	October 18, 2019	Liquid/Solid
Iodine-125[2]	60.14 Days	December 2014	Liquid
Iodine-131	8.040 Days	October 18, 2019	Liquid/Solid
Barium-133[1]	10.5 Years	October 18, 2019	Sealed
Xenon-133	5.245 Days	October 18, 2019	Gas
Cesium-137[1]	30.17 Years	October 18, 2019	Sealed
Europium-152[1]	13.6 Years	October 18, 2019	Sealed
Samarium-153	46.7 Hour	October 18, 2019	Liquid
Thallium-201	73.06 Hours	October 18, 2019	Liquid

[1]Denotes Sealed Sources

[2]These radionuclides may be removed from the list because they have fully decayed (over 10 half-lives) since last use.

Procedures pertaining to radiological use within the laboratory were well maintained. All sealed sources were leak tested every six months and there is no history of any leaking sealed sources at the facility. Therefore, the sealed sources listed in Table 3-1 can be eliminated as radionuclides of concern.

Of the radionuclides used in dispersible forms listed in Table 3-1, all are currently in use except for Sr-89 and I-125. These exceptions can be eliminated as radionuclides of concern based on their half-lives and date of last use. This report summarizing the surveys will be submitted to the NRC approximately three weeks following the completion of the surveys. This would result in approximately five weeks from the time operations have ceased and provide ample decay time (>10 half-lives) to eliminate most of the remaining radionuclides of concern with shorter half-

lives: Ga-67, Y-90, Mo-99, Tc-99m, In-111, I-123, Sm-153, and Tl-201. All that could possibly remain by the time the NRC receives this report would be I-131 and Xe-133.

4. PROJECT RELEASE CRITERIA

Radiological requirements for license termination are described Title 10 of the Code of Federal Regulations, Part 20, Subpart E, Radiological Criteria for License Termination, which states that a site will be considered acceptable for unrestricted release if the residual radioactivity that is distinguishable from background radiation results in a total effective dose equivalent (TEDE) to an average member of the critical group that does not exceed 25 millirem per year (mrem/y), and the residual radioactivity has been reduced to levels that are as low as reasonably achievable (ALARA).

Because the release criterion must consider dose from a variety of exposure pathways, it cannot be measured directly. Consequently, exposure pathway modeling is used to translate the release criterion into concentration limits. MARSSIM uses the term derived concentration guideline level (DCGL) to describe the radionuclide-specific activity concentration that could result in a dose equal to the release criterion. DCGL for this project was calculated using the NRC DandD Modeling Code, version 2.1.0. The code was used with default parameters to determine a DCGL for I-131 corresponding to a 25 mrem/y limit. The DandD summary report is provided in Attachment 1 of this plan. Table 6-1 shows the DCGL for this project.

DCGLs reflect total residual radioactivity concentration and assume that 10% of the total activity is removable. Table 4-1 shows the project DCGL and the removal contamination limit for this project.

Table 4-1: Facility Release Criteria

Radionuclide	Half-life	Predominant Emissions	DCGL ($dpm/100cm^2$)	Removable Contamination Limit ($dpm/100cm^2$)
Iodine-131	8.04 Days	Beta	1.18E+06	1.18E+05
Xe-133	5.245 Days	Beta	N/A[1]	N/A

[1] Xe-133 is not listed in DandD Version 2.1.0. Nor is it listed in the RESRAD Build code.

Xe-133 is a noble gas and due to its short half-life and low radiotoxicity, it stands to reason that it would have higher DCGL than I-131. It is therefore conservative to use the I-131 DCGL as the project release criterion.

5. SURVEY INSTRUMENTATION

Based on potential contaminants, their associated radiations, and the types of residual contamination categories to be evaluated, the detection sensitivities of various instruments and techniques were evaluated for use. Instruments were evaluated for use during surface scans, direct measurements, and analysis of removable contamination smears.

5.1. Instrument Calibration

Laboratory and portable field instruments were calibrated at least annually with National Institute of Standards and Technology traceable sources and to radiation emission types and energies that provide detection capabilities similar to the nuclides of concern. Instrument calibration certificates are provided for the instruments used during the decommissioning surveys in Attachment 2.

5.2. Daily Response Checks

For radiological instruments operated by Ameriphysics, a reference source was measured prior to use each day. The result is accurate if it falls within ±20% of originally determined values. This is consistent with the guidance in Section 6.5.4 of MARSSIM, Instrument Calibration.

Background readings are taken as part of the daily response checks and compared with the acceptance range for instrument and site conditions.

All instruments passed daily response tests within ±20% of originally determined values.

5.3. Determination of Counting Times and Minimum Detectable Concentrations

Minimum counting times for background determinations and counting times for measurement of total and removable contamination were chosen to provide minimum detectable concentrations (MDCs) that meet the Data Quality Objectives (DQOs). Count times and scanning rates are determined using the equations in the following sections.

5.3.1. Static Counting

Static counting MDC at a 95% confidence level is calculated using the following equation, which is an expansion of NUREG 1507, "Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions", Table 3.1 (Strom & Stansbury, 1992):

$$MDC_{static} = \frac{3 + 3.29\sqrt{B_r \cdot t_s \cdot (1 + \frac{t_s}{t_b})}}{t_s \cdot E_{tot} \cdot \frac{A}{100cm^2}}$$

Where:

MDC_{static} = minimum detectable concentration level in dpm/100cm^2
B_r = background count rate in counts per minute
t_b = background count time in minutes
t_s = sample count time in minutes
E_{tot} = total detector efficiency for radionuclide emission of interest (includes combination of instrument efficiency and surface efficiency)[1]
A = detector probe area in cm^2

[1]. Surface efficiency applied will be in accordance with the recommended value of 0.5 for all beta emitters with eMax >400keV.

Using the background rate of 346 counts per minute (cpm) (highest background rate among the surveys performed using the Ludlum 43-93 detector) and a surface efficiency of 0.5, the calculated MDC_{static} is 530 dpm/100cm^2. Lower background rates result in lower MDC values. See Attachment 5 for MDC_{static} calculations.

5.3.2. Ratemeter Scanning

Scanning MDC at a 95% confidence level is calculated using the following equation which is a combination of MARSSIM equations 6-8, 6-9, and 6-10:

$$MDC_{scan} = \frac{d'\sqrt{b_i}\left(\frac{60}{i}\right)}{\sqrt{p} \cdot E_{tot} \cdot \frac{A}{100cm^2}}$$

Where:

MDC_{scan} = minimum detectable concentration level in dpm/100 cm^2
d' = desired performance variable (1.38)
b_i = background counts during the residence interval
i = residence interval
p = surveyor efficiency (0.5)
E_{tot} = total detector efficiency for radionuclide emission of interest (includes combination of instrument efficiency and surface efficiency[1])
A = detector probe area in cm^2

[1]. Surface efficiency applied will be in accordance with the recommended value of 0.5 for all beta emitters with eMax >400keV.

Using the background rate of 346 cpm (highest background rate among the surveys performed using the Ludlum 43-93 detector) and a surface efficiency of 0.5, the calculated MDC_{scan} is 1,664 dpm/100cm^2. Lower background rates result in lower MDC values. Using the background rate of 748 cpm (background rate among the surveys performed using the Ludlum 43-37 large area detector) and a surface efficiency of 0.5, the calculated MDC_{scan} is 389 dpm/100cm^2. See Attachment 5 for MDC_{scan} calculations.

5.3.3. Removable Contamination Measurement Counting

Removable contamination measurement (smear) counting MDC at a 95% confidence level is calculated using the following equation, which is NUREG 1507, "Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions", Table 3.1 (Strom & Stansbury, 1992):

$$MDC_{smear} = \frac{3 + 3.29\sqrt{B_r \cdot t_s \cdot (1 + \frac{t_s}{t_b})}}{t_s \cdot E \cdot \frac{A}{100cm^2}}$$

Where:

MDC_{smear}	= minimum detectable concentration level in dpm/smear
B_r	= background count rate in counts per minute
t_b	= background count time in minutes
t_s	= sample count time in minutes
E	= 4π instrument efficiency for radionuclide emission of interest
A	= physical area of the smear in cm^2

Using the background rate of 61 cpm (background rate for the surveys performed using the Ludlum 3030E/43-10-1 detector) the calculated MDC_{smear} is 151 dpm/100cm^2. See Attachment 5 for MDC_{smear} calculations.

5.4. Instrumentation Specifications

The instrumentation used for facility final status surveys is summarized in the following tables. Table 5-1 lists the standard features of each instrument such as probe size and efficiency. Table 5-2 lists the actual operational parameters such as scan rate, count time, and the associated MDCs.

Table 5-1 - Instrumentation Specifications

Detector Model	Detector Type	Detector Area	Meter Model	Window Thickness	Actual Total Efficiency[1]
Ludlum 43-93	Alpha/Beta Scintillation	100 cm^2	Ludlum 2360	0.8 mg/cm^2	16.90 % (Tc-99) – Beta
Ludlum 43-10-1	Alpha/Beta Scintillation	100 cm^2	Ludlum 3030	0.4 mg/cm^2	26.00% (Tc-99) – Beta
Ludlum 43-37	Alpha/Beta Scintillation	584 cm^2	Ludlum 2360	0.8 mg/cm^2	18.21% (Tc-99) – Beta
Ludlum 44-17	Low Energy Gamma Scintillation	17.8 cm^2	Ludlum 2221	43 mg/cm^2	22% - I-129 – Gamma[2] 41% - I-125 – Gamma[2]

[1]The surface efficiency of 0.5 was used since the I-131 predominant beta is 606.3 keV E_{MAX}.
[2]Typical efficiencies from Ludlum Specification Sheet.

Table 5-2 –Instrument Operating Parameters and Sensitivities

Measurement Type	Detector Model	Meter Model	Scan Rate	Count Time	Background (cpm)	MDC ($dpm/100cm^2$)
Surface Scans	43-93	Ludlum 2360	7 cm/sec.	N/A	346	1,664 – Beta
Total Surface Activity	43-93	Ludlum 2360	N/A	60 sec.	346	530 – Beta
Surface Scans	43-37	Ludlum 2360	13.4 cm/sec.	N/A	748	389 – Beta
Removable Beta Activity	43-10-1	Ludlum 3030	N/A	60 sec.	61	151 – Beta
Gamma Surface Scans	44-17	Ludlum 2221	0.25 m/sec.	60 sec.	1,436	N/A[1]

[1]Instrument was used for comparison the background only.

5.5. Background Determination

The use of reference background areas or paired background comparisons was not necessary for the purposes of this plan because the release criteria were sufficiently higher than the ambient background. An ambient background measurement taken at waist level in the center of the non-restricted area was used for all of the survey units except for those used for bare concrete. A bare concrete background was obtained from bare concrete in the unrestricted area. The background values were subtracted from the applicable gross measurement count rates (in cpm) to determine the net measurement count rates.

6. SCOPING / CHARACTERIZATION SURVEYS

During initial scans in the unrestricted area (with the Ludlum 43-37 floor monitor), the technician found elevated activity on the carpet adjacent to the entrance to the restricted area. The Ludlum 43-93 hand-held detector was used to isolate and quantify the contamination at 22,142 dpm/100 cm^2. The surrounding area was 100% scan surveyed with the floor monitor. No additional contamination was identified. However, the areas around the doorway was upgraded from

Impacted – Class 3 to Impacted – Class 1 (see Section 7.2). The contamination at this location was decontaminated using a simple tape press.

Once it was determined there was no more contamination in the unrestricted area, the floor monitor was brought into the restricted area. Contamination was found on the floors of the restricted area Main Lab at an additional nineteen locations. These locations were isolated and total activity (static) measurements were performed with the Ludlum 43-93. The total activity ranged between 3,402 – 412,870 dpm/100 cm^2. No removable contamination measurements were collected prior to decontamination. All locations were successfully decontaminated by either tape press, simple scrub/wipe down, and/or removal of the floor tile.

Following the decontamination efforts, a post decontamination survey was performed. The documentation of the pre and post decontamination surveys is provided in Attachment 3.

7. FINAL STATUS SURVEY DESIGN

Final status surveys were performed to demonstrate that residual radioactivity in each survey unit satisfied the predetermined criteria for release for unrestricted use. The final status survey was conducted using the DQO process described in MARSSIM.

Final status surveys were conducted by performing required scan surveys, total direct surveys, and removable contamination measurements. All survey data was documented on survey maps and associated data information sheets.

7.1. Data Quality Objectives

The process of designing a final status survey begins with development of DQOs. On the basis of these objectives and the known or anticipated radiological conditions at the site, the numbers and locations of measurement and sampling points used to demonstrate compliance with the release criterion are then determined. Finally, survey techniques appropriate to develop adequate data are selected and implemented.

Survey results obtained in accordance with the MARSSIM guidelines were used to select between one condition of the environment (the null hypothesis, H_0) and an alternative condition (the alternative hypothesis, H_a). The null hypothesis is treated like a baseline condition that is assumed to be true in the absence of strong evidence to the contrary. Acceptance or rejection of the null hypothesis depends upon whether or not the particular survey results are consistent with the hypothesis.

A decision error occurs when the decision maker rejects the null hypothesis when it is true, or accepts the null hypothesis when it is false. These two types of decision errors are classified as Type I and Type II decision errors.

A Type I decision error occurs when the null hypothesis is rejected when it is true, and is sometimes referred to as a false positive error. The probability of making a Type I decision error, or the level of significance, is denoted by alpha (α). Alpha reflects the amount of evidence the decision maker would like to see before abandoning the null hypothesis and is also referred to as the size of the test.

A Type II decision error occurs when the null hypothesis is accepted when it is false. This is sometimes referred to as a false negative error. The probability of making a Type II decision error is denoted by beta (β). The term ($1-\beta$) is the probability of rejecting the null hypothesis when it is false and is also referred to as the power of the test.

The null hypothesis for this decommissioning project is that the residual radioactivity concentrations exceed the release criterion. Acceptable decision error probabilities for testing the hypothesis are set at $\alpha = 0.05$ and $\beta = 0.05$.

7.2. Area Classification

Classification is a critical step in the survey design process. The working hypothesis of MARSSIM is that all impacted areas being evaluated for release have a potential for radioactive contamination above the DCGL. This initial assumption means that all areas are initially considered Class 1 areas unless some basis for reclassification as Class 2, Class 3 or non-impacted is provided. Consistent with this approach, Class 1 areas have the greatest potential for contamination and, therefore, receive the highest degree of survey effort, followed by Class 2 and then Class 3 areas.

Areas that have no reasonable potential for residual contamination do not need any level of survey coverage and are designated as non-impacted areas. These areas have no radiological impact from site operations and are typically identified during the Historical Site Assessment (HSA).

As discussed previously, impacted areas are areas that have some potential for containing contaminated material. They can be subdivided into three classes:

- Class 1 areas: Areas that have, or had prior to remediation, a potential for radioactive contamination or known contamination. Examples of Class 1 areas include site areas previously subjected to remedial actions, locations where leaks or spills are known to have occurred, former burial or disposal sites, waste storage sites, and areas with contaminants in discrete solid pieces of material high specific activity.
- Class 2 areas: These areas have, or had prior to remediation, a potential for radioactive contamination or known contamination, but are not expected to exceed the DCGL. To justify changing an area's classification from Class 1 to Class 2, the existing data (from the HSA, scoping surveys, or characterization surveys) should provide a high degree of confidence that no individual measurement would exceed the DCGL. Examples of areas that might be classified as Class 2 include locations where radioactive materials were present in an unsealed

form, potentially contaminated transport routes, upper walls and ceilings of rooms subjected to airborne radioactivity, areas where low concentrations of radioactive materials were handled, and areas on the perimeter of former contamination control areas.

- Class 3 areas: Any impacted areas that are not expected to contain any residual radioactivity or are expected to contain levels of residual radioactivity at a small fraction of the DCGL, based on site operating history and previous radiological surveys. Examples of areas that might be classified as Class 3 include buffer zones around Class 1 or Class 2 areas, and areas with very low potential for residual contamination but insufficient information to justify a non-impacted classification.

The floors and lower walls (< 2 meters) of the Main Production Lab classified were impacted Class 1. The floors and lower walls of the Waste Storage Room and Product Storage Room were classified as impacted Class 1. The floors and lower walls of the Unrestricted area office space adjacent to the west side of the restricted area were upgraded to a Class 1 due to the contamination that was found just outside the entry door to the Main Laboratory Area. The balance of the non-restricted area floors was classified as impacted Class 3. The balance of the facility, including the upper walls and ceilings in the restricted area, were classified as non-impacted. See Table 7-1 for a matrix demonstrating area-specific survey unit classifications.

7.3. Survey Unit Identification

A survey unit is a physical area consisting of structures or land areas of specified size and shape for which a separate decision is made as to whether or not that area exceeds the release criterion. As this decision is made as a result of the final status survey, the survey unit is the primary entity for demonstrating compliance with the release criterion. To facilitate survey design and ensure that the number of survey data points for a specific site is relatively uniformly distributed among areas of similar contamination potential, the site was divided into survey units that share a common history, other characteristics or that are naturally distinguishable from other portions of the site.

A survey unit should not include areas that have different classifications. The survey unit's characteristics should be consistent with exposure pathway modeling that is used to convert dose or risk into radionuclide concentrations. For indoor areas each room may be designated as a survey unit. Indoor areas may also be subdivided into several survey units of different classification, such as separating floors and lower walls from upper walls and ceilings (and other upper horizontal surfaces) or subdividing a large warehouse based on floor area.

The impacted areas at Kansas City nuclear pharmacy include the restricted areas and the unrestricted area. Final survey unit classifications are as follows:

Table 7-1: Final Survey Unit Classification

Survey Unit ID	Description	Approximate Area (m^2)	Initial Classification
SU 1	Main Laboratory Area - floor and lower walls	81 (floor) 163 (total)	Class 1 Impacted
SU 2	Waste Storage Room and Product Storage Room – floor and lower walls	20 (floor) 71 (total)	Class 1 Impacted
SU 3	Office Areas Outside of Laboratory Entrance.	76 (floor) 153 (total)	Upgraded to Class 1 Impacted
SU 4	Balance of Unrestricted area: Office and Reception Areas – floors only	250 (floor)	Class 3 Impacted

MARSSIM states that survey units should be limited in size based on classification, exposure pathway modeling assumptions, and site-specific conditions. MARSSIM also suggests size limitations, which for Class 1 structural surfaces is 100 m^2 or less (floor area). The Class 1 survey units are all less than the size recommendation of 100 m^2 (floor area). MARSSIM does not have a suggested limit for Class 3 survey units.

7.4. Beta and Gamma Scan Surveys

Scan surveys were performed for beta on 100% of the accessible surfaces in both Class 1 and Class 3 survey units. In addition, gamma scan surveys were performed on these surfaces for low energy gamma using a thin window sodium iodide detector (Ludlum 44-17). Although these low energy gamma surveys are not required for the I-131 or Xe-133 (since they are detectable by beta scans), these low energy gamma scans were performed for the short lived radionuclides that were not of concern (due to short half-lives) that could still have been present at the time of the surveys. Many of these decay by electron capture or isomeric transition and would not be detectable by the beta scans. Following the decontamination discussed in Section 6, no elevated activity exceeding background was detected during the beta or gamma scans.

7.5. Total Surface Activity Measurements

Direct beta surveys (static measurements) were performed on building surfaces to the extent practical in impacted areas utilizing instrumentation of the best geometry based on the surface at the survey location.

Total surface contamination measurements for gross beta were taken at statistically determined sample locations. Scaler count times are based on achieving detection sensitivity below the DCGL. In addition, total surface activity measurements were performed on the remaining ductwork

and/or sink drains in Survey Units 1 and 2. Surface activity measurements were collected in Survey Units 1 – 4 and the results are provided in the individual survey unit packages in Attachment 4.

7.6. Determining the Number of Sample Locations

For situations where the contaminant is not present in background or is present at such a small fraction of the DCGL as to be considered insignificant, a background reference area is not necessary. Instead, the contaminant levels are compared directly with the DCGL value. In these instances, a sample design according to the methodology specified for the -sample Sign test was used to statistically demonstrate compliance with the release criterion.

The lower bound of the gray region (LBGR) was selected to be one-half the DCGL and was used as an arbitrary starting point for developing an acceptable survey design along with target values of 0.05 for α and β. The width of the gray region, equal to DCGL minus the LBGR, is a parameter that is central to the Sign test. This parameter is also referred to as the shift, Δ.

The absolute size of the shift is actually of less importance than the relative shift, Δ/σ, where σ is an estimate of the standard deviation of the measured values in the survey unit. Values estimated for σ include both the real spatial variability in the quantity being measured and the precision of the chosen measurement system. The relative shift, Δ/σ, is an expression of the resolution of the measurements in units of measurement uncertainty.

The importance of choosing appropriate values for σ must be emphasized. If the value is grossly underestimated, the number of data points will be too few to obtain the desired power level for the test and a resurvey may be recommended. Therefore, in the interest of conservatism a larger value is selected even though the number of data points determined is increased.

Table 5.5 of MARSSIM provides the number of data points used to demonstrate compliance using the Sign test for selected values of α, β, and Δ/σ. The sample numbers in Table 5.5 of MARSSIM were calculated using the methodology presented in MARSSIM and increased by 20% to account for missing or unusable data.

Since an actual value for σ was not known, it was preliminarily assumed to be no more than 30 percent of the DCGL. This important assumption was confirmed by a post-survey analysis of σ. Using this estimate of σ, the relative shift is calculated using a LBGR of 50% of the DCGL (Δ = 1 x DCGL – 0.5 x DCGL). This calculation is shown below.

$$\text{Relative shift} = \frac{\Delta}{\sigma} = \frac{1 - 0.5}{0.3} = 1.6$$

The value extracted from the table using the expected site-specific parameters is 17 and represents the minimum number of measurements performed in each survey unit.

Based on the post survey analysis of the survey data, the initial assumptions of less than 50% of the DCGL for the LBGR and less than 30% of the standard deviation (σ) were confirmed (see Section 8.2). Thus, a sufficient number of measurements were collected.

7.7. Determination of Sampling Locations

Class 1 survey units were sampled using a random start, systematic grid system. After determining the number of samples needed in the survey unit, sample spacing was determined from MARSSIM equation 5-8:

$$L = \sqrt{\frac{A}{n}} \text{ for a square grid}$$

Where:

- L = sample spacing interval
- A = the survey unit area
- n = number of samples needed in the survey unit

Maps were generated of the survey unit's permanent surfaces included in the statistical tests (floors and lower walls,) and folded out in a 2-dimensional view. A random starting point was determined using computer-generated random numbers coinciding with the x and y coordinates of the total survey unit. A grid (based on the random start point and the determined sample spacing) was then plotted across the survey unit surfaces. A measurement location was then plotted at each intersection of the grid plot. This is automated using the Visual Sample Plan software.

For the Class 3 survey unit, sample locations were selected using a simple random selection process. Random X and a random Y distances were determined, and the locations were plotted on the map. This is automated using the Visual Sample Plan software.

7.8. Removable Contamination Measurements

Removable contamination measurements (smears) were collected on building surfaces at each total activity sample location to determine the potential removable contamination. An area of approximately 100 cm^2 was wiped.

7.9. Survey Documentation

A survey package was developed for each survey unit containing the following:

- Survey Instruction Sheets
- General survey requirements
- Instrument requirements with associated MDCs, count times and scan rates
- Survey Maps

- Overview maps detailing survey locations and placement methodology
- Survey sub-unit maps with additional sample location information, as needed
- Survey Data Sheets
- Signature of Data Collector and Reviewer

8. FINAL STATUS SURVEY RESULTS

Attachment 4 contains the survey packages executed in conjunction with the Final Status Survey.

8.1. Data Validation

Field data was reviewed and validated to ensure:

- Completeness of forms and that the type of survey was correctly assigned to the survey unit.
- The MDCs for measurements met the established data quality objectives; independent calculations were performed for a representative sample of data sheets and survey areas.
- Instrument calibrations and daily functional checks were performed accurately and at the required frequency.

8.2. Total Surface Activity Sample Results

The highest total activity measurement was obtained in Survey Unit 2 on a wall. The net result at this location was 485 dpm/100 cm^2 which is less than the static MDC of 530 dpm/100 cm^2 (background of 346 cpm). Since all of the other survey units had total activity results below this level, it can be determined that all surface activity survey units are in compliance with the release criterion.

In addition to simply comparing the data against the release criteria, basic statistical quantities were calculated for the data obtained from the survey units. First, the average and the standard deviation of the data set were calculated. The average of the data is compared to the DCGL to get a preliminary indication of the survey unit status. Where remediation is inadequate, this comparison would have readily revealed that a survey unit contains excess residual radioactivity even before applying statistical tests. However, if every measurement in the survey unit is below the DCGL, the survey unit clearly met the release criterion.

The value of the sample standard deviation is especially important. If the value was too large compared to that assumed during the survey design, this would have indicated an insufficient number of samples were collected to achieve the desired power of the statistical test.

The highest <u>average</u> activity was 263 dpm/100 cm^2 and the highest standard deviation was 313 dpm/100 cm^2. The total activity DCGL is 1,800,000 dpm/100 cm^2. This results in an average of 0.015% of the DCGL and a standard deviation of 0.02% of the DCGL. Since these values are

significantly less than the 50% for the LBGR and 30% for the standard deviation assumed during planning, a conservative number of measurements were made. See Section 7.5.

The median is the middle value of the data set when the number of data points is odd and is the average of the two middle values when the number of data points is even. Thus 50% of the data points are above the median, and 50% are below the median. Large differences between the average and the median are an early indication of skewness in the data. In all instances, the difference between the average and median is less than one standard deviation. Thus, the data is not unusually skewed.

Examining the minimum and maximum of the data also provides useful information. The range should not be unusually large. Since there are 30 or fewer data points, values of the range much larger than about 4 to 5 standard deviations are considered unusual. For larger data sets the range might be wider. In all cases, the difference between the minimum and maximum values is less than 5 standard deviations.

*Table 8-1: Summary of Total Surface Activity**

Survey Unit	Location	Minimum	Maximum	Median	Average	Standard Deviation
SU 1	Main Laboratory Area - floor and lower walls	-243	379	-68	-5	199
SU 2	Waste Storage Room and Product Storage Room – floor and lower walls	-485	485	24	109	313
SU 3	Office Areas Outside of Laboratory Entrance.	-462	408	53	-9	237
SU 4	Balance of Unrestricted area: Office and Reception Areas – floors only	118	450	23	263	114

Note: The results are reported in net dpm/100 cm^2.

8.3. Removable Contamination Results

Removable contamination results are summarized in Table 8-2. The highest removable contamination measurement is 42 dpm/100 cm^2 and was obtained in Survey Unit 2. This result is significantly less the removable MDC of 151 dpm/100 cm^2. The purpose of evaluating removable activity measurements is to ensure that they are less than 10% of the DCGL. Since this is the case in all instances, we can confirm that the model used to develop DCGLs was conservative.

*Table 8-2: Summary of Removable Contamination Results**

Survey Unit	Location	Minimum	Maximum	Median	Average	Standard Deviation
SU 1	Main Laboratory Area - floor and lower walls	-46	38	4	1	22
SU 2	Waste Storage Room and Product Storage Room – floor and lower walls	-58	42	13	1	31
SU 3	Office Areas Outside of Laboratory Entrance.	-58	27	0	-8	23
SU 4	Balance of Unrestricted area: Office and Reception Areas – floors only	-69	35	0	-7	26

*Results are in units of net dpm/100 cm^2

9. CONCLUSION

Attachment 4 contains the survey packages executed in conjunction with the Final Status Survey performed at the Kansas City nuclear pharmacy. The survey results are summarized in Tables 8-1 and Table 8-2.

No total activity surface measurements results exceeding the DCGL were observed. Survey Unit 2 returned the highest total surface activity average at 263 dpm/100 cm^2 which is below its corresponding MDC of 530 dpm/100 cm^2. Using the MDC value, which is <0.03% of the DCGL of 1,800,000 dpm/100cm^2 corresponding to <0.0074 mrem/y.

10. REFERENCES

1. Title 10 of the Code of Federal Regulations, Part 20, Subpart E, "Radiological Criteria for License Termination"
2. NUREG-1575, "Multi-Agency Radiation Survey and Site Investigation Manual" (MARSSIM)
3. NUREG-1505, "A Nonparametric Statistical Methodology for the Design and Analysis of Final Decommissioning Surveys"
4. NUREG 1507, "Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions"
5. NUREG 1757, Volume 1 "Consolidated NMSS Decommissioning Guidance," Appendix B
6. NUREG 1757, Volume 2 "Consolidated NMSS Decommissioning Guidance,"
7. Triad Isotopes Radioactive Materials License Number 09-32781-04MD, Amendment No. 10

Attachment 1
DandD Summary Report for I-131

DandD Building Occupancy Scenario

DandD Version: 2.1.0
Run Date/Time: 10/9/2019 11:42:32 AM
Site Name: Triad Isotopes - Kansas City
Description: DCGL for I-131 @ 25 mrem/y
FileName:C:\Users\tpratt\Documents\I-131 at 25 mrem.mcd

Options:

Implicit progeny doses NOT included with explicit parent doses
Nuclide concentrations are distributed among all progeny
Number of simulations: 100
Seed for Random Generation: 8718721
Averages used for behavioral type parameters

External Pathway is ON
Inhalation Pathway is ON
Secondary Ingestion Pathway is ON

Initial Activities:

Nuclide	Area of Contamination (m^2)	Distribution
131I	UNLIMITED	CONSTANT(dpm/100 cm**2)
Justification for concentration: DCGL Determination		Value 1.18E+06

Site Specific Parameters:

General Parameters:

None

Correlation Coefficients:

None

Summary Results:

90.00% of the 100 calculated TEDE values are < 2.46E+01 mrem/year .
The 95 % Confidence Interval for the 0.9 quantile value of TEDE is 2.43E+01 to 2.50E+01 mrem/year

Attachment 2
Instrument Calibration Certs

GRIFFIN INSTRUMENTS

CALIBRATION CERTIFICATE FOR 2360 SERIAL# 297744

Owner: AMERIPHYSICS

DATE: 04/03/19 **LOCATION:** Griffin Inst

TECH: E.M. Glenn **DATE LAST CAL EXPIRES:** 03/16/19

Reason For Calibration: (●) Due For Calibration ( ) Repair (See Remarks)

( ) Other (See Remarks) ( ) Due and Repair (See Remarks)

NIST TRACEABLE EQUIPMENT USED DURING CALIBRATION

MODEL: 500-2 **SERIAL #:** 284951 **CAL. DUE:** 10/03/19

☑ Audio Response ☑ Geotropism **CABLE LENGTH:** 5'

CONDITION: Sat **AF MECHANICAL ZERO:** 0 **AL MECHANICAL ZERO:** 0

NEW BATTERIES: ( ) Yes (●) No **BATTERY CHECK:** Sat

HV (+/-10%)	AS FOUND HV	AS LEFT HV	WINDOW SETTINGS:	A.F.	A.L.
500 V:	500	A.F.	BT (3.5 mV +/- 1 mV):	3.6	A.F.
1000 V:	1000	A.F.	BW (30 mV +/-3 mV):	29	A.F.
1500 V:	1500	A.F.	AT (120 mV +/-10 mV):	115	A.F.

RATE METER / SCALER

SCALE	RATE CPM	AS FOUND		% ERROR	AS LEFT	% ERROR	AS FOUND	% ERROR	AS LEFT	% ERROR
x.1 or x1	100	100		0.0%	A.F.					
	250	250		0.0%	A.F.		249	0.4%	A.F.	
	400	400		0.0%	A.F.					
x1 or x10	1000	1000		0.0%	A.F.					
	2500	2500		0.0%	A.F.					
	4000	4000		0.0%	A.F.					
x10 or x100	10K	10	K	0.0%	A.F.					
	25K	25	K	0.0%	A.F.					
	40K	40	K	0.0%	A.F.					
x100 or x1000	100K	100	K	0.0%	A.F.					
	250K	250	K	0.0%	A.F.					
	400K	400	K	0.0%	A.F.					

Is the As Found Data Within 20% of the Set Point?: (●) Yes ( ) No

Overload Light: ( ) Adjusted / Verified (●) Not Adj.

REMARKS:

Does Instrument Meet Final Acceptance Criteria?: (●) Yes ( ) No

Calibration Sticker Attached?: (●) Yes ( ) No

Date Instrument is Due For Next Calibration: 04/03/20

INSTRUMENT MARRIED WITH 43-37 **# PR160079**

Performed/Reviewed by: E.M. Glenn **Date:** 4/3/2019 **Entered by:** ____ Initials

Calibrations performed to ANSI N323A-1997 standards

Header 1: John Q. Public
Header 2: SN: 297744
Header 3: SN: PR160079
Header 4: Site: Bldg 1
Header 5: RM 008, S. Wall
Header 6: Comment
Location: Hello

Calibration Due Date: 04/03/2020
Model 2360 Date: 04/03/2019
Model 2360 Time: 08:21:01 AM

Logged Samples: 0

User PC Scaler Count Time: 6.0 minutes

Alpha Ratemeter Alarm Setpoint:	999999
Beta Ratemeter Alarm Setpoint:	999999
Alpha + Beta Ratemeter Alarm Setpoint:	999999
Alpha Scaler Alarm Setpoint:	999999
Beta Scaler Alarm Setpoint:	999999
Alpha + Beta Scaler Alarm Setpoint:	999999

GRIFFIN INSTRUMENTS

CALIBRATION CERTIFICATE FOR 43-37 PROBE # PR160079

Owner: AMERIPHYSICS

DATE: 04/03/19 **LOCATION:** Griffin Inst

TECH: E.M. Glenn **DATE LAST CAL EXPIRES:** 03/16/19

REASON FOR CALIBRATION:

(●) Due For Calibration ( ) Repair (See Remarks) ( ) Other (See Remarks) ( ) Due and Repair

CABLE LENGTH: 5' **INPUT SENSITIVITY:** DUAL

NIST TRACEABLE EQUIPMENT AND STANDARDS USED DURING CALIBRATION

MODEL: 2360 **SERIAL #:** 297744 **CAL. DUE:** 04/03/20

NIST TRACEABLE SOURCES USED

Source Number	Isotope	4 pi Activity	Assay Date	2 pi Activity
P2-149	Tc99 SS	21,949 dpm	02/01/17	12,070 cpm
P2-152	Th230	22,166 dpm	02/01/17	11,190 cpm
2696-00	Pu239	18,500 dpm	12/02/09	9,370 cpm
2697-00	Sr90	12,200 dpm	03/01/00	8,530 cpm
PX-726	C14	48,780 dpm	01/21/08	18,660 cpm

Condition: (●) Sat ( ) Unsat

Efficiencies from last cal.:

Pu:		Th:	16.06%	Sr:	27.59%
Tc ss:	20.88%	C14:	13.17%	Tc Ni:	

As Found (AF) Efficiencies:

HV / Vernier:	Tc-99 Source Response Nickel (CPM):			Pu-239 Source Response (CPM):			Background (CPM):		Tc-99 Source Response Stainless Steel (CPM):		
	A ch.	B ch.	Net Eff.	A ch.	B ch.	Net Eff.	A ch.	B ch.	A ch.	B ch.	Net Eff.
1700 / N/A				3034	633	16.36%	7	447	3	4707	19.41%

Net A to B Xtalk: <10%	B to A Xtalk: <1%
5.8%	<1%

	Pu239	Tc99 Ni	Tc99 ss	Th-230	Sr90	C-14
AF CPM:	3034		4707	3446	2284	7093
AF 4 pi eff:	16.36%		19.41%	15.51%	23.84%	13.62%
AF 2 pi eff:	*32.31%*		*35.29%*	*30.73%*	*34.10%*	*35.62%*

Is as found efficiency within 20% of the efficiency from the last cal? (●) Yes ( ) No (See Remarks)

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

GRIFFIN INSTRUMENTS

PROBE #: PR160079
Date: 04/03/19

PLATEAU AND SET POINT DATA

HV / Vernier:	Tc-99 Source Response SS (CPM):			Pu-239 Source Response (CPM):			Background (CPM):		Net A to B Xtalk: <10%	B to A Xtalk: <1%
	A ch.	B ch.	Net Eff.	A ch.	B ch.	Net Eff.	A ch.	B ch.		
1675	2	4396	18.5%	2766	523	14.9%	1	342	6.1%	<1%
1700	1	4719	19.6%	2895	627	15.6%	2	414	6.9%	<1%
1725	4	4819	19.2%	3467	836	18.7%	3	606	6.2%	<1%
1750	2	4739	18.2%	3524	948	19.0%	3	743	5.5%	<1%

Alpha / Beta Bkg (cpm) 6 491

HV / Vernier		Pu-239	Tc-99 Ni	Tc-99 SS	Th-230	C-14	Sr-90
1710 / N/A	CPM:	3178		4886	3688	7092	2464
4 pi AL Efficiencies:		**17.15%**		**20.02%**	**16.61%**	**13.53%**	**25.61%**
2 pi AL Efficiencies:		***33.85%***		***36.41%***	***32.90%***	***35.38%***	***36.62%***

REMARKS:

Does Instrument Meet Final Acceptance Criteria?: (◉) Yes ( ) No

Calibration Sticker Attached?: (◉) Yes ( ) No

Date Instrument is Due For Next Calibration: **04/03/20**

INSTRUMENT MARRIED WITH **2360** **# 297744**

Performed/Reviewed by: E.M. Glenn **Date:** 4/3/2019 **Entered by:** ____ **Initials**

2 pi efficiencies denoted in italics.

Calibrations performed to ANSI N323A-1997 standards.

GRIFFIN INSTRUMENTS

CALIBRATION CERTIFICATE FOR 2360 SERIAL# 315452

Owner: AMERIPHYSICS

DATE: 04/03/19 **LOCATION:** Griffin Inst

TECH: E.M. Glenn **DATE LAST CAL EXPIRES:** 03/16/19

Reason For Calibration: (●) Due For Calibration ( ) Repair (See Remarks)

( ) Other (See Remarks) ( ) Due and Repair (See Remarks)

NIST TRACEABLE EQUIPMENT USED DURING CALIBRATION

MODEL: 500-2 **SERIAL #:** 284951 **CAL. DUE:** 10/03/19

[✓] Audio Response [✓] Geotropism **CABLE LENGTH:** 5'

CONDITION: Sat **AF MECHANICAL ZERO:** 0 **AL MECHANICAL ZERO:** 0

NEW BATTERIES: ( ) Yes (●) No **BATTERY CHECK:** Sat

HV (+/-10%)	AS FOUND HV	AS LEFT HV	WINDOW SETTINGS:	A.F.	A.L.
500 V:	500	A.F.	BT (3.5 mV +/- 1 mV):	3.3	3.5
1000 V:	1000	A.F.	BW (30 mV +/-3 mV):	28	30
1500 V:	1500	A.F.	AT (120 mV +/-10 mV):	115	120

RATE METER / SCALER

SCALE	RATE CPM	AS FOUND		% ERROR	AS LEFT	% ERROR	AS FOUND	% ERROR	AS LEFT	% ERROR
x.1 or x1	100	100		0.0%	A.F.					
	250	250		0.0%	A.F.		250	0.0%	A.F.	
	400	400		0.0%	A.F.					
x1 or x10	1000	1000		0.0%	A.F.					
	2500	2500		0.0%	A.F.					
	4000	4000		0.0%	A.F.					
x10 or x100	10K	10	K	0.0%	A.F.					
	25K	25	K	0.0%	A.F.					
	40K	40	K	0.0%	A.F.					
x100 or x1000	100K	100	K	0.0%	A.F.					
	250K	250	K	0.0%	A.F.					
	400K	400	K	0.0%	A.F.					

Is the As Found Data Within 20% of the Set Point?: (●) Yes ( ) No

Overload Light: (●) Adjusted / Verified ( ) Not Adj.

REMARKS:

Does Instrument Meet Final Acceptance Criteria?: (●) Yes ( ) No

Calibration Sticker Attached?: (●) Yes ( ) No

Date Instrument is Due For Next Calibration: 04/03/20

INSTRUMENT MARRIED WITH 43-93 **# PR323025**

Performed/Reviewed by: E.M. Glenn **Date:** 4/3/2019 **Entered by:** ____ Initials

Calibrations performed to ANSI N323A-1997 standards

Header 1: John Q. Public
Header 2: SN: 315452
Header 3: Det: PR323025
Header 4: Site: Bldg 1
Header 5: RM 008, S. Wall
Header 6: Comment
Location: Table 007

Calibration Due Date: 04/03/2020
Model 2360 Date: 04/03/2019
Model 2360 Time: 03:45:22 PM

Logged Samples: 0

User PC Scaler Count Time: 12.0 minutes

Alpha Ratemeter Alarm Setpoint:	999999
Beta Ratemeter Alarm Setpoint:	999999
Alpha + Beta Ratemeter Alarm Setpoint:	999999

Alpha Scaler Alarm Setpoint:	999999
Beta Scaler Alarm Setpoint:	999999
Alpha + Beta Scaler Alarm Setpoint:	999999

GRIFFIN INSTRUMENTS

CALIBRATION CERTIFICATE FOR 43-93 PROBE # PR323025

Owner: AMERIPHYSICS

DATE: 04/03/19 **LOCATION:** Griffin Inst
TECH: E.M. Glenn **DATE LAST CAL EXPIRES:** 03/16/19

REASON FOR CALIBRATION:

(●) Due For Calibration ( ) Repair (See Remarks) ( ) Other (See Remarks) ( ) Due and Repair

CABLE LENGTH: 5' **INPUT SENSITIVITY:** DUAL

NIST TRACEABLE EQUIPMENT AND STANDARDS USED DURING CALIBRATION

MODEL: 2360 **SERIAL #:** 315452 **CAL. DUE:** 04/03/20

NIST TRACEABLE SOURCES USED

Source Number	Isotope	4 pi Activity	Assay Date	2 pi Activity
P2-149	Tc99 SS	21,949 dpm	02/01/17	12,070 cpm
P2-152	Th230	22,166 dpm	02/01/17	11,190 cpm
2696-00	Pu239	18,500 dpm	12/02/09	9,370 cpm
2697-00	Sr90	12,200 dpm	03/01/00	8,530 cpm
PX-726	C14	48,780 dpm	01/21/08	18,660 cpm

Condition: (●) Sat ( ) Unsat

Efficiencies from last cal.:

Pu:		Th:	22.09%	Sr:	32.41%
Tc ss:	19.25%	C14:	9.88%	Tc Ni:	

As Found (AF) Efficiencies:

HV / Vernier:	Tc-99 Source Response Nickel (CPM):			Pu-239 Source Response (CPM):			Background (CPM):		Tc-99 Source Response Stainless Steel (CPM):		
	A ch.	B ch.	Net Eff.	A ch.	B ch.	Net Eff.	A ch.	B ch.	A ch.	B ch.	Net Eff.
800 / N/A				4358	550	23.52%	6	235	2	4413	19.04%

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

	Pu239	Tc99 Ni	Tc99 ss	Th-230	Sr90	C-14
AF CPM:	4358		4413	4815	2803	4832
AF 4 pi eff:	23.52%		19.04%	21.70%	33.33%	9.42%
AF 2 pi eff:	*46.45%*		*34.61%*	*42.98%*	*47.67%*	*24.64%*

Is as found efficiency within 20% of the efficiency from the last cal? (●) Yes ( ) No (See Remarks)

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

GRIFFIN INSTRUMENTS

PROBE #: PR323025
Date: 04/03/19

PLATEAU AND SET POINT DATA

HV / Vernier:	Tc-99 Source Response SS (CPM):			Pu-239 Source Response (CPM):			Background (CPM):		Net A to B Xtalk: <10%	B to A Xtalk: <1%
	A ch.	B ch.	Net Eff.	A ch.	B ch.	Net Eff.	A ch.	B ch.		
775	5	3705	16.0%	4278	343	23.1%	1	185	3.6%	<1%
800	5	4395	18.9%	4454	549	24.1%	0	256	6.2%	<1%
825	3	4686	20.2%	4411	772	23.8%	1	246	10.7%	<1%

Alpha / Beta Bkg (cpm) 0 254

HV / Vernier		Pu-239	Tc-99 Ni	Tc-99 SS	Th-230	C-14	Sr-90
800 / N/A	CPM:	4408		4333	4958	4869	2864
4 pi AL Efficiencies:		**23.83%**		**18.58%**	**22.37%**	**9.46%**	**33.87%**
2 pi AL Efficiencies:		***47.04%***		***33.79%***	***44.31%***	***24.73%***	***48.45%***

REMARKS: Cleaned screen and replaced mylar due to high alpha bkg as found.

Does Instrument Meet Final Acceptance Criteria?: (◉) Yes ( ) No

Calibration Sticker Attached?: (◉) Yes ( ) No

Date Instrument Is Due For Next Calibration: **04/03/20**

INSTRUMENT MARRIED WITH **2360** **# 315452**

Performed/Reviewed by: E.M. Glenn **Date:** 4/3/2019 **Entered by:** ____ **Initials**

2 pi efficiencies denoted in italics.

Calibrations performed to ANSI N323A-1997 standards.

GRIFFIN INSTRUMENTS

CALIBRATION CERTIFICATE FOR 3030E SERIAL# 328270

Owner: AMERIPHYSICS

DATE:	04/03/19	**LOCATION:**	Griffin Inst
TECH:	E.M. Glenn	**DATE LAST CAL EXPIRES:**	05/18/18

Reason For Calibration: (●) Due For Calibration ( ) Repair (See Remarks)

CABLE LENGTH: 39" ( ) Other (See Remarks) ( ) Due and Repair (See Remarks)

NIST TRACEABLE EQUIPMENT USED DURING CALIBRATION

MODEL:	500-2	**SERIAL #:**	284951	**CAL. DUE:**	10/03/19
MODEL:		**SERIAL #:**		**CAL DUE:**	

Condition: (●) Sat ( ) Unsat

AF Mechanical Zero: N/A

AL Mechanical Zero: N/A

Scaler Function Check	As Found	As Left		
Beta Channel Window (4-50 mV):	4-48	4-50		
Alpha Channel Window (175 mV, 120 for 3030):	110	120		
Alpha Counts w/Pulser @ 10,000 CPM:	9,966	A.F.	% Error:	0.3%
Beta Counts w/Pulser @ 10,000 CPM:	9,966	A.F.	% Error:	0.3%
HIGH VOLTAGE POWER SUPLY CAL. (2929 only)				
1 KV Reading (R-5 on HV Board):	1.025	1.0		
Max HV (1500 V +):	(●) Sat	( ) Unsat		

REMARKS:

Does Instrument Meet Final Acceptance Criteria?: (●) Yes ( ) No

Calibration Sticker Attached?: (●) Yes ( ) No

Date Instrument is Due For Next Calibration: **04/03/20**

INSTRUMENT MARRIED WITH 43-10-1 **# PR337591**

Performed/Reviewed by: E.M. Glenn EG/KP **Date:** 4/3/2019 **Entered by:** EG **Initials**

Calibrations performed to ANSI N323A-1997 standards.

Ludlum Measurements, Inc.
Model 3030 Parameters

4/3/2019
1:41:42 PM

Header 1: John Q Public
Header 2: Serial#328270
Header 3: DET#PR337591
Header 4: Room 7 EastWall
Header 5: More Comments?
Header 6: More Comments?

Calibration Due Date: 4/3/2020

Model 3030 Date: 4/3/2019
Model 3030 Time: 1:41:45 PM

Count Time Switch (min): 1.0
User PC Time (min): 2.0

Alpha Alarm: 999999
Beta Alarm: 999999
Alpha + Beta Alarm: 999999

High Voltage (VDC): 775

Loss of Count Time (min): 30.0

Count Mode: SCALER

Alpha Efficiency %: 34.6 - Th230 CB. 4-3-19
Beta Efficiency %: 26.0 - Tc 99

Background Subtract: OFF
Alpha Background: 0.0
Beta Background: 51.0

Crosstalk Correction: OFF
Alpha to Beta Crosstalk %: 4.9
Beta to Alpha Crosstalk %: 0.0

Show Parameters during startup: Enabled

Daily QC Check: OFF
Update Efficiency/Background Subtract from QC: SUB
Override QC Count Time: ON

Last Alpha Efficiency %: 35.1
Last Beta Efficiency %: 23.8

Standard Alpha Efficiency %: 30
Standard Beta Efficiency %: 27

Allowable Alpha QC Efficiency ± %: 20
Allowable Beta QC Efficiency ± %: 20

Alpha Source Size (dpm): 19584
Alpha Source Size (Bq): 326.4
Alpha Source Size (µCi): 0.00882162162

Beta Source Size (dpm): 25950
Beta Source Size (Bq): 432.5
Beta Source Size (µCi): 0.01168918919

Alpha QC Count Time (min): 1.0
Beta QC Count Time (min): 1.0
Background QC Count Time (min): 10.0

Last Alpha QC Background: 0.0
Last Beta QC Background: 0.3

Alpha Background Upper Limit (cpm): 3.0
Alpha Background Lower Limit (cpm): 0.0
Beta Background Upper Limit (cpm): 80.0
Beta Background Lower Limit (cpm): 0.0

Next Sample Number: FULL
User-defined Comment: AAAAAAAAAA
Logging Mode: Log All
Recycle Mode: OFF
Printer Mode: OFF

GRIFFIN INSTRUMENTS

CALIBRATION CERTIFICATE FOR 43-10-1 PROBE # PR337591

Owner: AMERIPHYSICS

DATE: 04/03/19 LOCATION: Griffin Inst

TECH: E.M. Glenn DATE LAST CAL EXPIRES: 05/18/18

REASON FOR CALIBRATION:

(◉) Due For Calibration ( ) Repair (See Remarks) ( ) Other (See Remarks) ( ) Due and Repair

CABLE LENGTH: 39" INPUT SENSITIVITY: DUAL

NIST TRACEABLE EQUIPMENT AND STANDARDS USED DURING CALIBRATION

MODEL: 3030E SERIAL #: 328270 CAL. DUE: 04/03/20

NIST TRACEABLE SOURCES USED

Source Number	Isotope	4 pi Activity	Assay Date	2 pi Activity
P2-149	Tc99 SS	21,949 dpm	02/01/17	12,070 cpm
P2-152	Th230	22,166 dpm	02/01/17	11,190 cpm
2696-00	Pu239	18,500 dpm	12/02/09	9,370 cpm
2697-00	Sr90	12,200 dpm	03/01/00	8,530 cpm
PX-726	C14	48,780 dpm	01/21/08	18,660 cpm

Condition: (◉) Sat ( ) Unsat

Efficiencies from last cal.:

Pu:		Th:	34.97%	Sr:	43.66%
Tc ss:	29.19%	C14:	14.96%	Tc Ni:	

As Found (AF) Efficiencies:

HV / Vernier:	Tc-99 Source Response Nickel (CPM):			Pu-239 Source Response (CPM):			Background (CPM):		Tc-99 Source Response Stainless Steel (CPM):		
	A ch.	B ch.	Net Eff.	A ch.	B ch.	Net Eff.	A ch.	B ch.	A ch.	B ch.	Net Eff.
750 / N/A				6927	416	37.44%	0	40	1	5701	25.79%

Net A to B Xtalk: <10%	B to A Xtalk: <1%
5.1%	<1%

	Pu239	Tc99 Ni	Tc99 ss	Th-230	Sr90	C-14
AF CPM:	6927		5701	7653	3350	7224
AF 4 pi eff:	37.44%		25.79%	34.53%	42.96%	14.73%
AF 2 pi eff:	*73.93%*		*46.90%*	*68.39%*	*61.44%*	*38.50%*

Is as found efficiency within 20% of the efficiency from the last cal? (◉) Yes ( ) No (See Remarks)

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

GRIFFIN INSTRUMENTS

PROBE #: PR337591
Date: 04/03/19

PLATEAU AND SET POINT DATA

HV / Vernier:	Tc-99 Source Response SS (CPM):			Pu-239 Source Response (CPM):			Background (CPM):		Net A to B Xtalk: <10%	B to A Xtalk: <1%
	A ch.	B ch.	Net Eff.	A ch.	B ch.	Net Eff.	A ch.	B ch.		
See attachment										

Alpha / Beta Bkg (cpm)		0	51				
HV / Vernier		**Pu-239**	**Tc-99 Ni**	**Tc-99 SS**	**Th-230**	**C-14**	**Sr-90**
775 / N/A	**CPM:**	6835		5758	7669	7337	3415
4 pi AL Efficiencies:		**36.95%**		**26.00%**	**34.60%**	**14.94%**	**43.66%**
2 pi AL Efficiencies:		***72.95%***		***47.28%***	***68.53%***	***39.05%***	***62.44%***

REMARKS:

Does Instrument Meet Final Acceptance Criteria?: (●) Yes ( ) No

Calibration Sticker Attached?: (●) Yes ( ) No

Date Instrument is Due For Next Calibration: **04/03/20**

INSTRUMENT MARRIED WITH **3030E** **# 328270**

Performed/Reviewed by: E.M. Glenn **Date:** 4/3/2019 **Entered by:** ____ **Initials**

2 pi efficiencies denoted in italics.

Calibrations performed to ANSI N323A-1997 standards.

Ludlum Measurements, Inc.
Model 3030 Plateau Data

4/3/2019
1:28:37 PM

Header 1: John Q Public
Header 2: Serial#328270
Header 3: DET#PR337591
Header 4: Room 7 EastWall
Header 5: More Comments?
Header 6: More Comments?

Calibration Due Date: 4/3/2020

Model 3030 Date: 4/3/2019
Model 3030 Time: 12:46:45 PM

User PC Time: 2.0

Alpha Isotope: Pu-239, # 2696-00, 12/02/2009
Alpha Source Size (dpm): 18500
Alpha Source Size (Bq): 308.33
Alpha Source Size (µCi): 0.008333333

Beta Isotope: Tc-99, #P2-149, 02/01/2017
Beta Source Size (dpm): 21949
Beta Source Size (Bq): 365.82
Beta Source Size (µCi): 0.009886937

Starting High Voltage: 650
Starting High Voltage: 850
High Voltage Increment: 25

Plateau Count Mode: SCALER
Source Count Time (min): 1.0
Background Count Time (min): 1.0

	ALPHA				BETA			
HV	Source (Beta)	Background	Eff	CrossTalk	Source (Alpha)	Background	Eff	Crosstalk
650	5997 (394)	0	32.4%	6.0%	3300 (1)	33	14.9%	0.0%
675	6478 (335)	0	35.0%	4.9%	3877 (0)	19	17.6%	0.0%
700	6518 (326)	0	35.2%	4.6%	4557 (0)	28	20.6%	0.0%
725	6631 (301)	0	35.8%	4.0%	4969 (0)	34	22.5%	0.0%
750	6998 (319)	0	37.8%	3.8%	5251 (0)	51	23.7%	0.0%
775 ←	6835 (385)	0	36.9%	4.9%	5758 (1)	51	26.0%	0.0%
800	7036 (715)	1	38.0%	9.4%	5951 (1)	56	26.9%	0.0%
825	6892 (866)	1	37.2%	11.2%	6044 (0)	94	27.1%	0.0%
850	6995 (999)	1	37.8%	12.0%	5906 (0)	158	26.2%	0.0%

Calibration Certificate for 2221,Serial # 183995, Bar Code # ,Property # SEC-5319

Date: 10/11/19 **Date Last Cal. Expires:** 05/08/20 **Technician:** Jacob Galyon

Location: 999999. **Reason For Calibration:** Due for Calibration

EQUIPMENT USED DURING CALIBRATION

MODEL: 500-2 **SERIAL #:** 268940 **CAL DUE:** 05/06/20

MODEL: **SERIAL #:** **CAL DUE:**

AS FOUND DATA Geotropism: SAT AS FOUND Instrument Condition: SAT AS LEFT Instrument Condition: SAT

HIGH VOLTAGE (+/- 10% tolerance)	AS FOUND HV	AS LEFT HV
500 V:	500 V	503 V
1000 V:	993 V	1000 V
1500 V:	1486 V	1496 V

☐ New Batteries? Threshold ratio: 100=10mV AF THRESHOLD: 10 mV AL THRESHOLD: 10 mV

AF Mechanical Zero: 0 AL Mechanical Zero: 0 AF HV Reading: 950 V AL HV Reading: 950 V

RATE METER

SCALE	RATE CPM	AS FOUND	% ERROR	AS LEFT	% ERROR
x.1 or x1	100	100	0.00%	AF	0.00%
	250	250	0.00%	AF	0.00%
	400	400	0.00%	AF	0.00%
x1 or x10	1000	1000	0.00%	AF	0.00%
	2500	2500	0.00%	AF	0.00%
	4000	4000	0.00%	AF	0.00%
x10 or x100	10K	10	0.00%	AF	0.00%
	25K	25	0.00%	AF	0.00%
	40K	40	0.00%	AF	0.00%
x100 or x1000	100K	100	0.00%	AF	0.00%
	250K	250	0.00%	AF	0.00%
	400K	400	0.00%	AF	0.00%

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

DIGITAL SCALER

AF 250: 250 % ERR: 0.00% AL 250: AF % ERR: 0.00%

AF 2500: 2498 % ERR: 0.08% AL 2500: AF % ERR: 0.08%

AF 25K: 24.98 K % ERR: 0.08% AL 25K: AF K % ERR: 0.08%

AF 250K: 249.8 K % ERR: 0.08% AL 250K: AF K % ERR: 0.08%

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

LOG SCALE

AF 200: 200 % ERR: 0.00% AL 200: AF % ERR: 0.00%

AF 2000: 2000 % ERR: 0.00% AL 2000: AF % ERR: 0.00%

AF 20K: 20 K % ERR: 0.00% AL 20K: AF K% ERR: 0.00%

AF 200K: 200 K % ERR: 0.00% AL 200K: AF K% ERR: 0.00%

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

REPRODUCIBILITY

x.1 or x1 Scale:	250	250	250
x1 or x10 Scale:	2500	2500	2500
x10 or x100 Scale:	25 K	25 K	25 K
x100 or x1000 Scale:	250 K	250 K	250 K

☑ Are the Individual Counts Within 10% of the Average?

Audio Response: SAT

Audio Divide: SAT

Push Buttons: SAT

Lamp: SAT

Scaler/Digital: SAT

☑ Fast / Slow Response Function Properly?

Comments: Married as a set with: Model: 44-17 Serial #: PR250869 Bar Code #:

☑ Does Instrument Meet Final Acceptance Criteria? ☑ Calibration Sticker Attached?

Date Instrument is Due For Next Calibration: 10/11/20

Performed by: Jacob Galyon Reviewed by: Date: 10/11/19

Printed Name: Jacob Galyon

All instrumentation is calibrated in accordance with the QAP to meet the criteria of ANSI N323AB-2013

Calibration Certificate for 44-17,Serial # PR250869, Bar Code # ,Property # SEC-6458

Date: 10/11/19 **Date Last Cal. Expires:** 03/30/18 **Technician:** Jacob Galyon
Location: 999999, **Reason For Calibration:** Due for Calibration

EQUIPMENT USED DURING CALIBRATION

MODEL: 2221 **SERIAL #:** 183995 **CAL DUE:** 10/11/20
MODEL: **SERIAL #:** **CAL DUE:**

NIST TRACEABLE SOURCES USED

SOURCE	ISOTOPE	ACTIVITY	2π	ASSAY DATE
728-36	Ba-133	0.2958 uCi		3/5/2018
99CS250-0288	Cs-137	5.9048 uCi		3/5/2018

Efficiency from Last Calibration: 1.85 % **HV From Last Calibration:** 950 V **Calibration Threshold:** 10 mV

AS FOUND DATA

AS FOUND Instrument Condition: SAT
HV: 950 V
Center: 11608
Background: 704
4 π Probe Efficiency: Ba-133 **1.66%**

1 MINUTE COUNTS (CPM)

AS LEFT DATA after repair of HV adjust

AS LEFT Instrument Condition: SAT
HV: 950 V
Center: 11608
Background: 704
4 π Probe Efficiency: Ba-133 **1.66%**

"AF" in the AL Efficiency fields means to refer to the AF Efficiencies in the AS FOUND DATA Section

☑ **Is the As Found Efficiency Within 20% of the efficiency from the last cal.?**

Reproducibility: **Isotope:** Ba-133 11595 11511 11343 **Average:** 11483 ☑ **Are the individual counts within 10% of the average?**

* If As Found Efficiency (even after repair) is within 10% of the last calibration and uniformity is <10%, the technician may N/A the Plateau Data and proceed to Comments. Geometry = NaI probes are 4 1/2" from source. All other probes are in contact with surface unless otherwise specified.

PLATEAU AND SET POINT DATA (CPM)

High Voltage	Source Response	Background	HV	CENTER	Background	4 π Efficiency	
N/A			950 V			Ba-133	
				23409	704	Cs-137	**0.17%**

Comments: **Married as a set with:** **Model:** 2221 **Serial #:** 183995 **Bar Code #:**

☑ **Does Instrument Meet Final Acceptance Criteria?** ☑ **Calibration Sticker Attached?**

Date Instrument is Due For Next Calibration: **10/11/20**

Performed by: Jacob Galyon **Reviewed by:** **Date:** 10/11/19
Printed Name: Jacob Galyon

All instrumentation is calibrated in accordance with the QAP to meet the criteria of ANSI N323AB-2013

Attachment 3
Scoping/Characterization Survey Reports

Ameriphysics, LLC
RC Program Form

Radiation Survey Record

Doc RCF 4-3 Date 3/11/2014 Rev # 1

AMERIPHYSICS	Project: Triad - KC	Project Number: 1169	Survey Area: Initial Contamination Survey	Survey Number: 1	Date: 10/22/2019 Time: 11:00	Page 1 of 2

Instrument	Serial Number	Detector	Serial Number	Cal. Due Date		2 PI Efficiency	4 PI Efficiency	Background	Units	MDC	Units
				Instrument	Detector						
Ludlum 26-1 Dose	PF007054	N/A	N/A	4/3/2020	N/A	N/A	N/A	0.01	mR/hr	N/A	N/A
Ludlum 3030E	328270	43-10-1	PR337591	4/3/2020	4/3/2020	N/A	26.00%	61	cpm	151	dpm
Ludlum 2360	315452	43-93	PR323025	4/3/2020	4/3/2020	N/A	16.90%	253	cpm	456	dpm
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Surveyor: Robert Hansen	Signature:	Reviewer: Tom Hansen III	Signature:

Total Activity Results

Item Number	Alpha		Beta-Gamma		Comments
	Gross CPM	Net DPM	Gross CPM	Net DPM	
1	N/A	N/A	3995	22142	See Below
2	N/A	N/A	1038	4645	See Below
3	N/A	N/A	4299	23941	See Below
4	N/A	N/A	975	4272	See Below
5	N/A	N/A	2347	12391	See Below
6	N/A	N/A	7042	40172	See Below
7	N/A	N/A	7172	40941	See Below
8	N/A	N/A	5813	32899	See Below
9	N/A	N/A	3735	20604	See Below
10	N/A	N/A	70028	412870	See Below
11	N/A	N/A	12202	70704	See Below
12	N/A	N/A	2011	10402	See Below
13	N/A	N/A	2747	14757	See Below
14	N/A	N/A	9430	54302	See Below
15	N/A	N/A	1167	5408	See Below
16	N/A	N/A	828	3402	See Below
17	N/A	N/A	39478	232101	See Below
18	N/A	N/A	18042	105260	See Below
19	N/A	N/A	1522	7509	See Below
20	N/A	N/A	4877	27361	See Below
N/A	N/A	N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A	N/A	N/A

Removable Activity Results

Item Number	Alpha		Beta-Gamma		Comments
	Gross CPM	Net DPM	Gross CPM	Net DPM	

N/A

Ameriphysics, LLC
RC Program Form

Radiation Survey Record

Doc RCF 4-3 Date 3/11/2014 Rev # 1

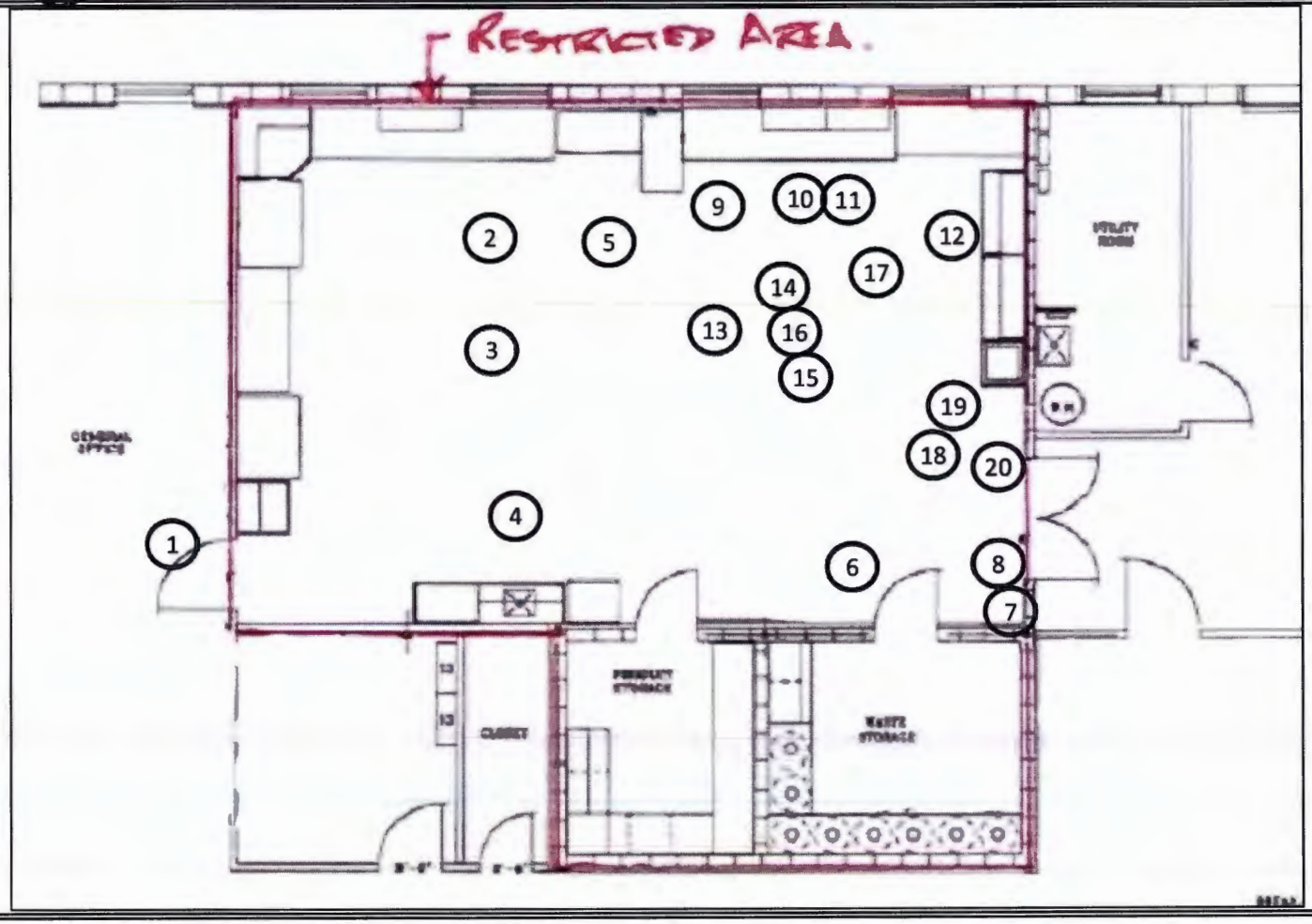
AMERIPHYSICS	Project:	Project Number:	Survey Area:	Survey Number:	Date:	Page 2 of 2
	Triad - KC	1169	Initial Contamination	1	10/22/2019	

Comments: No smears taken during initial findings of contaminated areas.

Contaminated areas were deconed using tape, and Triad transported decon materials to their new facility for decay and storage.

Post decon survey results are found on Survey #2.

smear location = #



Ameriphysics, LLC
RC Program Form

Radiation Survey Record

Doc RCF 4-3 Date 3/11/2014 Rev # 1

AMERIPHYSICS	Project: Triad - KC	Project Number: 1169	Survey Area: Clean Contamination Survey	Survey Number: 2	Date: 10/22/2019 Time: 14:30	Page 1 of 2

Instrument	Serial Number	Detector	Serial Number	Cal. Due Date		2 PI Efficiency	4 PI Efficiency	Background	Units	MDC	Units
				Instrument	Detector						
Ludlum 26-1 Dose	PF007054	N/A	N/A	4/3/2020	N/A	N/A	N/A	0.01	mR/hr	N/A	N/A
Ludlum 3030E	328270	43-10-1	PR337591	4/3/2020	4/3/2020	N/A	26.00%	61	cpm	151	dpm
Ludlum 2360	315452	43-93	PR323025	4/3/2020	4/3/2020	N/A	16.90%	346	cpm	530	dpm
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Surveyor: Robert Hansen	Signature:	Reviewer: Tom Hansen III	Signature:

Total Activity Results

Item Number	Alpha		Beta-Gamma		Comments
	Gross CPM	Net DPM	Gross CPM	Net DPM	
1	N/A	N/A	380	201	See Below
2	N/A	N/A	343	-18	See Below
3	N/A	N/A	372	154	See Below
4	N/A	N/A	399	314	See Below
5	N/A	N/A	359	77	See Below
6	N/A	N/A	410	379	See Below
7	N/A	N/A	409	373	See Below
8	N/A	N/A	394	284	See Below
9	N/A	N/A	411	385	See Below
10	N/A	N/A	370	142	See Below
11	N/A	N/A	351	30	See Below
12	N/A	N/A	361	89	See Below
13	N/A	N/A	415	408	See Below
14	N/A	N/A	371	148	See Below
15	N/A	N/A	359	77	See Below
16	N/A	N/A	323	-136	See Below
17	N/A	N/A	325	-124	See Below
18	N/A	N/A	334	-71	See Below
19	N/A	N/A	405	349	See Below
20	N/A	N/A	308	-225	See Below
N/A	N/A	N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A	N/A	N/A

Removable Activity Results

Item Number	Alpha		Beta-Gamma		Comments
	Gross CPM	Net DPM	Gross CPM	Net DPM	
1	N/A	N/A	70	35	See Below
2	N/A	N/A	64	12	See Below
3	N/A	N/A	66	19	See Below
4	N/A	N/A	56	-19	See Below
5	N/A	N/A	61	0	See Below
6	N/A	N/A	53	-31	See Below
7	N/A	N/A	50	-42	See Below
8	N/A	N/A	72	42	See Below
9	N/A	N/A	53	-31	See Below
10	N/A	N/A	69	31	See Below
11	N/A	N/A	62	4	See Below
12	N/A	N/A	56	-19	See Below
13	N/A	N/A	62	4	See Below
14	N/A	N/A	49	-46	See Below
15	N/A	N/A	61	0	See Below
16	N/A	N/A	66	19	See Below
17	N/A	N/A	55	-23	See Below
18	N/A	N/A	54	-27	See Below
19	N/A	N/A	59	-8	See Below
20	N/A	N/A	55	-23	See Below
N/A	N/A	N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A	N/A	N/A

Ameriphysics, LLC
RC Program Form

Radiation Survey Record

Doc RCF 4-3 Date 3/11/2014 Rev # 1

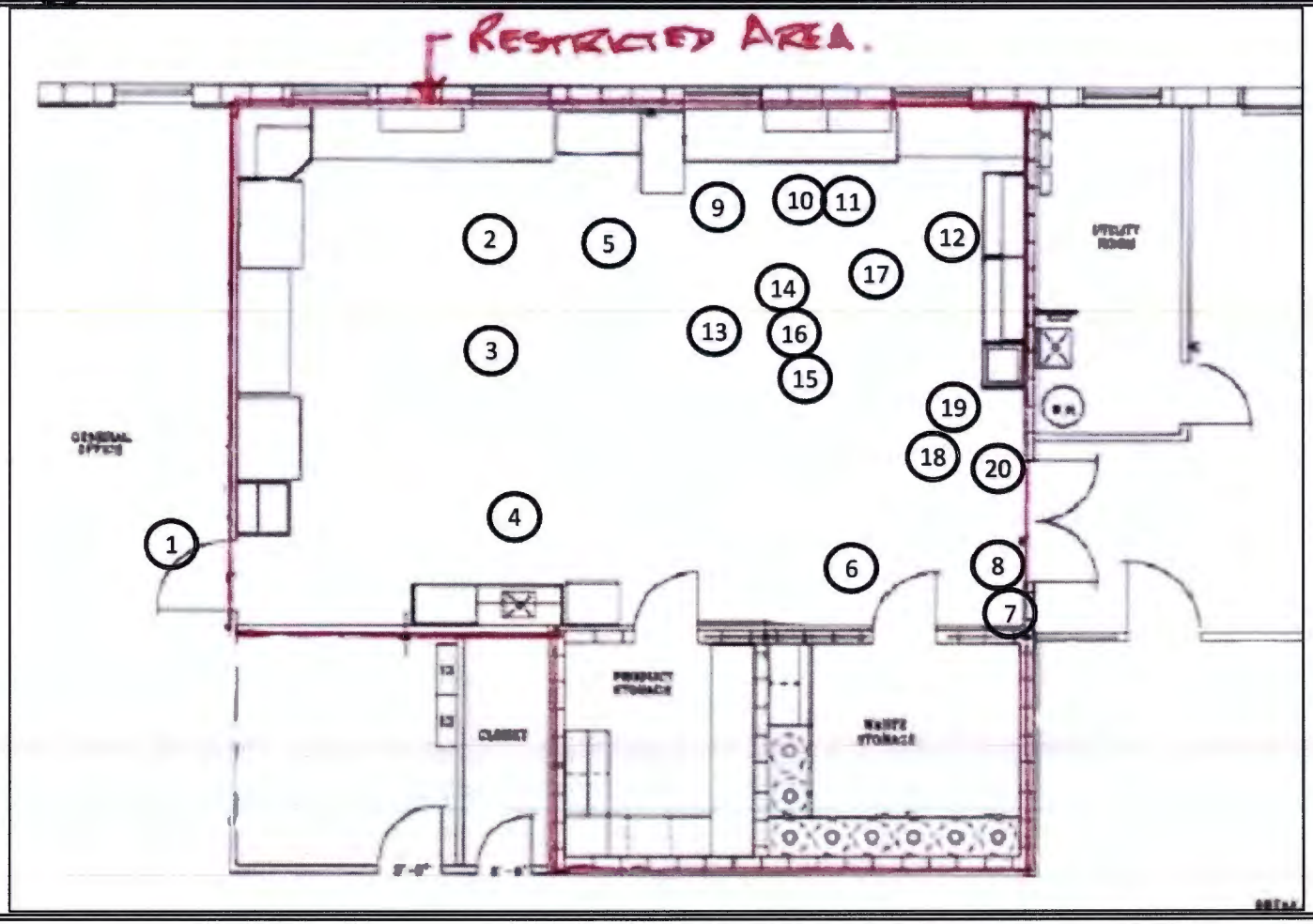
Ameriphysics	Project:	Project Number:	Survey Area:	Survey Number:	Date:	Page 2 of 2
	Triad - KC	1169	Clean Contamination	2	10/22/2019	

Comments: No readings above MDC were detected following cleanup of contaminated areas.

Triad personnel removed all floor tiles where contamination was present.

All readings above are taken on bare concrete floor after tile removal. BKG for concete areas is applied.

smear location = #



Ameriphysics, LLC
RC Program Form

Radiation Survey Record

Doc RCF 4-3 Date 3/11/2014 Rev # 1

AMERIPHYSICS	Project: Triad - KC	Project Number: 1169	Survey Area: Waste Survey	Survey Number: 3	Date: 10/23/2019 Time: 10:30	Page 1 of 1

Instrument	Serial Number	Detector	Serial Number	Cal. Due Date		2 PI Efficiency	4 PI Efficiency	Background	Units	MDC	Units
				Instrument	Detector						
Ludlum 26-1 Dose	PF007054	N/A	N/A	4/3/2020	N/A	N/A	N/A	0.01	mR/hr	N/A	N/A
Ludlum 3030E	328270	43-10-1	PR337591	4/3/2020	4/3/2020	N/A	26.00%	61	cpm	151	dpm
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Surveyor: Robert Hansen	Signature:	Reviewer: Tom Hansen III	Signature:

Total Activity Results

Item Number	Alpha		Beta-Gamma		Comments
	Gross CPM	Net DPM	Gross CPM	Net DPM	

N/A

Removable Activity Results

Item Number	Alpha		Beta-Gamma		Comments
	Gross CPM	Net DPM	Gross CPM	Net DPM	
1	N/A	N/A	51	-38	Drum 1169-01 (inner container)
2	N/A	N/A	56	-19	Drum 1169-01
3	N/A	N/A	61	0	Drum 1169-01
4	N/A	N/A	62	4	Drum 1169-01
5	N/A	N/A	51	-38	Drum 1169-02 (inner container)
6	N/A	N/A	53	-31	Drum 1169-02
7	N/A	N/A	68	27	Drum 1169-02
8	N/A	N/A	67	23	Drum 1169-02

N/A

Comments: Drums to be transported by Interstate Ventures to new facility located in Kansas City (Shipment # 1169-19-0001).

Container 1169-01: Highest dose rate on contact was 1.25 mR/hr; Highest dose rate at 1 meter was 0.03 mR/hr. Shipped as Radioactive Yellow-II

Container 1169-02: Highest dose rate on contact was 9.3 mR/hr; Highest dose rate at 1 meter was 0.18 mR/hr. Shipped as Radioactive Yellow-II

Attachment 4
Final Status Survey Packages

Final Status Survey Design Package

Building: Triad/Jubilant Kansas City, MO Facility
Survey
MARSSIM Classification: Class 1
Room Nos. Included in Survey Unit: Main Lab

Approvals

Prepared By:

Tom Hansen III _____ 10/11/2019
Print Name / Signature Date

Reviewed By:

Tim Pratt _____ 10/11/2019
Print Name / Signature Date

Completion and Review

Data Collected and/or Converted By:

Tom Hansen III/Robbie Hansen _____ 10/23/2019
Print Name / Signature Date

Reviewed and Verified By:

Tim Pratt _____ 10/29/2019
Print Name / Signature Date

Final Status Survey Design Package

Building: Triad/Jubilant Kansas City, MO Facility
Survey
MARSSIM Classification: Class 1
Room Nos. Included in Survey Unit: Main Lab

Radionuclides of Concern: I-131 and Xe-133

Release Limits (DCGLs)			
	Total Activity Limits	**Removable Activity Limit**	**Limits Based On:**
Beta/Gamma	1.18E+06 dpm/100cm^2	1.18E+05 dpm/100 cm^2	25 mrem/y I-131

Applicable Survey Unit Surfaces	**% of Accessible Surface for Scan Surveys**
Floor	100
Lower Walls	100
Upper Walls	n/a
Ceiling	n/a
Structures (Interior and Exterior Surfaces)	100

Required Survey Instrumentation	**Measurement Type**	**Sample Time**	**Background Count Time**	**Scan Rate**	**Efficiency Based On**
Ludlum 2360 / 43-93	Beta Scans / Beta Statics	1 minute	1 minute	7 cm/sec	Beta Tc-99
Ludlum 2360 / 43-37	Beta Scans	N/A	N/A	13.4 cm/sec	Beta Tc-99
Ludlum 3030E / 43-10-1	Beta Removable Activity	1 minute	1 minute	N/A	Beta Tc-99
Ludlum 2221 / 44-17	Gamma Scans	N/A	1 minute	0.3 m/sec	Gamma Ba-133

Final Status Survey Design Package

Building: Triad/Jubilant Kansas City, MO Facility **Survey** **MARSSIM Classification:** Class 1 **Room Nos. Included in Survey Unit:** Main Lab	
Survey Instructions	
1)	Perform the required beta and gamma scan surveys at the rates prescribed on the previous page. Document the performance of the scan surveys on the attached survey maps using markings and legends as necessary to allow the reviewer enough information to verify that sufficient area has been covered.
2)	The estimated number of static measurement locations needed for the statistical evaluation of this survey unit is 17.
3)	For Class 1 and Class 2 survey units, the locations are determined by using a random start point and a systematic spacing from this point. Due to this method, the actual number of plotted locations may vary. In this case, collect the actual locations provided on the survey map even if this number is greater than 17.
4)	Locate and mark the required measurement locations using the provided survey map(s). Survey maps have been provided with the required measurement locations. Sufficient detail has been provided on these maps to measure and locate all of these locations.
5)	Collect static measurements for gross beta at each identified location. Collect wipe samples for gross beta at each sample location. Document the results on the associated data results sheets. Additional measurements may be taken in suspect areas at the discretion of the Project Manager or survey technician. However, these additional locations are not included in the analysis of the statistical sample set.
6)	Notify the Project Manager if any static measurement or applicable removable contamination measurements exceeds the applicable investigation level.
7)	Collect 5% duplicate static measurement for gross beta. Collect 5% duplicate wipe samples for gross beta. Document results on the associated beta result sheet.
8)	Ensure that all package information is completed and signed prior to turning in this survey package to the Project Manager for review.

Building: Triad/Jubilant Kansas City, MO Facility
Survey
MARSSIM Classification: Class 1
Room Nos. Included in Survey Unit: Main Lab

Type	Location	Surface	X	Y
Systematic	1	Floor	2.71	0.26
Systematic	2	Floor	5.72	0.26
Systematic	3	Floor	8.73	0.26
Systematic	4	Floor	2.71	3.27
Systematic	5	Floor	5.72	3.27
Systematic	6	Floor	8.73	3.27
Systematic	7	Floor	2.71	6.28
Systematic	8	Floor	5.72	6.28
Systematic	9	Floor	8.73	6.28
Systematic	10	Wall 1	0.29	1.83
Systematic	11	Wall 1	3.29	1.83
Systematic	12	Wall 1	6.30	1.83
Systematic	13	Wall 1	9.31	1.83
Systematic	14	Wall 2	1.02	1.83
Systematic	15	Wall 2	4.03	1.83
Systematic	16	Wall 2	7.04	1.83
Systematic	17	Wall 3	2.35	1.83
Systematic	18	Wall 3	5.36	1.83
Systematic	19	Wall 3	8.37	1.83
Systematic	20	Wall 4	0.08	1.83
Systematic	21	Wall 4	3.09	1.83
Systematic	22	Wall 4	6.10	1.83

The local X and Y coordinates are in units of meters. X and Y are measured from an origin in the southern corner for floors. Wall coordinates are from the bottom left corner. See corresponding room map.

Final Status Survey Design Package

Building: Triad/Jubilant Kansas City, MO Facility
Survey
MARSSIM Classification: Class 1
Room Nos. Included in Survey Unit: Main Lab

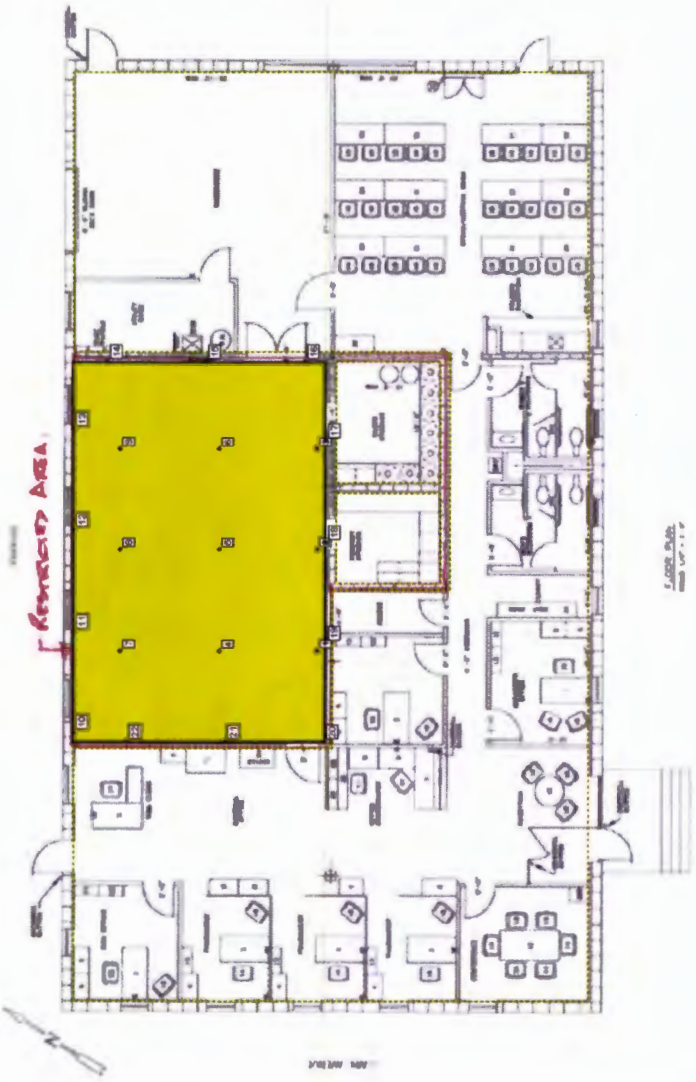
Surveyor: Tom Hansen III/Robbie Hansen	**Reviewer:** Tim Pratt	**Date:** 10/23/19
Signature:	**Signature:**	**Time:** 11:00

Instrument / Detector	Serial Number	Cal. Due Date	Total Efficiency	Background (cpm)	Probe Area (cm^2)	MDC
Ludlum 2360/43-93 - Beta - Static	315452 / PR323025	4/3/2020	16.90%	253	100	456
Ludlum 2360/43-93 - Beta - Scan	315452 / PR323025	4/3/2020	16.90%	253	100	1423
Ludlum 3030E/43-10-1 - Beta - Removable	328270 / PR337591	4/3/2020	26.00%	61	100	151
Ludlum 2360/43-37 - Beta - Scan	297744 / PR160079	4/3/2020	18.21%	748	584	389
Ludlum 2221/4417 - Gamma - Scan	183995 / PR250869	10/11/2020	1.66 %	1436	N/A	N/A

Location Code	Total Activity Results				Removable Activity Results			
	Alpha		Beta-Gamma		Alpha		Beta-Gamma	
	Gross Counts	Net dpm/100 cm^2	Gross Counts	Net dpm/100 cm^2	Gross Counts	Net dpm/100 cm^2	Gross Counts	Net dpm/100 cm^2
1	N/A	N/A	238	-89	N/A	N/A	65	15
2	N/A	N/A	271	107	N/A	N/A	54	-27
3	N/A	N/A	317	379	N/A	N/A	49	-46
4	N/A	N/A	272	112	N/A	N/A	62	4
5	N/A	N/A	294	243	N/A	N/A	63	8
6	N/A	N/A	265	71	N/A	N/A	69	31
7	N/A	N/A	263	59	N/A	N/A	56	-19
8	N/A	N/A	307	320	N/A	N/A	57	-15
9	N/A	N/A	302	290	N/A	N/A	54	-27
10	N/A	N/A	215	-225	N/A	N/A	63	8
11	N/A	N/A	224	-172	N/A	N/A	58	-12
12	N/A	N/A	231	-130	N/A	N/A	64	12
13	N/A	N/A	225	-166	N/A	N/A	62	4
14	N/A	N/A	212	-243	N/A	N/A	71	38
15	N/A	N/A	238	-89	N/A	N/A	61	0
16	N/A	N/A	286	195	N/A	N/A	62	4
17	N/A	N/A	268	89	N/A	N/A	53	-31
18	N/A	N/A	220	-195	N/A	N/A	66	19
19	N/A	N/A	245	-47	N/A	N/A	66	19
20	N/A	N/A	212	-243	N/A	N/A	57	-15
21	N/A	N/A	217	-213	N/A	N/A	69	31
22	N/A	N/A	226	-160	N/A	N/A	65	15
8 Dup	N/A	N/A	312	349	N/A	N/A	71	38
17 Dup	N/A	N/A	277	142	N/A	N/A	62	4
A	N/A	N/A	270	101	N/A	N/A	67	23
B	N/A	N/A	248	-30	N/A	N/A	62	4

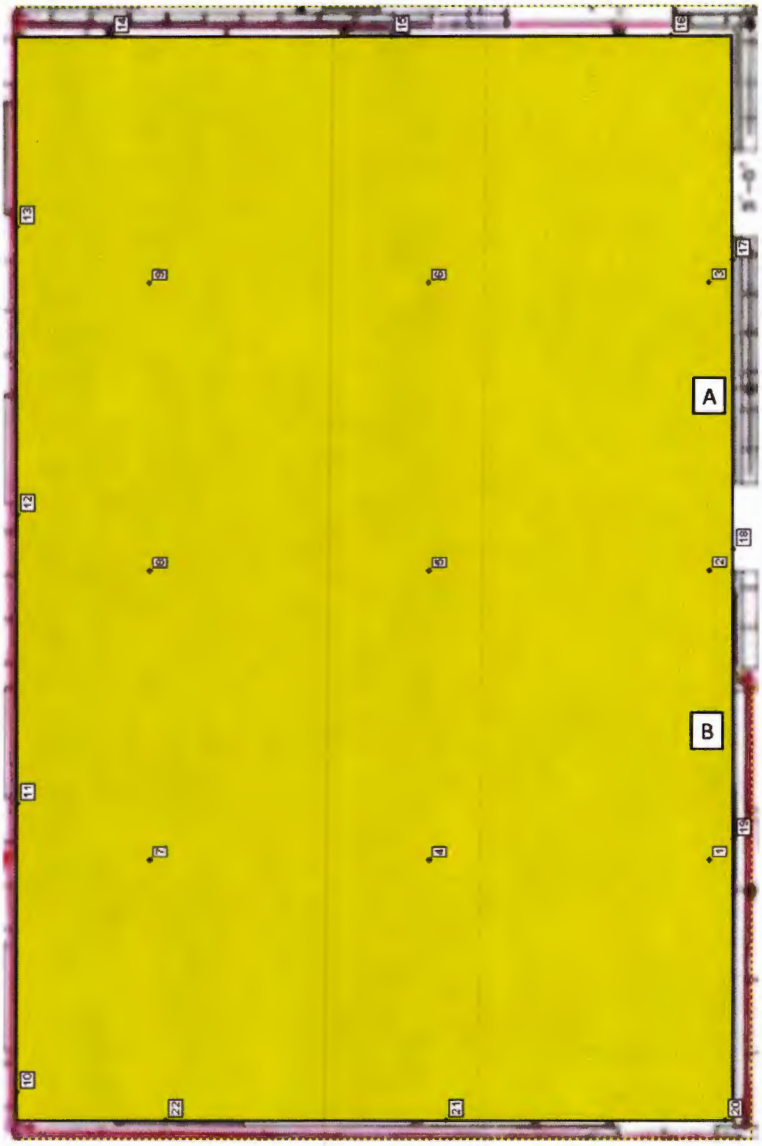
Final Status Survey Design Package

Building: Triad/Jubilant Kansas City, MO Facility
Survey
MARSSIM Classification: Class 1
Room Nos. Included in Survey Unit: Main Lab



Comments: None

Building: Triad/Jubilant Kansas City, MO Facility
Survey
MARSSIM Classification: Class 1
Room Nos. Included in Survey Unit: Main Lab



Comments: Location A indicates a ventilation duct. The duct is cut off approximately 1 ft from the ceiling, and was scanned and surveyed. Location B is the sink for the lab. The trap of the sink was removed and then scanned and surveyed. No readings above MDC were observed for either location.

Final Status Survey Design Package

Building: Triad/Jubilant Kansas City, MO Facility
Survey
MARSSIM Classification: Class 1
Room Nos. Included in Survey Unit: Main Lab

Comments Section

Date	Comment
10/23/2019	All smear results less than MDC. Highest smear results were at location 14; 71 gross cpm (38 net dpm/100 cm^2).
10/23/2019	All beta static results less than MDC. Highest recorded dpm for a static reading was at location 2; 319 gross cpm (379 net dpm/ 100cm^2).
10/23/2019	100% of floors, lower walls, and structures scanned with 43-93 or 43-37, nothing distinguishable from background.
10/23/2019	100% of floors, lower walls, and structures scanned with 44-17, nothing distinguishable from background.
	N/A

Final Status Survey Design Package

Building: Triad/Jubilant Kansas City, MO Facility
Survey Unit ID: SU 2
MARSSIM Classification: Class 1
Room Nos. Included in Survey Unit: Waste and Product Storage Rooms

Approvals

Prepared By:

Tom Hansen III _____ 10/11/2019
Print Name / Signature Date

Reviewed By:

Tim Pratt _____ 10/11/2019
Print Name / Signature Date

Completion and Review

Data Collected and/or Converted By:

Tom Hansen III/Robbie Hansen 10/23/2019
Print Name / Signature Date

Reviewed and Verified By:

Tim Pratt _____ 10/29/2019
Print Name / Signature Date

Final Status Survey Design Package

Building: Triad/Jubilant Kansas City, MO Facility
Survey Unit ID: SU 2
MARSSIM Classification: Class 1
Room Nos. Included in Survey Unit: Waste and Product Storage Rooms

Radionuclides of Concern: I-131 and Xe-133

Release Limits (DCGLs)			
	Total Activity Limits	**Removable Activity Limit**	**Limits Based On:**
Beta/Gamma	1.18E+06 dpm/100cm^2	1.18E+05 dpm/100 cm^2	25 mrem/y I-131

Applicable Survey Unit Surfaces	**% of Accessible Surface for Scan Surveys**
Floor	100
Lower Walls	100
Upper Walls	n/a
Ceiling	n/a
Structures (Interior and Exterior Surfaces)	100

Required Survey Instrumentation	**Measurement Type**	**Sample Time**	**Background Count Time**	**Scan Rate**	**Efficiency Based On**
Ludlum 2360 / 43-93	Beta Scans / Beta Statics	1 minute	1 minute	7 cm/sec	Beta Tc-99
Ludlum 2360 / 43-37	Beta Scans	N/A	N/A	13.4 cm/sec	Beta Tc-99
Ludlum 3030E / 43-10-1	Beta Removable Activity	1 minute	1 minute	N/A	Beta Tc-99
Ludlum 2221 / 44-17	Gamma Scans	N/A	1 minute	0.3 m/sec	Gamma Ba-133

Final Status Survey Design Package

Building: Triad/Jubilant Kansas City, MO Facility **Survey Unit ID:** SU 2 **MARSSIM Classification:** Class 1 **Room Nos. Included in Survey Unit:** Waste and Product Storage Rooms	
Survey Instructions	
1)	Perform the required beta and gamma scan surveys at the rates prescribed on the previous page. Document the performance of the scan surveys on the attached survey maps using markings and legends as necessary to allow the reviewer enough information to verify that sufficient area has been covered.
2)	The estimated number of static measurement locations needed for the statistical evaluation of this survey unit is 17.
3)	For Class 1 and Class 2 survey units, the locations are determined by using a random start point and a systematic spacing from this point. Due to this method, the actual number of plotted locations may vary. In this case, collect the actual locations provided on the survey map even if this number is greater than 17.
4)	Locate and mark the required measurement locations using the provided survey map(s). Survey maps have been provided with the required measurement locations. Sufficient detail has been provided on these maps to measure and locate all of these locations.
5)	Collect static measurements for gross beta at each identified location. Collect wipe samples for gross beta at each sample location. Document the results on the associated data results sheets. Additional measurements may be taken in suspect areas at the discretion of the Project Manager or survey technician. However, these additional locations are not included in the analysis of the statistical sample set.
6)	Notify the Project Manager if any static measurement or applicable removable contamination measurements exceeds the applicable investigation level.
7)	Collect 5% duplicate static measurement for gross beta. Collect 5% duplicate wipe samples for gross beta. Document results on the associated beta result sheet.
8)	Ensure that all package information is completed and signed prior to turning in this survey package to the Project Manager for review.

Final Status Survey Design Package

Building: Triad/Jubilant Kansas City, MO Facility
Survey Unit ID: SU 2
MARSSIM Classification: Class 1
Room Nos. Included in Survey Unit: Waste and Product Storage Rooms

Type	Location	Room	Surface	X	Y
Systematic	1	Waste	Floor	1.08	0.67
Systematic	2	Waste	Floor	2.95	0.67
Systematic	3	Waste	Floor	1.08	2.55
Systematic	4	Waste	Floor	2.95	2.55
Systematic	5	Waste	Wall 1	0.44	0.43
Systematic	6	Waste	Wall 1	2.31	0.43
Systematic	7	Waste	Wall 2	0.59	0.43
Systematic	8	Waste	Wall 2	2.47	0.43
Systematic	9	Waste	Wall 3	1.14	0.43
Systematic	10	Waste	Wall 3	3.02	0.43
Systematic	11	Waste	Wall 4	1.29	0.43
Systematic	12	Waste	Wall 4	3.17	0.43
Systematic	13	Product	Floor	0.82	1.23
Systematic	14	Product	Floor	2.70	1.23
Systematic	15	Product	Floor	0.82	3.11
Systematic	16	Product	Floor	2.70	3.11
Systematic	17	Product	Wall 1	1.83	1.56
Systematic	18	Product	Wall 2	1.01	1.56
Systematic	19	Product	Wall 2	2.89	1.56
Systematic	20	Product	Wall 3	1.56	1.56
Systematic	21	Product	Wall 4	0.74	1.56
Systematic	22	Product	Wall 4	2.61	1.56

The local X and Y coordinates are in units of meters. X and Y are measured from an origin in the southern corner for floors. Wall coordinates are from the bottom left corner. See corresponding room map.

Final Status Survey Design Package

Building: Triad/Jubilant Kansas City, MO Facility
Survey Unit ID: SU 2
MARSSIM Classification: Class 1
Room Nos. Included in Survey Unit: Waste and Product Storage Rooms

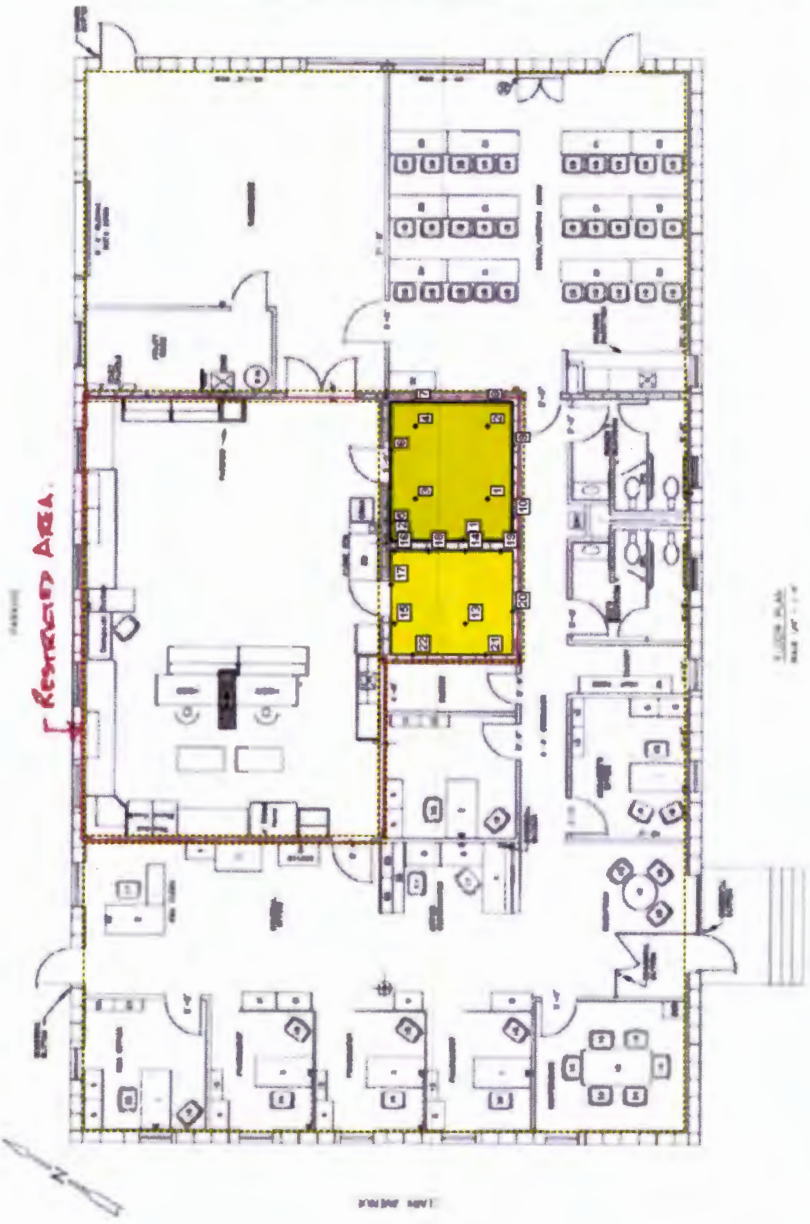
Surveyor: Tom Hansen III / Robbie Hansen	**Reviewer:** Tim Pratt	**Date:** 10/23/19
Signature:	**Signature:**	**Time:** 16:00

Instrument / Detector	Serial Number	Cal. Due Date	Total Efficiency	Background (cpm)	Probe Area (cm^2)	MDC
Ludlum 2360/43-93 - Beta - Static	315452 / PR323025	4/3/2020	16.90%	346	100	530
Ludlum 2360/43-93 - Beta - Scan	315452 / PR323025	4/3/2020	16.90%	346	100	1664
Ludlum 3030E/43-10-1 - Beta - Removable	328270 / PR337591	4/3/2020	26.00%	61	100	151
Ludlum 2360/43-37 - Beta - Scan	297744 / PR160079	4/3/2020	18.21%	748	584	389
Ludlum 2221/4417 - Gamma - Scan	183995 / PR250869	10/11/2020	N/A	1436	N/A	N/A

Location Code	Total Activity Results				Removable Activity Results			
	Alpha		Beta-Gamma		Alpha		Beta-Gamma	
	Gross Counts	Net dpm/100 cm^2	Gross Counts	Net dpm/100 cm^2	Gross Counts	Net dpm/100 cm^2	Gross Counts	Net dpm/100 cm^2
1	N/A	N/A	351	30	N/A	N/A	67	23
2	N/A	N/A	348	12	N/A	N/A	65	15
3	N/A	N/A	349	18	N/A	N/A	60	-4
4	N/A	N/A	331	-89	N/A	N/A	67	23
5	N/A	N/A	299	-278	N/A	N/A	60	-4
6	N/A	N/A	417	420	N/A	N/A	59	-8
7	N/A	N/A	398	308	N/A	N/A	69	31
8	N/A	N/A	424	462	N/A	N/A	52	-35
9	N/A	N/A	416	414	N/A	N/A	54	-27
10	N/A	N/A	341	-30	N/A	N/A	67	23
11	N/A	N/A	267	-467	N/A	N/A	69	31
12	N/A	N/A	264	-485	N/A	N/A	66	19
13	N/A	N/A	316	-178	N/A	N/A	64	12
14	N/A	N/A	341	-30	N/A	N/A	46	-58
15	N/A	N/A	314	-189	N/A	N/A	48	-50
16	N/A	N/A	346	0	N/A	N/A	69	31
17	N/A	N/A	405	349	N/A	N/A	46	-58
18	N/A	N/A	414	402	N/A	N/A	55	-23
19	N/A	N/A	428	485	N/A	N/A	56	-19
20	N/A	N/A	427	479	N/A	N/A	69	31
21	N/A	N/A	396	296	N/A	N/A	66	19
22	N/A	N/A	424	462	N/A	N/A	72	42
2 Dup	N/A	N/A	348	12	N/A	N/A	71	38
14 Dup	N/A	N/A	361	89	N/A	N/A	53	-31
A	N/A	N/A	352	36	N/A	N/A	63	8
B	N/A	N/A	321	-148	N/A	N/A	60	-4
C	N/A	N/A	346	0	N/A	N/A	69	31

Final Status Survey Design Package

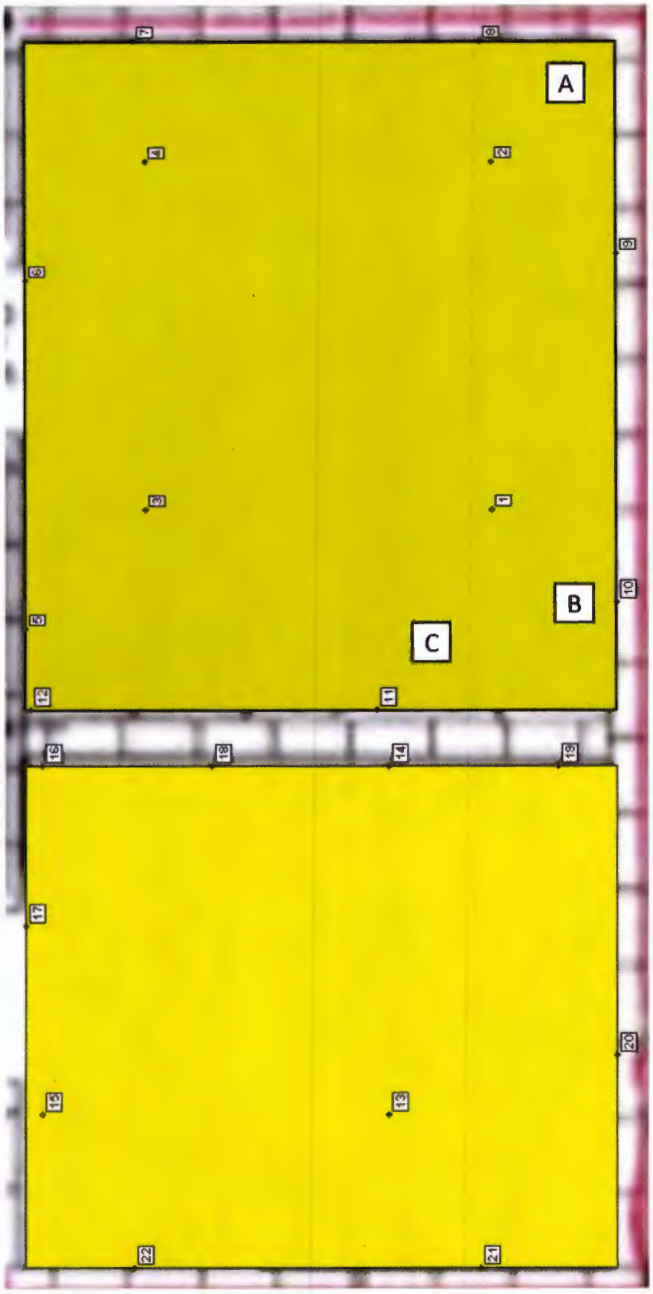
Building: Triad/Jubilant Kansas City, MO Facility
Survey Unit ID: SU 2
MARSSIM Classification: Class 1
Room Nos. Included in Survey Unit: Waste and Product Storage Rooms



Comments: None

Final Status Survey Design Package

Building: Triad/Jubilant Kansas City, MO Facility
Survey Unit ID: SU 2
MARSSIM Classification: Class 1
Room Nos. Included in Survey Unit: Waste and Product Storage Rooms



Comments: Locations A, B, and C indicate various ventilation ducts inside the survey unit. All duct work was scanned and surveyed. Survey results can be seen above. No results above MDC were observed for either location.

Final Status Survey Design Package

Building: Triad/Jubilant Kansas City, MO Facility
Survey Unit ID: SU 2
MARSSIM Classification: Class 1
Room Nos. Included in Survey Unit: Waste and Product Storage Rooms

Comments Section

Date	Comment
10/23/2019	All smear results less than MDC. Highest smear results were at location 22; 72 gross cpm (42 net dpm/100 cm^2).
10/23/2019	All beta static results less than MDC. Highest recorded dpm for a static reading was at location 19; 428 gross cpm (485 net dpm/ 100cm^2).
10/23/2019	100% of floors, lower walls, and structures scanned with 43-93 or 43-37, nothing distinguishable from background.
10/23/2019	100% of floors, lower walls, and structures scanned with 44-17, nothing distinguishable from background.
	N/A

Final Status Survey Design Package

Building: Triad/Jubilant Kansas City, MO Facility
Survey Unit ID: SU 3
MARSSIM Classification: Class 1
Room Nos. Included in Survey Unit: Office Area

Approvals

Prepared By:

Tom Hansen III — 10/23/2019
Print Name / Signature — Date

Reviewed By:

Tim Pratt — 10/24/2019
Print Name / Signature — Date

Completion and Review

Data Collected and/or Converted By:

Tom Hansen III/Robbie Hansen — 10/24/2019
Print Name / Signature — Date

Reviewed and Verified By:

Tim Pratt — 10/29/2019
Print Name / Signature — Date

Final Status Survey Design Package

Building: Triad/Jubilant Kansas City, MO Facility
Survey Unit ID: SU 3
MARSSIM Classification: Class 1
Room Nos. Included in Survey Unit: Office Area

Radionuclides of Concern: I-131 and Xe-133

Release Limits (DCGLs)			
	Total Activity Limits	**Removable Activity Limit**	**Limits Based On:**
Beta/Gamma	1.18E+06 dpm/100cm^2	1.18E+05 dpm/100 cm^2	25 mrem/y I-131

Applicable Survey Unit Surfaces	**% of Accessible Surface for Scan Surveys**
Floor	100
Lower Walls	100
Upper Walls	n/a
Ceiling	n/a
Structures (Interior and Exterior Surfaces)	n/a

Required Survey Instrumentation	**Measurement Type**	**Sample Time**	**Background Count Time**	**Scan Rate**	**Efficiency Based On**
Ludlum 2360 / 43-93	Beta Scans / Beta Statics	1 minute	1 minute	7 cm/sec	Beta Tc-99
Ludlum 2360 / 43-37	Beta Scans	N/A	N/A	13.4 cm/sec	Beta Tc-99
Ludlum 3030E / 43-10-1	Beta Removable Activity	1 minute	1 minute	N/A	Beta Tc-99
Ludlum 2221 / 44-17	Gamma Scans	N/A	1 minute	0.25 m/sec	Gamma Ba-133

Final Status Survey Design Package

Building: Triad/Jubilant Kansas City, MO Facility **Survey Unit ID:** SU 3 **MARSSIM Classification:** Class 1 **Room Nos. Included in Survey Unit:** Office Area	
Survey Instructions	
1)	Perform the required beta and gamma scan surveys at the rates prescribed on the previous page. Document the performance of the scan surveys on the attached survey maps using markings and legends as necessary to allow the reviewer enough information to verify that sufficient area has been covered.
2)	The estimated number of static measurement locations needed for the statistical evaluation of this survey unit is 17.
3)	For Class 1 and Class 2 survey units, the locations are determined by using a random start point and a systematic spacing from this point. Due to this method, the actual number of plotted locations may vary. In this case, collect the actual locations provided on the survey map even if this number is greater than 17.
4)	Locate and mark the required measurement locations using the provided survey map(s). Survey maps have been provided with the required measurement locations. Sufficient detail has been provided on these maps to measure and locate all of these locations.
5)	Collect static measurements for gross beta at each identified location. Collect wipe samples for gross beta at each sample location. Document the results on the associated data results sheets. Additional measurements may be taken in suspect areas at the discretion of the Project Manager or survey technician. However, these additional locations are not included in the analysis of the statistical sample set.
6)	Notify the Project Manager if any static measurement or applicable removable contamination measurements exceeds the applicable investigation level.
7)	Collect 5% duplicate static measurement for gross beta. Collect 5% duplicate wipe samples for gross beta. Document results on the associated beta result sheet.
8)	Ensure that all package information is completed and signed prior to turning in this survey package to the Project Manager for review.

Final Status Survey Design Package

Building: Triad/Jubilant Kansas City, MO Facility
Survey Unit ID: SU 3
MARSSIM Classification: Class 1
Room Nos. Included in Survey Unit: Office Area

Type	Location	Surface	X	Y
Systematic	1	Floor	1.02	2.00
Systematic	2	Floor	3.71	2.00
Systematic	3	Floor	6.40	2.00
Systematic	4	Floor	1.02	4.69
Systematic	5	Floor	3.71	4.69
Systematic	6	Floor	6.40	4.69
Systematic	7	Floor	1.02	7.38
Systematic	8	Floor	3.71	7.38
Systematic	9	Floor	6.40	7.38
Systematic	10	Floor	3.71	10.07
Systematic	11	Floor	6.40	10.07
Systematic	12	Wall 5	2.21	1.04
Systematic	13	Wall 4	2.82	1.04
Systematic	14	Wall 4	0.13	1.04
Systematic	15	Wall 3	0.94	1.04
Systematic	16	Wall 2	6.65	1.04
Systematic	17	Wall 2	3.96	1.04
Systematic	18	Wall 2	1.27	1.04
Systematic	19	Wall 1	6.08	1.04
Systematic	20	Wall 1	3.39	1.04
Systematic	21	Wall 1	0.70	1.04
Systematic	22	Wall 6	9.71	1.04
Systematic	23	Wall 6	7.02	1.04
Systematic	24	Wall 6	4.33	1.04
Systematic	25	Wall 6	1.64	1.04

The local X and Y coordinates are in units of meters. X and Y are measured from an origin in the southern corner for floors. Wall coordinates are from the bottom left corner. See corresponding room map.

Final Status Survey Design Package

Building: Triad/Jubilant Kansas City, MO Facility
Survey Unit ID: SU 3
MARSSIM Classification: Class 1
Room Nos. Included in Survey Unit: Office Area

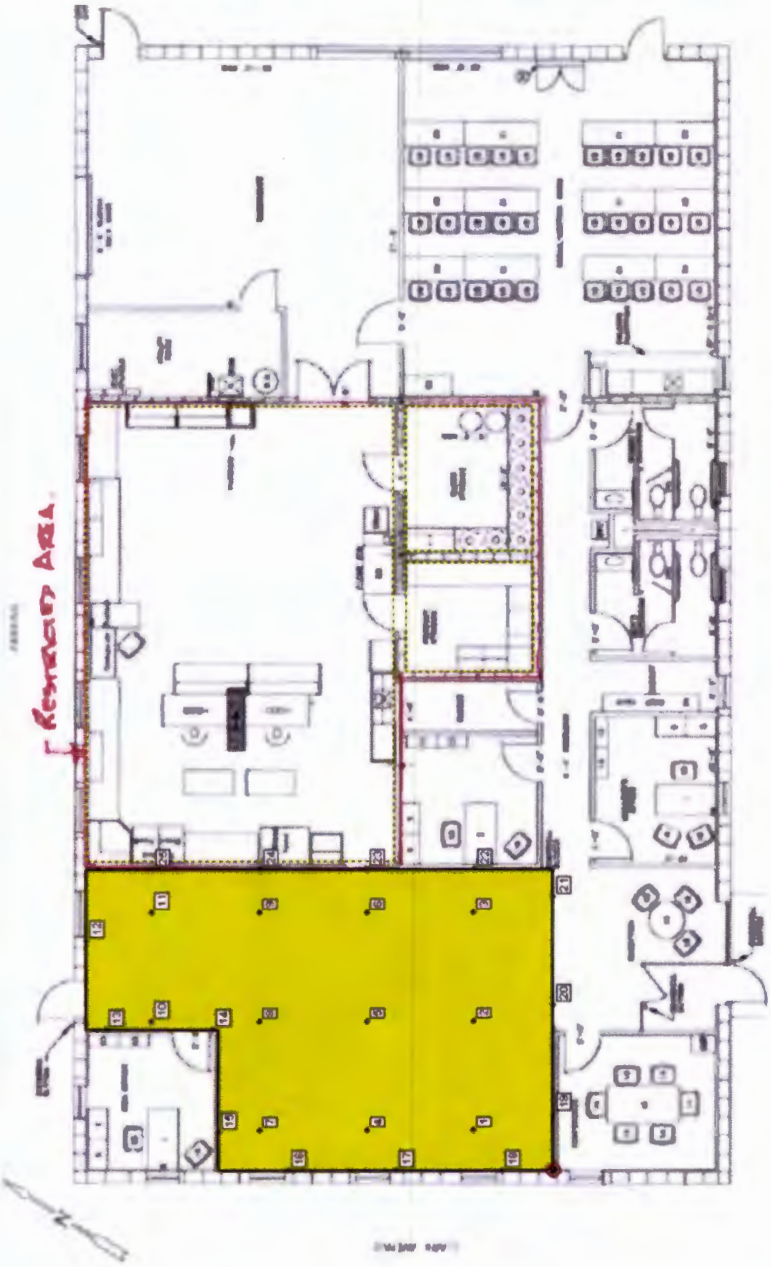
Surveyor: Tom Hasnen III / Robbie Hansen	**Reviewer:** Tim Pratt	**Date:** 10/24/19
Signature:	**Signature:**	**Time:** 9:00

Instrument / Detector	Serial Number	Cal. Due Date	Total Efficiency	Background (cpm)	Probe Area (cm^2)	MDC
Ludlum 2360/43-93 - Beta - Static	315452 / PR323025	4/3/2020	16.90%	253	100	456
Ludlum 2360/43-93 - Beta - Scan	315452 / PR323025	4/3/2020	16.90%	253	100	1394
Ludlum 3030E/43-10-1 - Beta - Removable	328270 / PR337591	4/3/2020	26.00%	61	100	151
Ludlum 2360/43-37 - Beta - Scan	297744 / PR160079	4/3/2020	18.21%	748	584	389
Ludlum 2221/4417 - Gamma - Scan	183995 / PR250869	10/11/2020	1.66%	1436	N/A	N/A

Location Code	Total Activity Results				Removable Activity Results			
	Alpha		Beta-Gamma		Alpha		Beta-Gamma	
	Gross Counts	Net dpm/100 cm^2	Gross Counts	Net dpm/100 cm^2	Gross Counts	Net dpm/100 cm^2	Gross Counts	Net dpm/100 cm^2
1	N/A	N/A	282	172	N/A	N/A	62	4
2	N/A	N/A	295	249	N/A	N/A	56	-19
3	N/A	N/A	285	189	N/A	N/A	65	15
4	N/A	N/A	275	130	N/A	N/A	55	-23
5	N/A	N/A	286	195	N/A	N/A	64	12
6	N/A	N/A	415	408	N/A	N/A	55	-23
7	N/A	N/A	286	195	N/A	N/A	61	0
8	N/A	N/A	295	249	N/A	N/A	63	8
9	N/A	N/A	271	107	N/A	N/A	59	-8
10	N/A	N/A	270	101	N/A	N/A	53	-31
11	N/A	N/A	275	130	N/A	N/A	46	-58
12	N/A	N/A	224	-172	N/A	N/A	63	8
13	N/A	N/A	216	-219	N/A	N/A	55	-23
14	N/A	N/A	215	-225	N/A	N/A	64	12
15	N/A	N/A	229	-142	N/A	N/A	51	-38
16	N/A	N/A	247	-36	N/A	N/A	58	-12
17	N/A	N/A	249	-24	N/A	N/A	64	12
18	N/A	N/A	262	53	N/A	N/A	61	0
19	N/A	N/A	235	-107	N/A	N/A	64	12
22	N/A	N/A	225	-166	N/A	N/A	55	-23
23	N/A	N/A	175	-462	N/A	N/A	68	27
24	N/A	N/A	182	-420	N/A	N/A	67	23
25	N/A	N/A	184	-408	N/A	N/A	47	-54
4 Dup	N/A	N/A	254	6	N/A	N/A	62	4
15 Dup	N/A	N/A	231	-130	N/A	N/A	54	-27

Final Status Survey Design Package

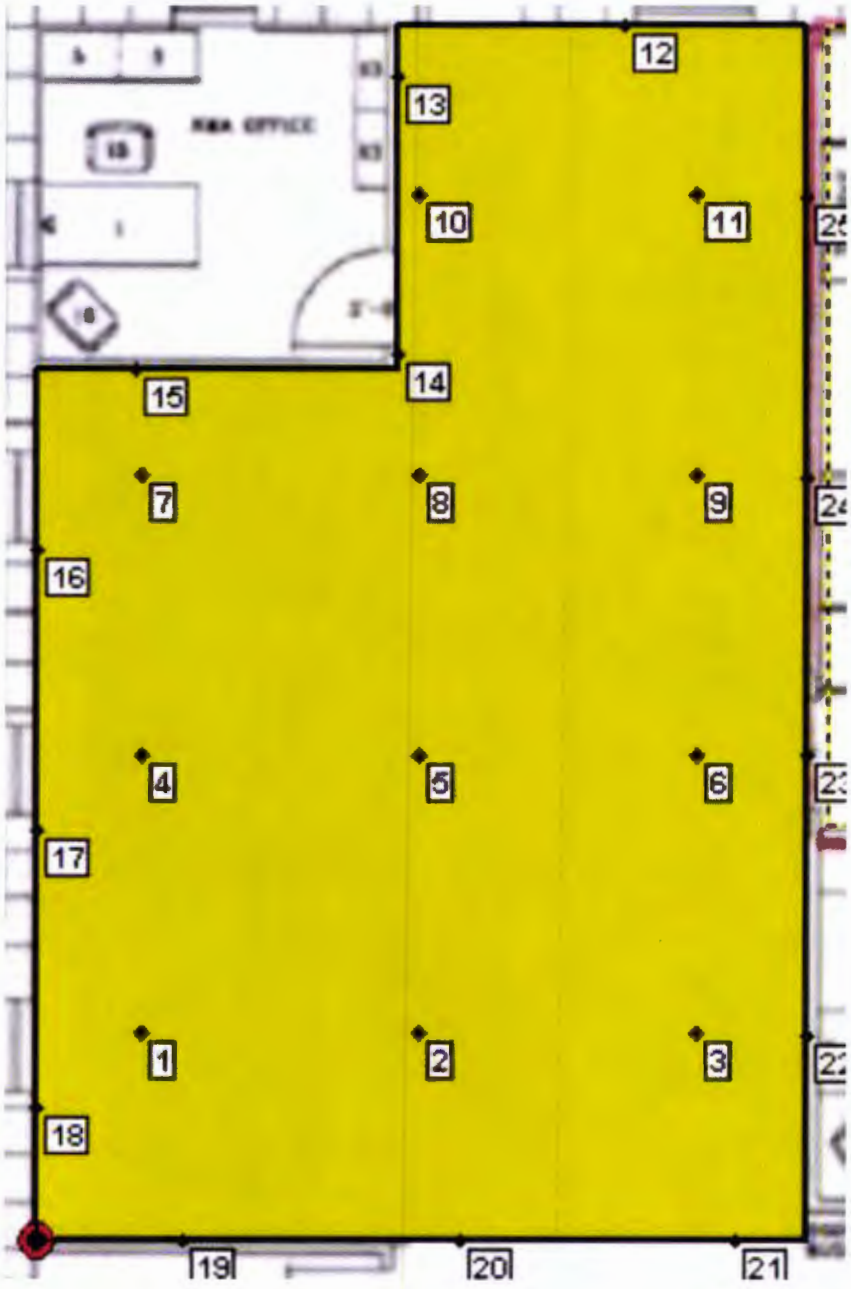
Building: Triad/Jubilant Kansas City, MO Facility
Survey Unit ID: SU 3
MARSSIM Classification: Class 1
Room Nos. Included in Survey Unit: Office Area



Comments: None

Final Status Survey Design Package

Building: Triad/Jubilant Kansas City, MO Facility
Survey Unit ID: SU 3
MARSSIM Classification: Class 1
Room Nos. Included in Survey Unit: Office Area



Comments: # 6 was on bare concrete. Bare Concrete BKG was 346 cpm. MDC = 530 dpm/100 cm^2 Wall locations #20 and #21 fell on an opening. No measurements were recorded for these locations, and they were removed from statistical analysis.

Final Status Survey Design Package

Building: Triad/Jubilant Kansas City, MO Facility
Survey Unit ID: SU 3
MARSSIM Classification: Class 1
Room Nos. Included in Survey Unit: Office Area

Comments Section

Date	Comment
10/24/2019	All smear results less than MDC. Highest smear results were at location 23; 68 gross cpm (23 net dpm/100 cm^2).
10/24/2019	All beta static results less than MDC. Highest recorded dpm for a static reading was at location 6; 415 gross cpm (408 net dpm/ 100cm^2).
10/24/2019	100% of floors and lower walls scanned with 43-93 or 43-37, nothing distinguishable from background.
10/24/2019	100% of floors and lower walls scanned with 44-17, nothing distinguishable from background.
	N/A

Final Status Survey Design Package

Building: Triad/Jubilant Kansas City, MO Facility
Survey Unit ID: SU 4
MARSSIM Classification: Class 3
Room Nos. Included in Survey Unit: Balance of Unrestricted area - Floors

Approvals

Prepared By:

Tom Hansen III _____ 10/23/2019
Print Name / Signature Date

Reviewed By:

Tim Pratt _____ 10/24/2019
Print Name / Signature Date

Completion and Review

Data Collected and/or Converted By:

Tom Hansen III/Robbie Hansen _____ 10/24/2019
Print Name / Signature Date

Reviewed and Verified By:

Tim Pratt _____ 10/29/2019
Print Name / Signature Date

Final Status Survey Design Package

Building: Triad/Jubilant Kansas City, MO Facility
Survey Unit ID: SU 4
MARSSIM Classification: Class 3
Room Nos. Included in Survey Unit: Balance of Unrestricted area - Floors

Radionuclides of Concern: I-131 and Xe-133

Release Limits (DCGLs)			
	Total Activity Limits	**Removable Activity Limit**	**Limits Based On:**
Beta/Gamma	1.18E+06 dpm/100cm^2	1.18E+05 dpm/100 cm^2	25 mrem/y I-131

Applicable Survey Unit Surfaces	**% of Accessible Surface for Scan Surveys**
Floor	10-100
Lower Walls	n/a
Upper Walls	n/a
Ceiling	n/a
Structures (Interior and Exterior Surfaces)	n/a

Required Survey Instrumentation	**Measurement Type**	**Sample Time**	**Background Count Time**	**Scan Rate**	**Efficiency Based On**
Ludlum 2360 / 43-93	Beta Scans / Beta Statics	1 minute	1 minute	7 cm/sec	Beta Tc-99
Ludlum 2360 / 43-37	Beta Scans	N/A	N/A	13.4 cm/sec	Beta Tc-99
Ludlum 3030E / 43-10-1	Beta Removable Activity	1 minute	1 minute	N/A	Beta Tc-99
Ludlum 2221 / 44-17	Gamma Scans	N/A	1 minute	0.25 m/sec	Gamma Ba-133

Final Status Survey Design Package

Building: Triad/Jubilant Kansas City, MO Facility **Survey Unit ID:** SU 4 **MARSSIM Classification:** Class 3 **Room Nos. Included in Survey Unit:** Balance of Unrestricted area - Floors	
Survey Instructions	
1)	Perform the required beta and gamma scan surveys at the rates prescribed on the previous page. Document the performance of the scan surveys on the attached survey maps using markings and legends as necessary to allow the reviewer enough information to verify that sufficient area has been covered.
2)	The estimated number of static measurement locations needed for the statistical evaluation of this survey unit is 17.
3)	For Class 3 survey units, the locations are determined randomly. Due to this method, the actual number of plotted locations is 17.
4)	Locate and mark the required measurement locations using the provided survey map(s). Survey maps have been provided with the required measurement locations. Sufficient detail has been provided on these maps to measure and locate all of these locations.
5)	Collect static measurements for gross beta at each identified location. Collect wipe samples for gross beta at each sample location. Document the results on the associated data results sheets. Additional measurements may be taken in suspect areas at the discretion of the Project Manager or survey technician. However, these additional locations are not included in the analysis of the statistical sample set.
6)	Notify the Project Manager if any static measurement or applicable removable contamination measurements exceeds the applicable investigation level.
7)	Collect 5% duplicate static measurement for gross beta. Collect 5% duplicate wipe samples for gross beta. Document results on the associated beta result sheet.
8)	Ensure that all package information is completed and signed prior to turning in this survey package to the Project Manager for review.

Final Status Survey Design Package

Building: Triad/Jubilant Kansas City, MO Facility
Survey Unit ID: SU 4
MARSSIM Classification: Class 3
Room Nos. Included in Survey Unit: Balance of Unrestricted area - Floors

Type	Location	Surface	X	Y
Systematic	1	Floor	0.39	13.26
Systematic	2	Floor	23.85	0.75
Systematic	3	Floor	20.40	11.28
Systematic	4	Floor	13.50	2.51
Systematic	5	Floor	27.30	7.77
Systematic	6	Floor	14.15	4.26
Systematic	7	Floor	21.05	14.79
Systematic	8	Floor	3.80	1.34
Systematic	9	Floor	24.50	3.09
Systematic	10	Floor	8.98	4.85
Systematic	11	Floor	22.78	10.11
Systematic	12	Floor	19.33	0.36
Systematic	13	Floor	26.23	10.89
Systematic	14	Floor	1.21	2.12
Systematic	15	Floor	21.91	3.87
Systematic	16	Floor	11.56	0.95
Systematic	17	Floor	25.36	6.21

The local X and Y coordinates are in units of meters. X and Y are measured from an origin in the southern corner for floors. See corresponding room map.

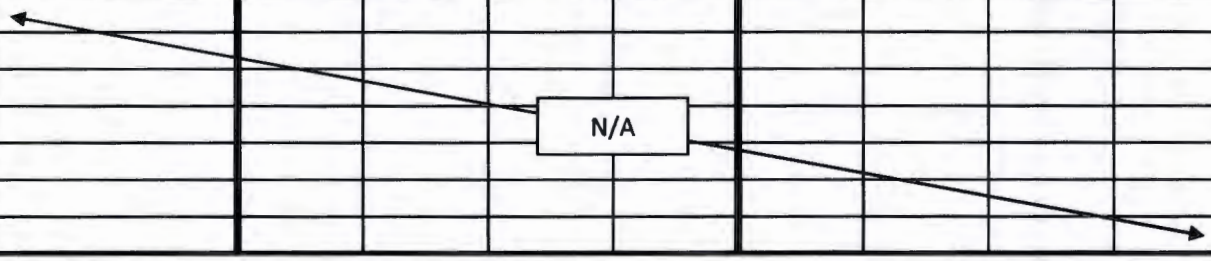
Final Status Survey Design Package

Building: Triad/Jubilant Kansas City, MO Facility
Survey Unit ID: SU 4
MARSSIM Classification: Class 3
Room Nos. Included in Survey Unit: Balance of Unrestricted area - Floors

Surveyor: Tom Hansen III / Robbie Hansen	**Reviewer:** Tim Pratt	**Date:** 10/24/19
Signature:	**Signature:**	**Time:** 11:00

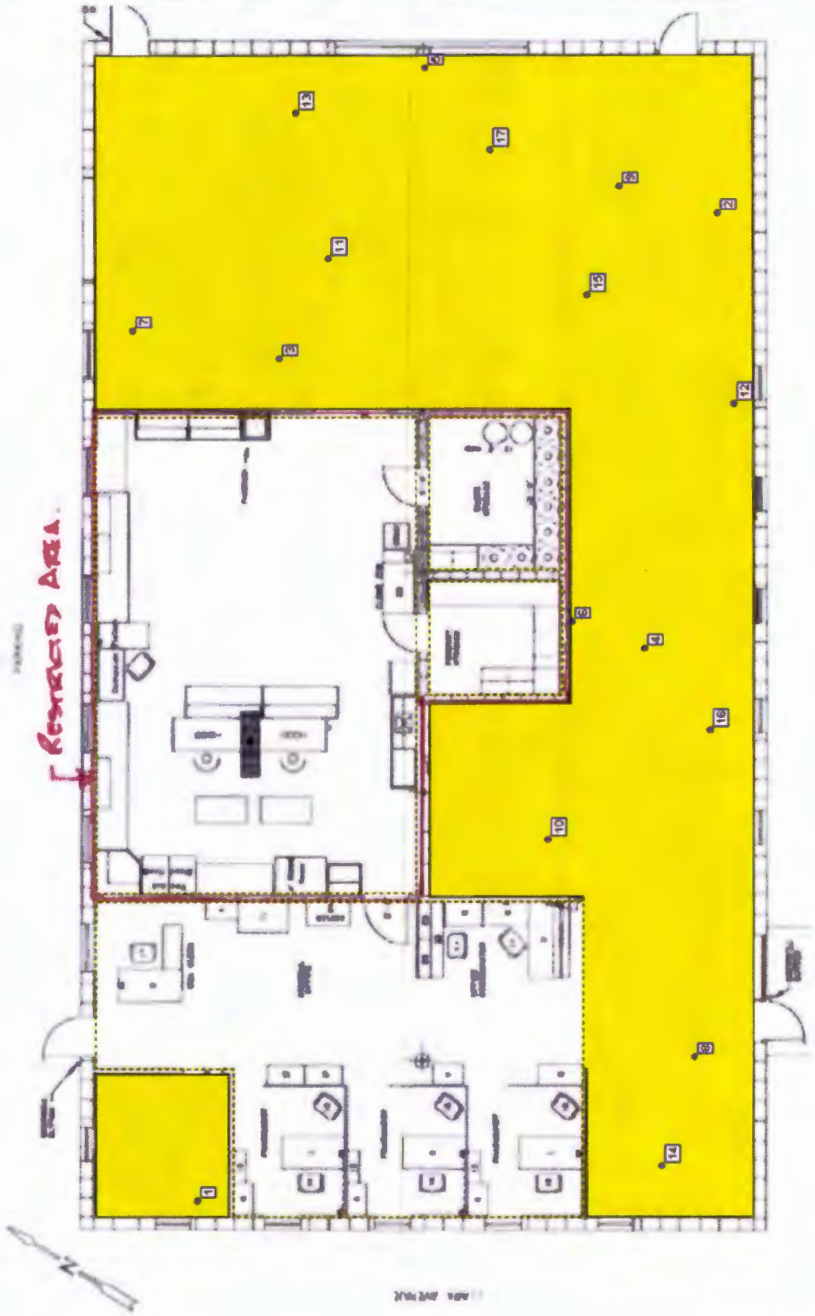
Instrument / Detector	Serial Number	Cal. Due Date	Total Efficiency	Background (cpm)	Probe Area (cm^2)	MDC
Ludlum 2360/43-93 - Beta - Static	315452 / PR323025	4/3/2020	16.90%	253	100	456
Ludlum 2360/43-93 - Beta - Scan	315452 / PR323025	4/3/2020	16.90%	253	100	1394
Ludlum 3030E/43-10-1 - Beta - Removable	328270 / PR337591	4/3/2020	26.00%	61	100	151
Ludlum 2360/43-37 - Beta - Scan	297744 / PR160079	4/3/2020	18.21%	748	584	389
Ludlum 2221/4417 - Gamma - Scan	183995 / PR250869	10/11/2020	1.66%	1436	N/A	N/A

Location Code	Total Activity Results				Removable Activity Results			
	Alpha		Beta-Gamma		Alpha		Beta-Gamma	
	Gross Counts	Net dpm/100 cm^2	Gross Counts	Net dpm/100 cm^2	Gross Counts	Net dpm/100 cm^2	Gross Counts	Net dpm/100 cm^2
1	N/A	N/A	297	260	N/A	N/A	63	8
2	N/A	N/A	283	178	N/A	N/A	61	0
3	N/A	N/A	408	367	N/A	N/A	52	-35
4	N/A	N/A	327	438	N/A	N/A	63	8
5	N/A	N/A	273	118	N/A	N/A	70	35
6	N/A	N/A	288	207	N/A	N/A	49	-46
7	N/A	N/A	416	414	N/A	N/A	67	23
8	N/A	N/A	292	231	N/A	N/A	58	-12
9	N/A	N/A	275	130	N/A	N/A	62	4
10	N/A	N/A	280	160	N/A	N/A	43	-69
11	N/A	N/A	418	426	N/A	N/A	59	-8
12	N/A	N/A	286	195	N/A	N/A	66	19
13	N/A	N/A	422	450	N/A	N/A	59	-8
14	N/A	N/A	295	249	N/A	N/A	63	8
15	N/A	N/A	277	142	N/A	N/A	55	-23
16	N/A	N/A	294	243	N/A	N/A	54	-27
17	N/A	N/A	299	272	N/A	N/A	63	8
10 Dup	N/A	N/A	269	95	N/A	N/A	67	23
17 Dup	N/A	N/A	279	154	N/A	N/A	59	-8



Final Status Survey Design Package

Building: Triad/Jubilant Kansas City, MO Facility
Survey Unit ID: SU 4
MARSSIM Classification: Class 3
Room Nos. Included in Survey Unit: Balance of Unrestricted area - Floors



Comments: #'s 3, 7, 11, 13 are on bare concrete. Bare Concrete backgournd was 346 cpm. MDC = 530 dpm/100cm^2.

Final Status Survey Design Package

Building: Triad/Jubilant Kansas City, MO Facility
Survey Unit ID: SU 4
MARSSIM Classification: Class 3
Room Nos. Included in Survey Unit: Balance of Unrestricted area - Floors

Comments Section

Date	Comment
10/24/2019	All smear results less than MDC. Highest smear results were at location 5; 70 gross cpm (35 net dpm/100 cm^2).
10/24/2019	All beta static results less than MDC. Highest recorded dpm for a static reading was at location 13; 422 gross cpm (450 net dpm/ 100cm^2).
10/24/2019	100% of floors scanned with 43-93 or 43-37, nothing distinguishable from background.
10/24/2019	100% of floors scanned with 44-17, nothing distinguishable from background.
	N/A

Attachment 5
MDC Calculations

MDC Determination

1. Instrument Information

Meter Model Number 2360 Meter Serial Number 297744

Probe Model Number 43-37 Probe Serial Number PR160079

Application: ☑ Beta ☐ Alpha ☐ Removable

2. Background Determination

Background Count Time (min)	Background Counts (counts)	Background Count Rate (cpm)	Sample Count Time (min)
1	748	748	1

3. Preliminary Calculations

i - Residence Interval $\quad Residence\ Interval\ (sec) = Detector\ Width\ (cm) \div Scan\ Rate(cm/sec)$

Detector Width (cm)	Scan Rate (cm/sec)	i (sec)
13.40	13.4	1.00

b_i - Background Counts during Residence Interval $\quad b_i(counts) = i\ (sec) \times \frac{background\ count\ rate\ (counts/\min)}{60\ (sec/min)}$

i (sec)	Background Count Rate (cpm)	Constant - Minutes to Seconds	b_i (counts)
1.00	748	60	12.46666667

E_{total} - Total Detector Efficiency $\quad E_{total} = 2\pi\ efficiency \times surface\ efficiency$

2π Instrument Alpha Efficiency	2π Instrument Beta Efficiency	Surface Efficiency	Beta E_{total}	Alpha E_{total}
N/A	36.41%	50.00%	18.21%	N/A

4. MDC_{scan} Calculation

$$MDC_{scan}(dpm/100cm^2) = \frac{d'\sqrt{b_i}\left(\frac{60}{i}\right)}{\sqrt{p}E_{total}\frac{A}{100cm^2}}$$

d'	b_i (counts)	i (sec)	p	E_{total}	A (cm^2)	MDC_{Scan} (dpm/100 cm^2)
1.38	12.4666667	1.00	0.50	18.21%	584	389

MDC Determination

1. Instrument Information

Meter Model Number 2360 Meter Serial Number 315452

Probe Model Number 43-93 Probe Serial Number PR323025

Application: ☑ Beta ☐ Alpha ☐ Removable

2. Background Determination

Background Count Time (min)	Background Counts (counts)	Background Count Rate (cpm)	Sample Count Time (min)
1	346	346	1

3. Preliminary Calculations

i - Residence Interval $\quad Residence\ Interval\ (sec) = Detector\ Width\ (cm) \div Scan\ Rate(cm/sec)$

Detector Width (cm)	Scan Rate (cm/sec)	i (sec)
7.00	7	1.00

b_i - Background Counts during Residence Interval $\quad b_i(counts) = i\ (sec) \times \frac{background\ count\ rate\ (counts/\min)}{60\ (sec/min)}$

i (sec)	Background Count Rate (cpm)	Constant - Minutes to Seconds	b_i (counts)
1.00	346	60	5.766666667

E_{total} - Total Detector Efficiency $\quad E_{total} = 2\pi\ efficiency \times surface\ efficiency$

2π Instrument Alpha Efficiency	2π Instrument Beta Efficiency	Surface Efficiency	Beta E_{total}	Alpha E_{total}
N/A	33.79%	50.00%	16.90%	N/A

4. MDC_{scan} Calculation

$$MDC_{scan}(dpm/100cm^2) = \frac{d'\sqrt{b_i}\left(\frac{60}{i}\right)}{\sqrt{p}E_{total}\frac{A}{100cm^2}}$$

d'	b_i (counts)	i (sec)	p	E_{total}	A (cm^2)	MDC_{Scan} (dpm/100 cm^2)
1.38	5.76666667	1.00	0.50	16.90%	100	1664

MDC Determination

1. Instrument Information

Meter Model Number 2360 Meter Serial Number 315452

Probe Model Number 43-93 Probe Serial Number PR323025

Application: ☑ Beta ☐ Alpha ☐ Removable:

2. Background Determination

Background Count Time (min)	Background Counts (counts)	Background Count Rate (cpm)	Sample Count Time (min)
1	346	346	1

3. Preliminary Calculations

E_{total} - Total Detector Efficiency $E_{total} = 2\pi\ efficiency \times surface\ efficiency$

2π Instrument Alpha Efficiency	2π Instrument Beta Efficiency	Surface Efficiency	Beta E_{total}	Alpha E_{total}
N/A	33.79%	50.00%	16.90%	N/A

4. MDC_{static} Calculation

$$MDC_{static}(dpm/100cm^2) = \frac{3 + 3.29\sqrt{B_r \times t_s \times \left(1 + \frac{t_s}{t_b}\right)}}{t_s \times E_{total} \times \frac{A}{100cm^2}}$$

B_r (cpm)	t_b (min)	t_s (min)	E_{total}	A (cm^2)	MDC_{Static} (dpm/100 cm^2)
346	1	1	16.90%	100	529.86

MDC Determination

1. Instrument Information

Meter Model Number 3030 Meter Serial Number 328270

Probe Model Number 43-10-1 Probe Serial Number PR337591

Application: ☑ Beta ☐ Alpha ☑ Removable Nuclide: Tc 99

2. Background Determination

Background Count Time (min)	Background Counts (counts)	Background Count Rate (cpm)	Sample Count Time (min)
1	61	61	1

3. Preliminary Calculations

E_{total} - Total Detector Efficiency

4π Instrument Efficiency
26%

4. MDC_{static} Calculation

$$MDC_{static}(dpm/100cm^2) = \frac{3 + 3.29\sqrt{B_r \times t_s \times \left(1 + \frac{t_s}{t_b}\right)}}{t_s \times E_{total} \times \frac{A}{100cm^2}}$$

B_r (cpm)	t_b (min)	t_s (min)	E_{total}	A (cm^2)	MDC_{Static} (dpm/100 cm^2)
61	1	1	26%	100	151

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