



14 September 2022

Licensing Assistant Section  
Nuclear Materials Safety Branch  
U.S. Nuclear Regulatory Commission, Region 1  
2100 Renaissance Boulevard, Suite 100  
King Of Prussia, PA 19406-2713

License Number: 06-35429-01

Subject: License Termination, 06-35429-01

Dear Licensing Assistant Section,

GlaxoSmithKline/ViiV Healthcare has terminated radioactivity work at the site located at 36 E. Industrial Road, Branford, CT 06405. This amendment is for the termination of our Radioactive Materials License. All radioactive material work has ceased at this site. Enclosed is a copy of our decommissioning survey, performed by Chase Environmental, which included all locations where licensed radioactive material was used since the beginning of licensed operations at the site.

Please send an email confirmation that this amendment request was received and being processed.

Enclosed:     Amendment Application – NRC Form 31  
                  ViiV Healthcare Final Status Survey Report Rev. 1  
                  Certificate of Disposal/Manifest Shipment 1  
                  Manifest shipment 2

Sincerely,

**Leo Foley** US Radiation Safety & DEA Compliance Manager, RSO

**GSK R&D EHS USA**

1250 S Collegeville Rd. UP4100, Collegeville PA 19426

Email: [Leo.P.Foley@gsk.com](mailto:Leo.P.Foley@gsk.com)

Phone: 484-571-4643



**CERTIFICATE OF DISPOSITION  
OF MATERIALS**

APPROVED BY OMB: NO. 3150-0028

EXPIRES: 03/31/2023

Estimated burden per response to comply with this mandatory collection request: 30 minutes. This submittal is used by NRC as part of the basis for its determination that the facility is released for unrestricted use. Send comments regarding burden estimate to the FOIA, Library, and Information Collections Branch (T-6 A10M), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by e-mail to [Infocollections.Resource@nrc.gov](mailto:Infocollections.Resource@nrc.gov), and the OMB reviewer at: OMB Office of Information and Regulatory Affairs, (3150-0028), Attn: Desk Officer for the Nuclear Regulatory Commission, 725 17th Street NW, Washington, DC 20503; e-mail: [ofra\\_submission@omb.eop.gov](mailto:ofra_submission@omb.eop.gov). The NRC may not conduct or sponsor, and a person is not required to respond to, a collection of information unless the document requesting or requiring the collection displays a currently valid OMB control number.

LICENSEE NAME AND ADDRESS

ViiV Healthcare  
36 E. Industrial Road  
Branford, CT 06405

LICENSE NUMBER

06-35429-01

DOCKET NUMBER

030-39051

LICENSE EXPIRATION DATE

August 31, 2027

**A. LICENSE STATUS (Check the appropriate box)**

- ☐ This license has expired. ☒ This license has not yet expired; please terminate it.

**B. DISPOSAL OF RADIOACTIVE MATERIAL**

*(Check the appropriate boxes and complete as necessary. If additional space is needed, provide attachments)*

The licensee, or any individual executing this certificate on behalf of the licensee, certifies that:

- ☐ 1. No radioactive materials have ever been procured or possessed by the licensee under this license.
- ☒ 2. All activities authorized by this license have ceased, and all radioactive materials procured and/or possessed by the licensee under this license number cited above have been disposed of in the following manner.
- ☐ a. Transfer of radioactive materials to the licensee listed below:
- ☒ b. Disposal of radioactive materials:
- ☐ 1. Directly by the licensee:
- ☐ 2. By licensed disposal site:
- ☒ 3. By waste contractor:  
Ecology Services, Inc. 9135 Guilford Road Suite 200 Columbia, MD 21046  
See attached Certificate of Disposal and manifests.
- ☒ c. All radioactive materials have been removed such that any remaining residual radioactivity is within the limits of 10 CFR Part 20, Subpart E, and is ALARA.

**C. SURVEYS PERFORMED AND REPORTED**

- ☒ 1. A radiation survey was conducted by the licensee. The survey confirms:
- ☐ a. the absence of licensed radioactive materials
- ☒ b. that any remaining residual radioactivity is within the limits of 10 CFR 20, Subpart E, and is ALARA.
- ☒ 2. A copy of the radiation survey results:
- ☒ a. is attached; or ☐ b. is not attached (Provide explanation); or ☐ c. was forwarded to NRC on: 13SEP2022  
Date
- ☐ 3. A radiation survey is not required as only sealed sources were ever possessed under this license, and
- ☐ a. The results of the latest leak test are attached; and/or ☒ b. No leaking sources have ever been identified.

The person to be contacted regarding the information provided on this form:

NAME	TITLE	TELEPHONE (Include Area Code)	E-MAIL ADDRESS
Leo P. Foley	US Radiation Safety & DEA Compliance Manager, RSO	(484) 571-4643	Leo.P.Foley@gsk.com

Mail all future correspondence regarding this license to:

Andre Lowe, ViiV Healthcare, 36 E. Industrial Road, Branford, CT 06405

**C. CERTIFYING OFFICIAL**

**I CERTIFY UNDER PENALTY OF PERJURY THAT THE FOREGOING IS TRUE AND CORRECT**

PRINTED NAME AND TITLE	SIGNATURE	DATE
Leo P. Foley US Radiation Safety & DEA Compliance Manager, RSO		13SEP2022

**WARNING: FALSE STATEMENTS IN THIS CERTIFICATE MAY BE SUBJECT TO CIVIL AND/OR CRIMINAL PENALTIES. NRC REGULATIONS REQUIRE THAT SUBMISSIONS TO THE NRC BE COMPLETE AND ACCURATE IN ALL MATERIAL RESPECT. 18 U.S.C. SECTION 1001 MAKES IT A CRIMINAL OFFENSE TO MAKE A WILLFULLY FALSE STATEMENT OR REPRESENTATION TO ANY DEPARTMENT OR AGENCY OF THE UNITED STATES AS TO ANY MATTER WITHIN ITS JURISDICTION.**

## CERTIFICATE OF DISPOSITION OF MATERIALS

PLEASE READ THESE INSTRUCTIONS BEFORE COMPLETING NRC FORM 314.

Subpart E of 10 CFR Part 20 establishes the radiological criteria for license terminations/decommissioning of facilities licensed under 10 CFR Parts 30, 40, 50, 60, 61, 70, and 72, as well as other facilities subject to the Commission's jurisdiction under the Atomic Energy Act of 1954, as amended, and the Energy Reorganization Act of 1974, as amended.

### INSTRUCTIONS

#### Section B, Item 2.

Licensees should describe the specific radioactive material transfer actions. If radioactive wastes were generated in terminating this license, the licensee should describe the disposal actions taken, including the disposition of low-level radioactive waste, mixed waste, greater-than-Class-C waste, and sealed sources.

#### Section B, Item 2.a.

The information provided concerning the transfer of radioactive material to another licensee should specify the date of the transfer, the name of the licensee recipient, an individual contact name and telephone number for the licensee recipient, and the recipient's NRC or Agreement State license number.

#### Section B, Item 2.b.

For disposal of radioactive materials, licensees should describe the specific disposal method or procedure (e.g., decay-in-storage). For those cases when radioactive materials are disposed of by a licensed disposal site or by a waste contractor, the licensee should specify the name, address, and telephone number of the licensed disposal site operator or waste contractor.

#### Section B, Item 2.c.

"Residual radioactivity," as defined in 10 CFR 20.1003, means radioactivity in 'areas' (structures, materials, soils, etc.) remaining as a result of activities (licensed and unlicensed) under the licensee's control from sources used by the licensee, excluding background radiation. ALARA is defined in 10 CFR 20.1003.

### FILE CERTIFICATES AS FOLLOWS:

#### IF YOU ARE LOCATED IN:

ALABAMA, CONNECTICUT, DELAWARE, DISTRICT OF COLUMBIA, FLORIDA, GEORGIA, KENTUCKY, MAINE, MARYLAND, MASSACHUSETTS, NEW HAMPSHIRE, NEW JERSEY, NEW YORK, NORTH CAROLINA, PENNSYLVANIA, PUERTO RICO, RHODE ISLAND, SOUTH CAROLINA, TENNESSEE, VERMONT, VIRGINIA, VIRGIN ISLANDS, OR WEST VIRGINIA, SEND CERTIFICATES TO:

LICENSING ASSISTANT SECTION  
NUCLEAR MATERIALS SAFETY BRANCH  
U.S. NUCLEAR REGULATORY COMMISSION, REGION I  
2100 RENAISSANCE BOULEVARD, SUITE 100  
KING OF PRUSSIA, PA 19406-2713

ILLINOIS, INDIANA, IOWA, MICHIGAN, MINNESOTA, MISSOURI, OHIO, OR WISCONSIN, SEND CERTIFICATES TO:

MATERIALS LICENSING SECTION  
U.S. NUCLEAR REGULATORY COMMISSION, REGION III  
2443 WARRENVILLE ROAD, SUITE 210  
LISLE, IL 60532-4352

#### IF YOU ARE LOCATED IN:

ALASKA, ARIZONA, ARKANSAS, CALIFORNIA, COLORADO, HAWAII, IDAHO, KANSAS, LOUISIANA, MISSISSIPPI, MONTANA, NEBRASKA, NEVADA, NEW MEXICO, NORTH DAKOTA, OKLAHOMA, OREGON, PACIFIC TRUST TERRITORIES, SOUTH DAKOTA, TEXAS, UTAH, WASHINGTON, OR WYOMING, SEND CERTIFICATES TO:

MATERIAL RADIATION PROTECTION SECTION  
U. S. NUCLEAR REGULATORY COMMISSION, REGION IV  
1600 E. LAMAR BOULEVARD  
ARLINGTON, TX 76011-4511



**ECOLOGY SERVICES, INC.**

---

10427 Hickory Path Way  
Knoxville, TN 37922  
Phone (865) 766-5873  
Fax (865) 766-5908

October 7, 2021

Matthew Schilling  
ViiV Healthcare  
36 E Industrial Rd.  
Branford, CT 06405

*Re: Certificate of Disposal / Destruction*

Dear Matthew:

The following manifest has been closed out:

Manifest No. 0806-092220EN

The radioactive materials specified on the above referenced manifest were closed out on September 29, 2021 in accordance with all applicable federal, state, and local laws and regulations.

Sincerely,

A handwritten signature in black ink, appearing to read 'David R. DeLaCruz', with a stylized flourish at the end.

David R. DeLaCruz  
Logistics Manager  
Ecology Services, Inc.





**ECOLOGY SERVICES, INC.**

---

10427 Hickory Path Way  
Knoxville, TN 37922  
Phone (865) 766-5873  
Fax (865) 766-5908

July 1, 2021

Matthew Schilling  
ViiV Healthcare  
36 E Industrial Rd.  
Branford, CT 06405

*Re: Receipt Acknowledgement*

Dear Matthew:

The following manifest has been received at the designated processing/disposal facility:

Manifest No. 0806-092220EN

The radioactive materials specified on above referenced manifest were shipped from your facility on September 22, 2020. In accordance with the requirements of 10 CFR Part 20, Appendix G, the attached signed copy of the NRC Uniform Low-Level Radioactive Waste Manifest is your notice of receipt and acceptance of the materials at EnergySolutions (Duratek). This is acknowledgement of receipt only and does not certify destruction or final disposal of material.

Sincerely,

A handwritten signature in dark ink, appearing to read "David R. DeLaCruz", with a large, stylized flourish at the end.

David R. DeLaCruz  
Logistics Manager  
Ecology Services, Inc.

Attachment: Signed NRC Manifest

---




Estimated burden per response to comply with this information collection request: 45 minutes. This uniform manifest is required by NRC to meet reporting requirements of Federal and State Agencies for the safe transportation and disposal of low-level waste. Send comments regarding burden estimates to the Records and Privacy Service Branch (7-4133), U.S. Nuclear Regulatory Commission, Washington, DC 20545-0041, or by Internet e-mail to [info@nrc.gov](mailto:info@nrc.gov), and to the Chief Clerk, Office of Information and Regulatory Affairs, NRC-18502, (205) 854-1843. Office of Management and Budget, Washington, DC 20503. If a manifest used in response to an information collection does not display a currently valid OMB control number, the NRC may not conduct or sponsor, and a person is not required to respond to, the information collection.

FORM 540 EnergySolutions, Bear Creek Processing Operations UNIFORM LOW-LEVEL RADIOACTIVE WASTE MANIFEST SHIPPING PAPER		5. SHIPPER - NAME AND FACILITY ESI @ Viv Healthcare 38 F Ingham Rd Branford, CT 06405		SHIPMENT BY NUMBER 0806-092220EN		7. FORM 540 AND 540A FORM 541 AND 541A FORM 542 AND 542A ADDITIONAL INFORMATION PAGE 1 OF 1 PAGE(S) 1 PAGE(S) 1 PAGE(S) NONE PAGE(S)		8. MANIFEST NUMBER (Use this number on all continuation pages) 0806-092220EN	
1. EMERGENCY TELEPHONE NUMBER (Include Area Code) 800-451-8346		USER PERMIT NUMBER T-ND004-L20		SHIPMENT NUMBER 0806-092220EN		9. CONSIGNEE - Name and Facility Address EnergySolutions, Bear Creek Processing Operations Operated By EnergySolutions 1525 Bear Creek Road Oak Ridge, TN 37830		CONTACT Brent McInnis TELEPHONE NUMBER (865) 481-0227	
ORGANIZATION Verisk SE (12489)		CONTACT Matthew Schilling		TELEPHONE NUMBER (865) 265-6234		SIGNATURE - Authorized consignee/acknowledging [Signature] DATE 09/22/2020		DATE 09/22/2020	
2. IS THIS AN "EXCLUSIVE USE" SHIPMENT? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO		3. TOTAL NUMBER OF PACKAGES IDENTIFIED ON THIS MANIFEST 1		6. CARRIER - Name and Address Ecology Services, Inc. 9135 Guilford Road, Suite 200 Columbia, MD 21046		EPA ID NUMBER MDR000524712		10. CERTIFICATION This is to certify that the material named herein is and properly classified, identified, packaged, marked, and labeled and is in proper condition for transportation according to the applicable regulations of the Department of Transportation. The signifier certifies that the material is classified, packaged, marked, and labeled and is in proper condition for transportation and disposal in accordance with the requirements of 49 CFR Parts 171 and 173, as amended, and other applicable regulations.	
4. DOES EPA REGULATED WASTE REQUIRE A MANIFEST ACCOMPANY THIS SHIPMENT? If "Yes", provide Manifest Number _____		EPA MANIFEST NUMBER N/A		CONTACT Greg Keck SIGNATURE - Authorized carrier/acknowledging waste receipt [Signature] DATE 09/22/2020		AUTHORIZED SIGNATURE [Signature] TITLE ES Manager DATE 09/22/2020			
11. U.S. DEPARTMENT OF TRANSPORTATION DESCRIPTION (Including proper shipping name, hazard class, UN ID number, and any additional information)		12. DOT LABEL "RADIOACTIVE"		13. TRANSPORT INDEX NA		14. PHYSICAL AND CHEMICAL FORM LIQUID/OXIDES		15. IDENTIFICATION NUMBER OF PACKAGE VIV-1 (20 001096)	
UN2810, Radioactive material, excepted package-limited quantity of material, 7 NON HAZ I SV 1 - 5 GAL POLY DRUM		NA		NA		C-14 : H-3 : S-35		TOTAL PACKAGE ACTIVITY - (LSA/RCO) (S/LAR) (If not appropriate write) 2.5729E+03 (8.9539E+01) NA 0.08 R <sup>2</sup> 10 00000 lb	
FOR CONSIGNEE USE ONLY				20. Generator Certification Statement					
Transporter "License For Delivery" No. _____				A) Radioactive Materials: Certification is hereby made that this shipment of low-level radioactive waste has been prepared in accordance with applicable waste management programs which have been approved by the Nuclear Regulatory Commission or the appropriate State regulatory authority and with the current edition of the site Material Acceptance Criteria.					
South Carolina Transport Permit No. _____				B) Hazardous Materials: Generator hereby certifies that this material does not contain a hazardous waste as defined in 40 CFR 271.21.					
US Ecology Generator No. _____				C) Data: Generator hereby represents and warrants that all data and facts in this Uniform Low-Level Radioactive Waste Manifest are true and correct in all respects and is accordance with applicable governmental laws, rules, regulations and the Radioactive Material License.					
US Ecology Permit No. _____				D) SPECIALIZED SURVEILLANCE: Generator hereby certifies that the quality of waste not meeting the above criteria is not shipped in excess of 1%.					
				Matthew J. Schilling on behalf of Viv Healthcare 09/22/2020					

# ViiV Healthcare Branford, CT Site Final Status Survey Report

**NRC Radioactive Material License  
No. 06-35429-01**

**November 1, 2021**

Prepared:	 Stefan Herold	Project Manager	Date: 11-1-21
Reviewed:	 Dave Culp	Field Services Manager	Date: 11-2-21
Approved:	 Chris Echterling	Chase Radiation Safety Officer	Date: 11-2-21



**Prepared by:  
Chase Environmental Group, Inc.  
200 Sam Rayburn Parkway  
Lenoir City, TN 37771  
865-816-6015**

## TABLE OF CONTENTS

<b>1.0</b>	<b>INTRODUCTION.....</b>	<b>1</b>
<b>2.0</b>	<b>FACILITY DESCRIPTION AND HISTORY .....</b>	<b>2</b>
<b>3.0</b>	<b>RADIOLOGICAL RELEASE CRITERIA.....</b>	<b>4</b>
<b>4.0</b>	<b>NUCLIDES OF CONCERN.....</b>	<b>4</b>
<b>5.0</b>	<b>DERIVED CONCENTRATION GUIDELINE LEVELS.....</b>	<b>4</b>
<b>6.0</b>	<b>INVESTIGATION LEVELS .....</b>	<b>5</b>
<b>7.0</b>	<b>DATA QUALITY OBJECTIVES (DQO).....</b>	<b>5</b>
<b>8.0</b>	<b>PROJECT MANAGEMENT AND ORGANIZATION .....</b>	<b>6</b>
<b>9.0</b>	<b>TRAINING .....</b>	<b>6</b>
<b>10.0</b>	<b>RADIATION SAFETY AND HEALTH PROGRAM.....</b>	<b>6</b>
<b>11.0</b>	<b>ENVIRONMENTAL MONITORING PROGRAM.....</b>	<b>6</b>
<b>12.0</b>	<b>RADIOACTIVE WASTE MANAGEMENT .....</b>	<b>6</b>
<b>13.0</b>	<b>QUALITY ASSURANCE PROGRAM .....</b>	<b>6</b>
<b>14.0</b>	<b>SURVEY INSTRUMENTATION.....</b>	<b>6</b>
14.1	Instrument Calibration .....	6
14.2	Functional Checks.....	6
14.3	Efficiency Determination.....	7
14.4	Background Determination.....	7
14.5	Minimum Detectable Concentrations .....	7
14.5.1	Static Counting.....	7
14.5.2	Ratemeter Scanning .....	8
14.5.3	Smear Counting.....	9
14.6	Uncertainty.....	10
14.7	Instrumentation Specifications.....	10
14.8	Datalogging.....	11
<b>15.0</b>	<b>AREA CLASSIFICATIONS.....</b>	<b>12</b>
15.1	Non-Impacted Area.....	12
15.2	Impacted Areas .....	12
15.2.1	Class 1 Area .....	12
15.2.2	Class 2 Area .....	12
15.2.3	Class 3 Area .....	12
15.3	Survey Units.....	13
<b>16.0</b>	<b>FINAL STATUS SURVEYS.....</b>	<b>13</b>
16.1	Surface Scans .....	14
16.2	Total Surface Activity Measurements.....	14
16.2.1	Determining the Number of Samples.....	14
16.2.2	Determination of Sample Locations.....	16
16.3	Removable Surface Activity Measurements.....	17
16.4	Survey Documentation.....	17
<b>17.0</b>	<b>Equipment and Materials Release.....</b>	<b>18</b>
<b>18.0</b>	<b>CHARACTERIZATION SURVEYS.....</b>	<b>19</b>
<b>19.0</b>	<b>REMEDIATION .....</b>	<b>19</b>
<b>20.0</b>	<b>SURVEY RESULTS AND DATA QUALITY ASSESSMENT .....</b>	<b>19</b>
20.1	Data Validation .....	19
20.2	Preliminary Data Review .....	20
20.3	Building Structural Surfaces Scan Data.....	20
20.4	Data Summary Tables.....	20
20.5	Determining Compliance for Building Structural Surfaces .....	21

<b>21.0</b>	<b>QUALITY ASSURANCE SURVEYS</b>	<b>21</b>
21.1	QA Survey Methods	21
21.2	QA Survey Results	22
<b>22.0</b>	<b>ALARA ANALYSIS</b>	<b>22</b>
<b>23.0</b>	<b>CONCLUSION</b>	<b>23</b>
<b>24.0</b>	<b>REFERENCES</b>	<b>23</b>

## TABLES

Table 2-1: License 06-35429-01 Possession Limits and Uses	2
Table 4-1: Nuclides of Concern for Decommissioning	4
Table 5-1: Default Screening Values for Nuclides of Concern	4
Table 14-1: Instrumentation Specifications	10
Table 14-2: Typical Instrument Operating Parameters and Sensitivities	11
Table 15-1: Building Structural Survey Units	13
Table 15-2: Scan Survey Coverage by Classification	14
Table 15-3: Location Code Description	18
Table 18-1: Structural Surfaces Total Beta Surface Activity Summary	20
Table 18-2: Building Structural Surfaces Removable H-3 Summary	20
Table 18-3: Building Structural Surfaces Removable C-14 Summary	21
Table 18-4: Building Structural Surfaces Removable Open Channel Summary	21
Table 18-5: Structural Surfaces Total Beta Surface Activity Dose Calculations	21
Table 19-1: QA Survey Locations	22
Table 19-2: QA Building Structural Surfaces Total Activity Summary	22
Table 19-3: QA Building Structural Surfaces Removable H-3 Summary	22
Table 19-4: QA Building Structural Surfaces Removable C-14 Summary	22
Table 19-5: QA Building Structural Surfaces Removable Open Channel Summary	22

## FIGURES

Figure 2-1: Room 226 Radioactive Material Storage Freezer	3
Figure 2-2: Room 226 Radioactive Material Storage Lockbox Within Freezer	3

## APPENDICES

Appendix A – Site Satellite Photograph  
Appendix B – Building Floor Plan  
Appendix C – Instrument Calibration Records  
Appendix D – Final Status Survey Location Maps  
Appendix E – 4-Plot Graphs  
Appendix F – Structural Surfaces Final Status Survey Results  
Appendix G – Quality Assurance Survey Results

## ACRONYMS

ALARA	As Low As Reasonably Achievable
CFR	Code of Federal Regulations
Chase	Chase Environmental Group
CT DEEP	Connecticut Department of Energy and Environmental Protection
DCGL	Derived Concentration Guideline Level
DCGL <sub>EMC</sub>	Derived Concentration Guideline Level – Elevated Measurement Comparison
DCGL <sub>W</sub>	Derived Concentration Guideline Level – Wilcoxon Rank Sum
DWP	Decommissioning Work Plan
DQA	Data Quality Assessment
DQO	Data Quality Objective
DSV	Default Screening Value
FSS	Final Status Survey
FSSR	Final Status Survey Report
GSK	GlaxoSmithKline
LBGR	Lower Bound of the Gray Region
LSC	Liquid Scintillation Counter
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
MDC	Minimum Detectable Concentration
NRC	U.S. Nuclear Regulatory Commission
NIST	National Institute of Standards and Technology
QA	Quality Assurance
TEDE	Total Effective Dose Equivalent
ViiV	ViiV Healthcare

## 1.0 INTRODUCTION

ViiV Healthcare (ViiV) in partnership with GlaxoSmithKline (GSK) has decided to permanently decommission their facility located at 36 E. Industrial Road in Branford, CT and terminate US Nuclear Regulatory Commission (NRC) Radioactive Materials license No. 06-35429-01. A site satellite photo is presented in Appendix A. The facility consists of research laboratory, mechanical, and office space totaling approximately 50,000 ft<sup>2</sup>. Radioactive materials usage consisted of storage of approximately thirty sealed samples containing H-3, C-14, and S-35. Research using radioactive materials was never performed and the samples remained sealed in a lockbox within a freezer until they were removed from the site for disposal.

Decommissioning activities were conducted under the Chase Commonwealth of Kentucky radioactive materials license number 201-605-15, utilizing a reciprocal agreement with the NRC, and in accordance with a Decommissioning Work Plan (DWP). The DWP was developed using the guidance provided in NUREG 1757, "*Consolidated NMSS Decommissioning Guidance*" and NUREG 1575, "*Multi-Agency Radiation Survey and Site Investigation Manual*" (MARSSIM). Final status surveys (FSS) were designed to implement the protocols and guidance provided in MARSSIM to demonstrate compliance with NRC default screening values (DSVs). These methods ensured technically defensible data were generated to aid in determining whether or not the site meets the release criteria for unrestricted use specified in 10 CFR 20 Subpart E and the Connecticut Department of Energy and Environmental Protection (CT DEEP) release criterion of 19 mrem per year. Additionally, conservative investigation levels were implemented for building structural surfaces based on the release criteria for equipment and materials specified in NUREG 1556, Volume 7, Table M- 2, "Acceptable Surface Contamination Levels."

On-site decommissioning activities were performed on October 18, 2021. Radiological surveys of the lockbox internal surfaces identified H-3 contamination up to 52,607 dpm/100 cm<sup>2</sup>; external surfaces of the lockbox did not have detectable residual radioactivity. The lockbox was decontaminated and additional removable contamination measurements were taken within the lockbox, freezer, surrounding floor, and area of packaging for disposal shipment. All radioactive waste generated from decontamination was sealed and turned over to ViiV for disposal. Radiological surveys of building structural surfaces did not identify residual radioactivity above the investigation levels.

This report presents sufficient data to conclude the impacted laboratories are suitable for unrestricted release in accordance with NRC and CT DEEP requirements. Final status surveys demonstrate that building structural surfaces included in the scope of this report are below release criteria and are suitable for unrestricted release. All final status surface activity measurement results were a small fraction of the Derived Concentration Guideline Level (DCGL). Based on the Building Occupancy Scenario of NRC DandD dose modeling software Version 2.4, **the Total Effective Dose Equivalent (TEDE) to an average member of the critical group is 0.004 mrem/year (0.017% of the NRC release criterion of 25 mrem/yr, and .023% of the CT DEEP release criterion of 19 mrem/yr).**

## 2.0 FACILITY DESCRIPTION AND HISTORY

ViiV provided Chase historical information regarding radioactive material usage at the facility. The two-story building contains research laboratories, office space, and other support areas. The building is shared between multiple companies. The ViiV research laboratories, and offices are primarily located on the eastern half of the second floor. A building floor plan is provided in Appendix B.

The facility currently operates under NRC license No. 06-35429-01 Amendment 1 issued to ViiV Healthcare with an expiration date of August 31, 2027. Amendment 1 possession limits and authorized uses are summarized in the table below.

**Table 2-1: License 06-35429-01 Possession Limits and Uses**

Nuclide	Form	Possession Limit	Authorized Usage
Hydrogen-3	Any	500 mCi	For research and development as defined in 10 CFR 30.4, including in-vitro studies.
Carbon-14	Any	25 mCi	
Phosphorus-32	Any	75 mCi	
Phosphorus-33	Any	25 mCi	
Sulfur-35	Any	25 mCi	
Iodine-125	Non-volatile	10 mCi	

The only possession of radioactive materials under the license consisted of approximately thirty samples containing H-3, C-14, and S-35 that were received and stored. No research was ever performed, and the samples were never opened. Historically, radioactive samples were stored inside a lockbox within a freezer in Room 233. The freezer and its contents, including the radioactive samples, were subsequently moved to Room 226. ViiV removed the samples from the site on 9-22-20, but the freezer and lockbox remained in Room 226. Photos of the freezer and lockbox are provided below.





Figure 2-1: Room 226 Radioactive Material Storage Freezer



Figure 2-2: Room 226 Radioactive Material Storage Lockbox Within Freezer

### 3.0 RADIOLOGICAL RELEASE CRITERIA

The unrestricted radiological release criteria of CT DEEP are used for decommissioning the facility. Specifically, the facility was surveyed in accordance with the guidance contained in MARSSIM to demonstrate compliance with the criteria of 10 CFR 20.1402, "Radiological Criteria for Unrestricted Use" normalized to the CT DEEP criteria. The criteria are that residual radioactivity results in a TEDE to an average member of the critical group that does not exceed 19 mrem per year and the residual radioactivity has been reduced to levels that are as low as reasonably achievable (ALARA).

### 4.0 NUCLIDES OF CONCERN

C-14 and H-3 are the only nuclides used at the building and are the only nuclides of concern for decommissioning. S-35 has decayed to undetectable levels due to its short half-life.

**Table 4-1: Nuclides of Concern for Decommissioning**

Nuclide	Half Life (years)	Dispersible Form?	Half Life >120 days?
Hydrogen-3	1.2E+01	YES	YES
Carbon-14	5.7E+03	YES	YES

### 5.0 DERIVED CONCENTRATION GUIDELINE LEVELS

A DCGL is a radionuclide-specific surface activity concentration that could result in a dose equal to the release criterion. Derived Concentration Guideline Level – Wilcoxon Rank Sum (DCGL<sub>w</sub>) is the concentration limit if the residual activity is evenly distributed over a large area. In the case of non-uniform contamination, MARSSIM allows for evaluation of higher levels of activity over small areas using the Derived Concentration Guideline Level – Elevated Measurement Comparison (DCGL<sub>EMC</sub>); however, the DCGL<sub>EMC</sub> was not used.

The NRC has published default screening values (DSV) in NUREG 1757, Volume 1, Appendix B for commonly used radionuclides. The DSVs for surfaces under default conditions (generic screening levels) and the project DCGLs (DSVs normalized to the DEEP criterion of 19 mrem/yr) are provided in the table below. Additionally, due to ViiV's conservative ALARA goals, application of the unity rule for multiple radionuclides is not required to demonstrate compliance with the release criteria.

**Table 5-1: Default Screening Values for Nuclides of Concern**

Nuclide	Half-life (years)	Predominant Emissions	Structural Surface DSV (dpm/100 cm <sup>2</sup> )	DCGL Normalized to 19 mremr/yr (dpm/100 cm <sup>2</sup> )
H-3	1.2E+01	Low Energy Beta	1.28E+08	9.1E+07
C-14	5.7E+03	Low Energy Beta	3.7E+06	2.8E+06

An important assumption of the dose model is that removable contamination is <10% of total contamination. Characterization, final status, and quality assurance (QA) survey results confirm that removable contamination levels are very low and meet this assumption. H-3 cannot be accurately detected directly by field instrumentation due to its low energy; therefore, H-3 contamination was evaluated by removable contamination measurements only.

Additionally, due to the conservative investigation levels and the minor dose contribution of H-3 relative to C-14, application of the unity rule for multiple radionuclides is not required to demonstrate compliance with the release criteria.

## 6.0 INVESTIGATION LEVELS

Investigation levels were based on NUREG 1556, Volume 7, Table M-2, "Acceptable Surface Contamination Levels." Specifically, the following investigation levels were used:

- 5,000 dpm/100 cm<sup>2</sup> total surface contamination
- 1,000 dpm/100 cm<sup>2</sup> removable surface contamination

Because of the conservatism of the investigation levels, these criteria were applied to gross beta measurements and the unity rule was not applied. The number of measurements required by MARSSIM to demonstrate compliance with the release criteria was calculated using the DCGL<sub>w</sub>.

## 7.0 DATA QUALITY OBJECTIVES (DQO)

The following is a list of the major DQOs for the survey design:

- Static measurements were taken to achieve an  $MDC_{static}$  of less than 5,000 dpm/100 cm<sup>2</sup>.
- Scanning was conducted at a rate to achieve an  $MDC_{scan}$  of less than 5,000 dpm/100 cm<sup>2</sup>.
- Removable contamination measurements were counted to achieve an  $MDC_{smear}$  of less than 1,000 dpm/100 cm<sup>2</sup>.
- Individual measurements were made to a 95% confidence interval.
- Decision error probability rates were set at 0.05 for both  $\alpha$  and  $\beta$ .
- The null hypothesis ( $H_0$ ) and alternative hypothesis ( $H_A$ ) are that of NUREG 1505 scenario A:
  - $H_0$  is that the survey unit does not meet the release criteria
  - $H_A$  is that the survey unit meets the release criteria
- Characterization and remedial action support surveys were conducted under the same quality assurance criteria as final status surveys such that the data was used as final status survey data to the maximum extent possible.
- Quality Assurance Surveys were conducted at a rate of 5%.

## **8.0 PROJECT MANAGEMENT AND ORGANIZATION**

Decommissioning activities were performed under Chase Commonwealth of Kentucky radioactive materials license number 201-605-15, and in accordance with the DWP. ViiV oversaw decommissioning activities and maintained responsibility for building maintenance, fire, and security functions.

## **9.0 TRAINING**

ViiV provided Chase personnel with site specific Contractor Site Orientation Training. Chase provided all project personnel with radiation worker training required by the radioactive materials license, as well as training for project-specific programs, plans, and procedures required by the DWP.

## **10.0 RADIATION SAFETY AND HEALTH PROGRAM**

Radiological work was performed according to the Chase radioactive materials license Radiation Safety Program.

## **11.0 ENVIRONMENTAL MONITORING PROGRAM**

Due to the limited scope of the project, a project-specific environmental monitoring program was not required.

## **12.0 RADIOACTIVE WASTE MANAGEMENT**

All radioactive waste generated from decontamination of the lockbox was packaged and sealed to prevent release of radioactivity and the external surfaces of the package were verified free of residual radioactivity. Decontamination waste consisted of plastic, cardboard, decontamination materials, and spent PPE. All waste was turned over to ViiV for disposal.

## **13.0 QUALITY ASSURANCE PROGRAM**

Project-specific QA requirements were included in the DWP to meet the guidelines of MARSSIM Section 9.

## **14.0 SURVEY INSTRUMENTATION**

### **14.1 Instrument Calibration**

Laboratory and portable field instruments were calibrated within the previous year with National Institute of Standards and Technology (NIST) traceable sources to radiation emission types and energies to provide detection capabilities similar to the nuclides of concern. Portable instrument calibration records are included as Appendix C.

### **14.2 Functional Checks**

Functional checks were performed at least daily when in use. The background, source check, and field measurement count times for radiation detection instrumentation were specified by procedure to ensure measurements were statistically valid. Background

readings were taken as part of the daily instrument check and compared with the acceptance range for instrument and site conditions.

Daily functional checks of the liquid scintillation counter consisted of performing the instrument's automatic quality assurance protocol that utilizes H-3 and C-14 sources as well as a background standard.

#### 14.3 Efficiency Determination

ISO 7503-1 methods were used for the limiting nuclide (C-14) to determine field concentrations for final status data and calculation of resultant doses from residual radioactivity. MARSSIM protocols for building structures use ISO-7503-1 methodology that takes into account the texture of the surface and the  $2\pi$  detector efficiency. Under MARSSIM, the default surface efficiency for beta emitters with maximum energies less than 400 keV is conservatively set at 0.25.

#### 14.4 Background Determination

The use of reference background areas or paired background comparisons was not necessary. Material and ambient background values were not significant compared to DCGLs or investigation levels. For direct measurements, an ambient background was determined for each survey, was subtracted from gross measurements, and was used to calculate the actual survey MDCs and associated count errors. Material-specific background determinations were not performed. Background was subtracted from removable activity measurements and results are reported in net dpm/100 cm<sup>2</sup> for H-3 and C-14, and net cpm/100 cm<sup>2</sup> for the open channel.

#### 14.5 Minimum Detectable Concentrations

Minimum counting times for background determinations and measurement of total and removable contamination were chosen to provide a minimum detectable concentration (MDC) that met the data quality objectives (DQOs). MARSSIM equations relative to building surfaces have been modified to convert to units of dpm/100 cm<sup>2</sup>. Count times and scanning rates are determined using the following equations:

##### 14.5.1 Static Counting

Static counting Minimum Detectable Concentration 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):

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

Where:

$MDC_{static}$	= minimum detectable concentration (dpm/100 cm <sup>2</sup> )
$B_r$	= background count rate (counts per minute)
$t_b$	= background count time (minutes)
$t_s$	= sample count time (minutes)
$E_{tot}$	= total detector efficiency for radionuclide emission of interest (cpm/dpm)
$A$	= detector probe area (cm <sup>2</sup> )

A typical static MDC calculation for C-14 using the Ludlum Model 43-37 gas flow proportional detector is shown below:

$$MDC_{static} = \frac{3 + 3.29 \sqrt{(1500)(0.1) \left(1 + \frac{0.1}{0.1}\right)}}{(0.1)(0.075) \left(\frac{584}{100cm^2}\right)} = 1,370 \text{ dpm}/100cm^2$$

#### 14.5.2 Ratemeter Scanning

Scanning Minimum Detectable Concentration 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 (dpm/100 cm <sup>2</sup> )
$d'$	= desired performance variable (1.38)
$b_i$	= background counts during the residence interval (counts)
$i$	= residence interval (seconds)
$p$	= surveyor efficiency (0.5)
$E_{tot}$	= total detector efficiency for radionuclide emission of interest (cpm/dpm)
$A$	= detector probe area (cm <sup>2</sup> )

A typical  $MDC_{SCAN}$  calculation for C-14 using the Ludlum 43-37 gas flow proportional detector is shown below:

$$i = 13.3 \text{ cm} \cdot \frac{\text{inch}}{2.54 \text{ cm}} \cdot \frac{\text{sec}}{20 \text{ inch}} = 0.262 \text{ sec}$$

$$b_i = 0.262 \text{ sec} \cdot \frac{1500 \text{ counts}}{\text{minute}} \cdot \frac{\text{minute}}{60 \text{ sec}} = 6.55 \text{ counts}$$

$$MDC_{scan} = \frac{1.38\sqrt{6.55}\left(\frac{60}{0.262}\right)}{(\sqrt{0.5})(0.075)\left(\frac{584}{100cm^2}\right)} = 2,612 \text{ dpm}/100 \text{ cm}^2$$

#### 14.5.3 Smear Counting

Smear counting Minimum Detectable Concentration 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):

$$MDC_{smear} = \frac{3 + 3.29 \sqrt{B_r \cdot t_s \cdot \left(1 + \frac{t_s}{t_b}\right)}}{t_s \cdot E}$$

Where:

- $MDC_{smear}$  = minimum detectable concentration level (dpm/smear)
- $B_r$  = background count rate (counts per minute)
- $t_b$  = background count time (minutes)
- $t_s$  = sample count time (minutes)
- $E$  = instrument efficiency for radionuclide emission of interest (cpm/dpm)

The liquid scintillation counter was setup to count samples in three channels as described in section 16.3. The MDC calculation for each LSC channel using conservative parameters is shown below. Even though channel 3 results were used qualitatively, the MDCR was calculated for evaluation of survey results to use the same MDC equation for all three LSC channels, the efficiency for Channel 3 is set to 1 to report MDCR in cpm.

$$^3H \text{ } MDC_{smear} = \frac{3 + 3.29 \sqrt{(15)(1) \left(1 + \frac{1}{1}\right)}}{(1)(0.6)} = 35 \text{ dpm}$$

$$^{14}C \text{ } MDC_{smear} = \frac{3 + 3.29 \sqrt{(25)(1) \left(1 + \frac{1}{1}\right)}}{(1)(0.8)} = 33 \text{ dpm}$$

$$\text{Open Channel } MDCR_{smear} = \frac{3 + 3.29 \sqrt{(50)(1) \left(1 + \frac{1}{1}\right)}}{(1)(1)} = 36 \text{ cpm}$$

Because the counting efficiency is different for each LSC measurement depending on quench characteristics, and in consideration of the errors associated with wipe counting (i.e., area wiped, wiping pressure, etc.), the *a priori* estimates of smear MDCs calculated above are applied to all removable contamination measurements.

#### 14.6 Uncertainty

The uncertainty for each static measurement is calculated using equation 6-15 from MARSSIM:

$$\sigma = 1.96 \sqrt{\frac{C_{s+b}}{T_{s+b}^2} + \frac{C_b}{T_b^2}}$$

where:

- $\sigma$  = uncertainty
- 1.96 = multiplier to achieve a 95% confidence level
- $C_{s+b}$  = gross sample counts
- $T_{s+b}$  = sample count time (min.)
- $C_b$  = gross background counts
- $T_b$  = background count time (min.)

Uncertainties presented with total surface activity results are additionally corrected for detection efficiency and probe area for presentation in the same units as total surface activity results.

#### 14.7 Instrumentation Specifications

The instrumentation used for facility decommissioning surveys is summarized in the following tables. The first table lists the standard features of each instrument such as probe size and efficiency. The second table lists the typical operational parameters such as scan rate, count time, and the associated Minimum Detectable Concentrations (MDC). These parameters are typical of the instrumentation; actual instrument-specific parameter values were used for each measurement to verify that DQOs were met.

**Table 14-1: Instrumentation Specifications**

Detector Model	Detector Type	Detector Area	Meter Model	Window Thickness	Typical Efficiency <sup>1</sup>
Ludlum 43-68	Gas Flow Proportional	126 cm <sup>2</sup>	Ludlum 2241-3	0.8 mg/cm <sup>2</sup>	7.5 % (C-14)
Ludlum 43-37	Gas Flow Proportional	584 cm <sup>2</sup>	Ludlum 2241-3	0.8 mg/cm <sup>2</sup>	7.5 % (C-14)
Packard TriCarb	Liquid Scintillation	N/A	N/A	N/A	25% (H-3) 45% (C-14) 95% (open)

<sup>1</sup> The efficiency for each smear sample is automatically determined by the liquid scintillation counter for the H-3 and C-14 channels, depending on the quench characteristics of the sample. The values presented are typical values for samples that are not highly quenched as would be expected in a facility that was recently decontaminated.



**Table 14-2: Typical Instrument Operating Parameters and Sensitivities**

Measurement Type	Detector Model	Max. Scan Rate <sup>2</sup>	Count Time	Background (cpm)	MDC (dpm/100 cm <sup>2</sup> )
Surface Scans	Ludlum 43-68	5 in./sec.	N/A	500	4,297
Surface Scans	Ludlum 43-37	20 in./sec.	N/A	1,500	2,612
Total Surface Activity	Ludlum 43-68	N/A	6 sec.	500	3,799
Total Surface Activity	Ludlum 43-37	N/A	6 sec.	1,500	1,370
Removable Activity	Packard TriCarb	N/A	60 sec.	15 (H-3) 25 (C-14) 50 (open)	35 (H-3) 33 (C-14) 38 (open)

#### 14.8 Datalogging

Structural surface scans and static measurements were performed using datalogging instrumentation. While scanning, in addition to the surveyor listening to the audible output, integrated counts were recorded. Logged data was downloaded and processed using data management software to perform data analyses and reporting. Reporting includes graphical (4-plot) presentation of scan data as well as summary statistics functions. The 4-Plot is described in the NIST e-Handbook of Statistical Methods.  
(<http://www.itl.nist.gov/div898/handbook/index.htm>)

A 4-plot consists of the following:

- A run **sequence plot** presents logged data in chronological order, providing a time history of the survey data.
- A **lag plot** checks whether a data set or time series is random or not. Random data should not exhibit any identifiable structure in the lag plot. Non-random structure in the lag plot indicates that the underlying data are not random.
- A **histogram plot** graphically summarizes the distribution of a univariate data set, showing center (i.e., the location) of the data, spread (i.e., the scale) of the data, skewness of the data, presence of outliers, and presence of multiple modes.
- A **probability plot** is a test used to verify the distributional model. The normal probability plot is a graphical technique for assessing whether or not a data set is approximately normally distributed. The data are plotted against a theoretical normal distribution in such a way that the points should form an approximate straight line. Departures from this straight line indicate departures from normality.

<sup>2</sup> Maximum scan rates are calculated based on the instrument MDC DQOs. Actual scan rates were slower.

## 15.0 AREA CLASSIFICATIONS

Based on the historical site assessment and previous survey results, facility areas were classified as impacted or non-impacted.

### 15.1 Non-Impacted Area

Non-impacted areas were areas without residual radioactivity from licensed activities and were not surveyed during final status surveys. The following areas were classified as non-impacted:

- Building structural surfaces above a two-meter height
- Building exterior surfaces
- Building mechanical system internals (ventilation, vacuum, drain, etc.)
- Indoor areas not classified below

### 15.2 Impacted Areas

Impacted areas were those areas that had potential residual radioactivity from licensed activities. Impacted areas are subdivided into Class 1, Class 2, or Class 3 areas. Class 1 areas have the greatest potential for contamination and therefore receive the highest degree of survey effort for the final status survey using a graded approach, followed by Class 2, and then by Class 3. Impacted sub-classifications are defined as follows:

#### 15.2.1 Class 1 Area

Areas with the highest potential for contamination and meet the following criteria: (1) impacted; (2) potential for delivering a dose above the release criterion; (3) potential for small areas of elevated activity; and (4) insufficient evidence to support classification as Class 2 or Class 3.

There were no Class 1 areas.

#### 15.2.2 Class 2 Area

Areas that meet the following criteria: (1) impacted; (2) low potential for delivering a dose above the release criterion; and (3) little or no potential for small areas of elevated activity.

There were no Class 2 areas.

#### 15.2.3 Class 3 Area

Areas that meet the following criteria: (1) impacted; (2) little or no potential for delivering a dose above the release criterion; and (3) little or no potential for small areas of elevated activity.

Indoor areas with a history of storage of radionuclides, and areas bordering historical storage areas were classified as Class 3.

### 15.3 Survey Units

A survey unit is a geographical area of specified size and shape for which a separate decision is made whether or not that area meets the release criteria. A survey unit is normally a portion of a building or site that is surveyed, evaluated, and released as a single unit. Areas of similar construction and composition were grouped together as a survey unit and tested individually against the DCGLs and the null hypothesis to show compliance with the release criteria.

#### Survey Unit Numbering Protocol

Each survey unit is assigned a unique number consisting of the building number followed by a dash and a four-digit identifier. The four-digit identifier consists of one digit for the elevation, one digit for the classification, and two digits as a numerical identifier using the format below:

Building Number – Elevation/Classification/Numerical Identifier

The default numeric identifier is 01

Building:

VHB = ViiV Healthcare

Elevation:

2 = 2<sup>nd</sup> Floor

Examples:

VHB-2301 is ViiV Healthcare, Second Floor, Class 3

Survey unit classifications and designations were determined from the historical site assessment and characterization survey results and are listed in the tables below. Survey unit designations are identified on the building floor plans presented in Appendix B.

**Table 15-1: Building Structural Survey Units**

Survey Unit	Description
VHB-2301	Room 233, Room 226, and bordering corridors

## 16.0 FINAL STATUS SURVEYS

Final status surveys were performed using the DQO process to demonstrate that residual radioactivity in each survey unit satisfied the predetermined criteria for release for unrestricted use. Final status surveys were conducted by performing the appropriate combination of scan surveys, total activity measurements and removable activity measurements as discussed further in this section. All final status surveys were performed according to written instructions. Survey data were documented on survey maps and/or associated data information sheets.

## 16.1 Surface Scans

Scanning was used to identify locations within the survey unit that exceed the investigation level. The table below summarizes the minimum scan percentage of accessible building structural surfaces based on classification.

**Table 16-1: Scan Survey Coverage by Classification**

Structure	Class 3
Floors	20%
Other Structures	10%

For surfaces that received less than 100% scan survey, the surfaces scanned were those with the highest potential to contain residual radioactivity at the discretion of the surveyor. Floor areas near room entrances and exits received a 100% scan survey regardless of the area classification. These surveys would provide indications of potential migration of residual contamination to areas outside of the facility.

## 16.2 Total Surface Activity Measurements

Direct surveys (static measurements) for total surface activity were taken on building surfaces in impacted areas utilizing instrumentation of the best geometry based on the surface at the survey location. Scaler count times were determined to achieve the detection sensitivities stated in the DQOs. Field measurements were converted to activity concentrations using the following equation:

$$\text{Activity (dpm/100 cm}^2\text{)} = \frac{R_{s+b} - R_b}{E_{\text{total}} \times \frac{A}{100 \text{ cm}^2}}$$

Where:

- $R_{s+b}$  = The gross count rate of the measurement (cpm)
- $R_b$  = The background count rate (cpm)
- $E_{\text{total}}$  = Total efficiency (cpm/dpm)
- $A$  = Area of the detector window (cm<sup>2</sup>)

### 16.2.1 Determining the Number of Samples

The minimum number of samples required for the Sign Test was calculated using equations in Section 5 of MARSSIM. The LBGR was set at one half of the DCGL. The calculations performed to determine the required numbers of samples are provided below.

#### Determination of the Relative Shift

The number of required samples depends on the ratio involving the activity level to be measured relative to the variability in the concentration. The ratio to be used is called the Relative Shift,  $\Delta/\sigma_s$ , and is defined in MARSSIM as:

$$\Delta/\sigma_s = \frac{DCGL - LBGR}{\sigma_s}$$

Where:

- DCGL = derived concentration guideline level (dpm/100 cm<sup>2</sup>)
- LBGR = concentration at the lower bound of the gray region. The LBGR is the average concentration to which the survey unit should be cleaned in order to have an acceptable probability of passing the test (dpm/100 cm<sup>2</sup>)
- $\sigma_s$  = the standard deviation of the residual radioactivity in the survey unit (dpm/100 cm<sup>2</sup>)

The actual calculation is provided below:

$$\Delta/\sigma_s = \frac{2.8 E6 - 1.4 E6}{560} = 2500$$

#### **Determination of Acceptable Decision Errors**

A decision error is the probability of making an error in the decision on a survey unit by passing a unit that should fail ( $\alpha$  decision error) or failing a unit that should pass ( $\beta$  decision error). The decision errors are 0.05 for both  $\alpha$  and  $\beta$ .

#### **Determination of Number of Data Points (Sign Test)**

The number of direct measurements for a particular survey unit, employing the Sign Test, is determined from MARSSIM Table 5.5, which is based on the following equation (MARSSIM equation 5-2):

$$N = \frac{(Z_{1-\alpha} + Z_{1-\beta})^2}{4(\text{Sign}P - 0.5)^2}$$

Where:

- N = number of samples needed in the survey unit
- $Z_{1-\alpha}$  = percentile represented by the decision error  $\alpha$
- $Z_{1-\beta}$  = percentile represented by the decision error  $\beta$ .
- SignP* = estimated probability that a random measurement will be less than the DCGL when the survey unit median is actually at the LBGR

*Note: SignP is determined from MARSSIM Table 5.4*

MARSSIM recommends increasing the calculated number of measurements by 20% to ensure sufficient power of the statistical tests and to allow for possible data losses. MARSSIM Table 5.5 values include an increase of 20% of the calculated value. The following calculations were made to determine this number:

$$N = \frac{(1.645 + 1.645)^2}{4(1.0 - 0.5)^2} = 11$$

$Z_{1-\alpha}$  and  $Z_{1-\beta}$  are equal to 1.645 using the error rate of 0.05 from MARSSIM Table 5.2. SignP is equal to 1.0 from MARSSIM Table 5.4. Adding an additional 20% to account for data losses resulted in a value of 14.

Therefore, the determined number of samples per survey unit for the final status surveys for planning purposes was 14.

#### 16.2.2 Determination of Sample Locations

Class 3 survey units generally consist of multiple rooms. The process to identify, map and locate measurement coordinates in survey units with many rooms is complicated due to the noncontiguous nature of the survey unit once walls are “folded-out”. Therefore, the MARSSIM sample measurement locations (i.e., random static and wipe measurements) were determined only on horizontal surfaces as determined on floor plans. This protocol increases the sample density on the surfaces with the highest probability for residual contamination (floors, benchtops, fume hood working surfaces, etc.). The appropriate percentage of all survey unit surfaces (including vertical surfaces) was scanned according to the survey unit classification. In laboratory areas, permanent counter tops and other horizontal surfaces that block floor surfaces were included as a replacement to the blocked floor surface.

As part of characterization, the survey technician judgmentally selected ten locations with the highest probability of contamination on vertical surfaces for a static measurement and smear, such as light switches, doorknobs, door pulls, push plates, and other locations. These measurements were in addition to and were not included in the statistical analysis of the locations selected by MARSSIM protocols. No areas of residual radioactivity were identified by these judgmental measurements and all results were less than the instrument MDC.

Determination of Class 3 survey unit sample locations was accomplished by first determining sample spacing and then systematically plotting the sample locations from a randomly generated start location.<sup>3</sup> 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 floor area

N = number of samples needed in the survey unit

---

<sup>3</sup> MARSSIM recommends random sampling (random x, random y) for Class 3 areas. However, in this survey design, the Class 3 area is sampled on a systematic grid pattern in the same manner as MARSSIM recommends for Class 1 and Class 2 areas.

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 was plotted across the survey unit surfaces based on the random start point and the determined sample spacing. A measurement location was plotted at each intersection of the grid. A map of final status survey locations for the survey unit is included in Appendix D.

### 16.3 Removable Surface Activity Measurements

Removable surface activity measurements were collected by wiping an area of approximately 100 cm<sup>2</sup> on building structural surfaces. The smears were counted to achieve the detection sensitivities stated in the DQOs. The LSC was set up for three channels with background subtraction at the following energies:

Channel 1 ( <sup>3</sup> H dpm):	0 – 18.6 keV
Channel 2 ( <sup>14</sup> C dpm):	18.6 – 156 keV
Channel 3 (cpm):	0 – 2,000 keV

Channel 3 results were used to verify that H-3 and C-14 are the only nuclides of concern.

### 16.4 Survey Documentation

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

- Survey Unit number (e.g., Building and Room Number, etc.)
- General survey requirements
- Survey Instruction Sheets
- Percentage of surfaces requiring scan surveys
- Number of total and removable contamination measurements required
- Instrument requirements with associated MDCs, count times and scan rates
- Maps of the survey unit surfaces detailing survey locations and placement methodology
- Any additional specific survey instruction
- Survey Data Sheets
- Signature of Data Collector and Reviewer

To ensure proper data management and organization, a unique location code system was used so that survey data could be properly entered and organized in the Final Status Survey Database. A breakdown of the location code and specific code components are provided in the table below.

**Table 16-2: Location Code Description**

A unique location code was assigned to each individual survey location to ensure proper data management of the survey results. The following format was used to ensure consistency throughout the final status survey process:	
<b>BBB-RRRR-SS-M-LLL</b>	
Where:	
BBB:	= Building Code. This field represents the building number. (3 characters) VHB = ViiV Healthcare
RRRR:	= Survey Unit Number. This is the assigned survey unit number. (4 characters)
SS:	= Structural Surface Code. This field represents the structural surface such as floor, wall, ceiling, etc. (2 characters) F1 = Floor
M:	= Structural Material Code. This field represents the type of structural material on which a particular measurement is taken. (1 character) V = Vinyl Tile/Sheeting
LLL:	= Numerical Identifier. This field represents the survey location number. The field "001" means survey point location number 1. Numerical identifiers are unique within a survey unit. (3-characters)

## 17.0 Equipment and Materials Release

The lockbox and freezer are not considered building structures and therefore did not receive final status surveys; instead, these are considered equipment/materials and received release surveys per NUREG 1556, Volume 7 to meet the limits of Table M-2, "Acceptable Surface Contamination Levels."

Radiological surveys of the lockbox internal surfaces identified H-3 contamination of 52,607 dpm/100 cm<sup>2</sup> at one location; external surfaces of the lockbox did not have detectable residual radioactivity. The lockbox was decontaminated by wet wiping with a mild detergent and removal of plastic and cardboard containers within the lockbox. Radioactive waste from decontamination was sealed and turned over to ViiV for disposal.

After decontamination of the lockbox, additional removable contamination measurements were taken within lockbox, the freezer, the floor surrounding the freezer's location, and on the table and surrounding floor where the samples were packaged for disposal. The highest result was 321 dpm/100 cm<sup>2</sup> (H-3) removable on one of the lead pigs stored in the lockbox.



## **18.0 CHARACTERIZATION SURVEYS**

The survey protocol for building surfaces consisted of performing the scanning portion of the final status survey protocol, with judgmental smears and static measurements on areas of highest probability for residual radioactivity. Judgmental static measurements and smears were taken on vertical surfaces as part of the Class 3 final status survey protocols described in section 16.2.2.

The purpose of scanning was to identify locations of elevated activity. The minimum scan percentages are presented in section 16.1. Scanning was performed by moving the probe over surfaces at a distance of approximately 0.5 cm or less and at a rate less than the maximum allowable scan rate necessary to achieve DQOs.

No elevated activity was identified above investigation levels during facility structural characterization surveys.

## **19.0 REMEDIATION**

No remediation of building structural surfaces was required; all impacted surfaces were below investigation levels.

## **20.0 SURVEY RESULTS AND DATA QUALITY ASSESSMENT**

The statistical guidance contained in Section 8 of MARSSIM was used to determine if areas are acceptable for unrestricted release and whether additional surveys or sample measurements were required.

### **20.1 Data Validation**

Field data were reviewed by the Project Manager and validated to ensure:

- Completeness of forms
- Proper types of surveys were performed
- The MDCs for measurements met the established data quality objectives
- Independent calculations were performed on a representative sample of data sheets
- Satisfactory instrument calibrations and daily functionality checks were performed as required

Additionally, all final status survey data were entered into the Final Status Survey Database. This provided the means to sort survey data, verify activity calculations, and to compute the associated MDC and counting errors. Once data entry for a survey unit was complete, a verification report was printed and compared to original data sheets to ensure correct data entry.

## 20.2 Preliminary Data Review

A preliminary data review was performed for the survey unit to identify any patterns, relationships, or anomalies. Additionally, measurement data were reviewed and compared with the DCGLs and investigation levels to confirm the correct classification of the survey unit.

The following preliminary data reviews were performed:

- Review of the 4-Plot graphs of scan data
- Calculations of the survey unit mean, median, maximum, minimum, and standard deviation for each type of reading
- Comparison of the actual standard deviation to the assumed standard deviation used for calculating the number of measurements
- Comparison of survey data with applicable investigation levels

The actual standard deviation for the survey unit was less than the assumed standard deviation used for calculating the number of measurements, therefore an adequate number of samples were collected.

## 20.3 Building Structural Surfaces Scan Data

The surveyor scanned approximately 80% of floor surfaces and 20% of wall surfaces within the survey unit. No elevated activity was identified by listening to the audible detector response. A 4-Plot of scan data was produced for the survey unit. The 4-Plot graph indicates that the scan data is approximately normally distributed. The 4-Plot graph of the scan results is provided in Appendix E.

## 20.4 Data Summary Tables

All calculations of means, standard deviations, minimum and maximum values and comparisons between survey data and investigation levels are presented in the following tables. Building structural surface activity reports for each survey unit are included as Appendix F.

**Table 20-1: Structural Surfaces Total Beta Surface Activity Summary**

Survey Unit	# of Sample Locations	Mean	MDC	Standard Deviation	Min.	Max.	Investigation Level	Any Result Exceeding Investigation Level?
		(net dpm/100 cm <sup>2</sup> )						
VHB-2301	12	639	2,659	560	-420	1,366	5,000	NO

**Table 20-2: Building Structural Surfaces Removable H-3 Summary**

Survey Unit	# of Sample Locations	Mean	Standard Deviation	Min.	Max.	Investigation Level	Any Result Exceeding Investigation Level?
		(net dpm/100 cm <sup>2</sup> )					
VHB-2301	12	5	5	0	14	1,000	NO

**Table 20-3: Building Structural Surfaces Removable C-14 Summary**

Survey Unit	# of Sample Locations	Mean	Standard Deviation	Min.	Max.	Investigation Level	Any Result Exceeding Investigation Level?
		(net dpm/100 cm <sup>2</sup> )					
VHB-2301	12	6	5	0	15	1,000	NO

**Table 20-4: Building Structural Surfaces Removable Open Channel Summary**

Survey Unit	# of Sample Locations	Mean	Standard Deviation	Min.	Max.	Investigation Level	Any Result Exceeding Investigation Level?
		(net cpm/100 cm <sup>2</sup> )					
VHB-2301	12	9	6	0	20	1,000	NO

## 20.5 Determining Compliance for Building Structural Surfaces

Final status survey results were initially compared to the investigation levels. All total and removable surface activity measurements were below the investigation levels and well below the DCGL.

The results of the data quality assessment and calculations of the dose from the structural surface survey unit based on MARSSIM grid locations are presented in the table below.

**Table 20-5: Structural Surfaces Total Beta Surface Activity Dose Calculations**

Survey Unit	Standard Deviation (dpm/100 cm <sup>2</sup> )	# Samples Required	Actual # of Samples	Adequate # of Samples?	Mean (dpm/100 cm <sup>2</sup> )	Calculated Annual TEDE <sup>4</sup> (mrem/yr)
VHB-2301	560	11	12	YES	639	0.004
					Maximum	0.004

## 21.0 QUALITY ASSURANCE SURVEYS

### 21.1 QA Survey Methods

Quality assurance surveys consisted of re-performing the FSS protocol for building structural surfaces to achieve a minimum of 5% duplication of scans, static measurements, and smears. The Project Manager implemented QA surveys by re-performing judgmentally selected survey locations as survey unit VHB-QA01. The locations of QA survey total and removable surface activity measurements are presented in the table below.

<sup>4</sup> The TEDE shown is conservatively calculated by multiplying 25 mrem/yr by the ratio of the mean total surface activity to the C-14 DSV of 3.7E6 dpm/100 cm<sup>2</sup>.

**Table 21-1: QA Survey Locations**

QA Survey Location	FSS Location
VHB-QA01-F1-V-001	VHB-2301-F1-V-011

## 21.2 QA Survey Results

All QA survey results were similar to FSS data and the conclusions were the same as those based on the initial surveys. QA survey results are presented in Appendix G and are summarized in the tables below.

**Table 21-2: QA Building Structural Surfaces Total Activity Summary**

Survey Unit	# of Sample Locations	Mean	MDC	Standard Deviation	Min.	Max.	Investigation Level	Any Result Exceeding Investigation Level?
		(net dpm/100 cm <sup>2</sup> )						
VHB-QA01	1	525	2,807	N/A	525	525	5,000	NO

**Table 21-3: QA Building Structural Surfaces Removable H-3 Summary**

Survey Unit	# of Sample Locations	Mean	Standard Deviation	Min.	Max.	Investigation Level	Any Result Exceeding Investigation Level?
		(net dpm/100 cm <sup>2</sup> )					
VHB-QA01	1	1	N/A	1	1	1,000	NO

**Table 21-4: QA Building Structural Surfaces Removable C-14 Summary**

Survey Unit	# of Sample Locations	Mean	Standard Deviation	Min.	Max.	Investigation Level	Any Result Exceeding Investigation Level?
		(net dpm/100 cm <sup>2</sup> )					
VHB-QA01	1	3	N/A	3	3	1,000	NO

**Table 21-5: QA Building Structural Surfaces Removable Open Channel Summary**

Survey Unit	# of Sample Locations	Mean	Standard Deviation	Min.	Max.	Investigation Level	Any Result Exceeding Investigation Level?
		(net cpm/100 cm <sup>2</sup> )					
VHB-QA01	1	5	N/A	5	5	1,000	NO

## 22.0 ALARA ANALYSIS

Due to the extremely low doses associated with residual radioactivity at the facility, a quantitative ALARA analysis was not required. Default screening values normalized to 19 mrem/yr were used to establish DCGLs. NUREG 1757, Volume 2, Appendix N states in part: "For ALARA during decommissioning, all licensees should use typical good-practice efforts such as floor and wall washing, removal of readily removable radioactivity in buildings or in

soil areas, and other good housekeeping practices. In addition, licensees should provide a description in the Final Status Survey Report (FSSR) of how these practices were employed to achieve the final activity levels. In light of the conservatism in the building surface and surface soil generic screening levels developed by NRC, NRC staff presumes, absent information to the contrary, that licensees who remediate building surfaces or soil to the generic screening levels do not need to provide analyses to demonstrate that these screening levels are ALARA.”

## 23.0 CONCLUSION

Radiological surveys demonstrate that building structural surfaces included in the scope of this report are below release criteria and are suitable for unrestricted release. A sufficient number of samples were taken in the survey unit, and all total and removable surface activity results were less than the investigation levels and significantly less than the applicable DCGL, so no further statistical tests are required.

*Conclusion: The null hypothesis is rejected; the survey unit passes the statistical tests and is suitable for release for unrestricted use.*

## 24.0 REFERENCES

- ViiV Healthcare Radioactive Materials License Number 06-35429-01
- USNRC Regulations
- CT DEEP Regulations
- Chase Kentucky License Number 201-605-15
- Chase Radiation Safety Manual
- Chase Quality Assurance Program
- NUREG-1757, Volume 1, Revision 2, “Consolidated NMSS Decommissioning Guidance: Decommissioning Process for Materials Licensees,” September 2006
- NUREG-1575, Revision 1, “Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM),” August 2000
- NUREG 1507, Revision 1 “Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions,” August 2020
- NUREG 1556, Volume 7, Revision 1, “Consolidated Guidance About Materials Licenses, Program-Specific Guidance About Academic, Research and Development, and Other Licenses of Limited Scope Including Gas Chromatographs and X-Ray Fluorescence Analyzers,” February 2018
- ISO-7503-1, “Evaluation of Surface Contamination – Part 1: Beta Emitters and Alpha Emitters,” 1988

# **Appendix A**

## **Site Satellite Photograph**

ViiV Healthcare



ViiV Healthcare  
Branford, CT Site  
Final Status Survey Report



Site Satellite Photograph

Page: A.1 of A.1



## **Appendix B**

### **Building Floor Plan**



VHB-2301

Class 3



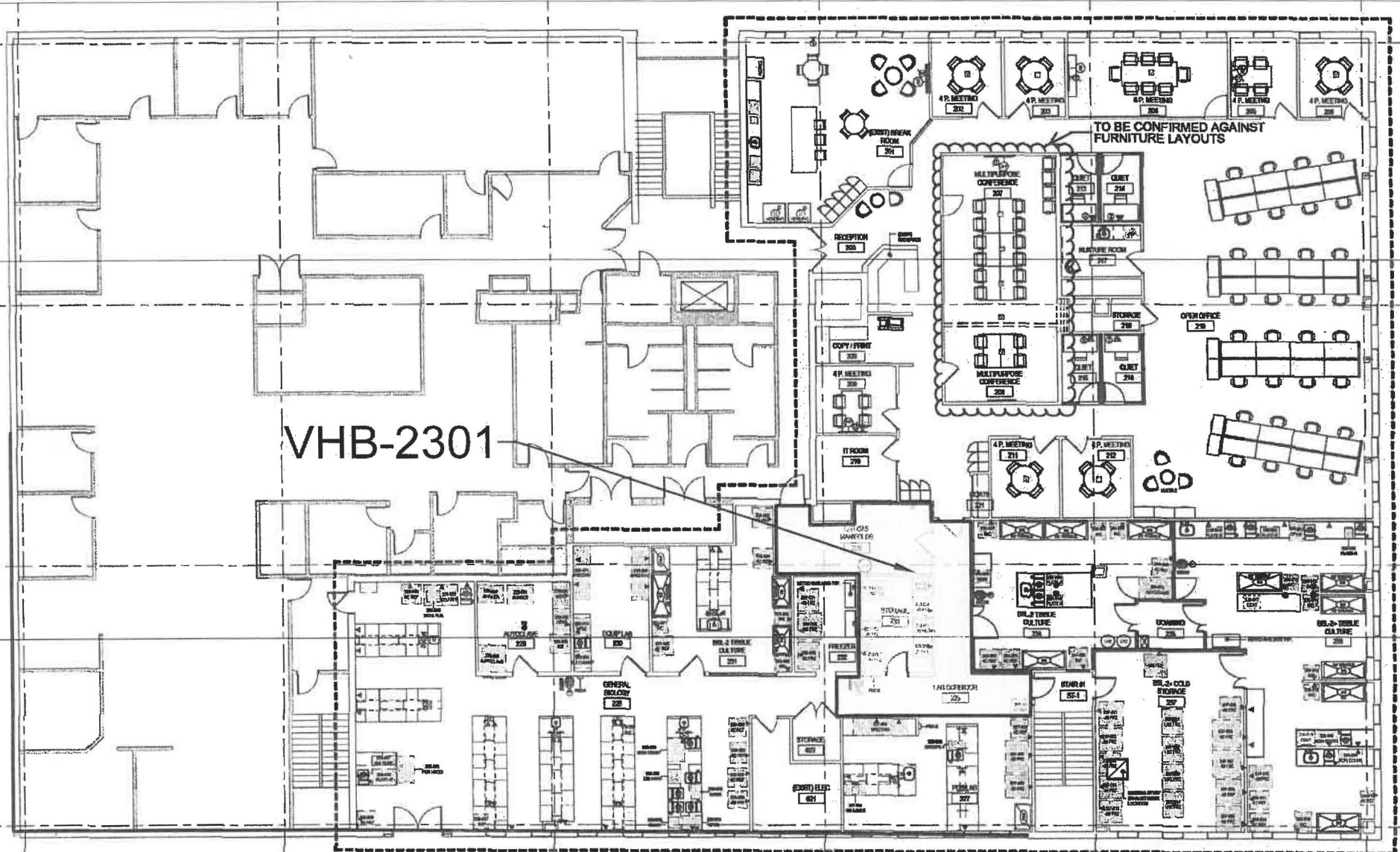
ViV Healthcare  
Branford, CT Site  
Final Status Survey Report



Building: VHB

Elevation: 2nd

Page: B.1 of B.1



## **Appendix C**

# **Instrument Calibration Records**

## SEC INSTRUMENTATION SERVICES

10512 Lexington Drive  
Suite 200  
Knoxville, TN 37932

SEC Corporate  
2800 Solway Road  
Knoxville, TN 37931



### Model 2241-3 CALIBRATION FORM

Serial number : 253356 Customer Name : Chase  
Previous due date : 10/14/2021 P.O Number :  
Date : 9/30/2021 Technician : Jacob Galyon

Reason For Calibration : Due for Calibration

INSTRUMENT(S) USED DURING CALIBRATION		
Model Number: 500-2	Serial Number: 268940	Calibration Due date: 6/9/2022
Model Number:	Serial Number:	Calibration Due date:

Instrument Condition	
As Found	As Left
SAT	SAT

Threshold	
As Found	As Left
4.0	4.0

Battery Indicator
SAT

SCA/RATE Switch
SAT

Detector #	Set Voltage		High Voltage Range	
	As Found	As Left	As Found	As Left
1	1750	1750	SAT	SAT
2	1875	1875	SAT	SAT
3	1125	1125	SAT	SAT
4	1275	1275	SAT	SAT

Digital Scaler				
Target	As Found	%Error	As Left	%Error
250	249	0.40%	249	0.40%
2,500	2,491	0.36%	2,491	0.36%
25,000	24,907	0.37%	24,907	0.37%
250,000	249,072	0.37%	249,072	0.37%

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

OK	Is the As Found Data within 20% of the set point?	OK	Audio Response
OK	Are the Individual counts within 10% of the average?	OK	Push Buttons
OK	Fast / Slow response switch functions properly?	OK	RESET
OK	Does Instrument meet final Acceptance Criteria?	OK	Audio Switch
OK	Calibration sticker attached?	OK	Light

Married with:	1750V	DET 1	Model:	43-68	Serial Number:	PR289219
	1875V	DET 2	Model:	43-37	Serial Number:	PR281040
	1125V	DET 3	Model:	43-68	Serial Number:	PR289219
Comments :	1275V	DET 4	Model:	43-37	Serial Number:	PR281040

Instrument calibrated per SEC-IS-423.

5 foot cable used for the 43-68

10 foot cable used for the 43-37

Date instrument is due for next calibration : 9/30/2022

Performed by : Jacob Galyon Date: 9/30/21 Reviewed by: [Signature] Date: 10/8/21  
Printed name : Jacob Galyon



**Safety and Ecology Corporation** SEC PROCEDURE # SEC-IS-417 Rev 5  
10512 Lexington Drive, Suite 200, Knoxville, TN 37932  
**Calibration Certificate**

**Calibration Certificate for 43-68, Serial # PR289219, Bar Code # Orange, Property # Chase51**

Date: 09/30/21 Date Last Cal. Expires: 10/14/21 Technician: Jacob Galyon Reason For Calibration: Due for Calibration

Temp RelHum: BP: CableLength 5 Ft

**EQUIPMENT USED DURING CALIBRATION** MODEL: 2241-3 SERIAL #: 253356 CAL DUE 09/30/22

NIST TRACEABLE SOURCES USED	SOURCE	ISOTOPE	ACTIVITY	2π	ASSAY DATE
<b>Efficiencies from last calibration</b>					
Pu-239: 18.19 %	4079-02	Pu-239	28992 dpm	14,696 cpm	1/20/2021
Tc-99: 24.63 %	4072-02	Tc-99	28299 dpm	17,699 cpm	1/20/2021
Th-230: 15.68 %	4071-02	Th-230	40296 dpm	20,498 cpm	1/20/2021
SrY-90: 39.20 %	4076-02	Sr-90	9539 dpm	6,693 cpm	1/20/2021

**AS FOUND DATA** AS FOUND Instrument Condition: SAT  
Calibration Setpoints

HV (Alpha): 1125 V HV (Beta): 1750 V Threshold: 4 mV

Back	Alpha	Beta	AF 4 π Efficiencies
ground:	1 CPM	251 CPM	
Pu-239:	5192 CPM	N/A	17.90%
Tc-99:	N/A	7215 CPM	24.61%
Th-230:	6467 CPM	N/A	16.05%
SrY-90:	N/A	4023 CPM	39.54%

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

**AS LEFT Instrument Condition: SAT**  
AS LEFT DATA after repair, HV adjust or Plateau

HV (Alpha): 1125 V HV (Beta): 1750 V Threshold: 4 mV

Back	Alpha	Beta	AL 4 π Efficiencies
ground:	1 CPM	251 CPM	
Pu-239:	5192 CPM	N/A	17.90%
Tc-99:	N/A	7215 CPM	24.61%
Th-230:	6467 CPM	N/A	16.05%
SrY-90:	N/A	4023 CPM	39.54%

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

Reproducibility : Isotope: Sr-90 4002 3984 4111 Average: 4032.3 ☒ Are the individual counts within 10% of the average?

If the As Found data (even after repair) is within 10% of the last calibration, then the technician may N/A Plateau Data and go directly to Comments. Geometry of source = flush to surface, except gas proportional probes = 1/8" from surface unless otherwise specified.

Alpha Source: Th-230

**PLATEAU DATA**

Beta Source: Tc-99

HV	CPM	CPM
(Alpha)	A ch.	A ch. Net 4π Eff.
N/A		

HV	CPM	CPM
(Beta)	B ch.	B ch. Net 4π Eff.
N/A		

**2 Pi Efficiencies:** Pu-239 35.32% Tc-99 39.35% Th-230 31.54% SrY-90 56.36%

**Comments:** Married as a set with: Model: 2241-3 Serial #: 253356 Bar Code #: Orange

☒ Does Instrument Meet Final Acceptance Criteria?

☒ Calibration Sticker Attached?

Date Instrument is Due For Next Calibration: 09/30/22

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

The results in this report relate only to the item calibrated or tested.

Performed by: Jacob Galyon  
Printed Name: Jacob Galyon

Reviewed by: [Signature] Issue Date: 10/8/21





## SEC INSTRUMENTATION SERVICES

10512 Lexington Drive  
Suite 200  
Knoxville, TN 37932

### C-14 SOURCE CALIBRATION FORM

Probe Model Number : 43-68 Customer Name : Chase Environmental  
Probe Serial Number : PR289219 Technician : Jacob Galyon  
Date of Calibration : 9/30/2021

Instruments used during calibration			
Model Number:	2241-3	Serial Number:	253356
Model Number:		Serial Number:	

NIST Traceable Source(s) used : Activity(s)

	Source S/N	Emission Rate	2 Pi (cpm)	uCi	4Pi (dpm)	Assay Date
1> C-14	DX 295	432	25,920	0.0305405	67,800	5/3/1994

#### Data

Instrument condition : Sat  
High Voltage: 1750

Background: 251

C-14 Count: 8124

2 $\pi$  Efficiency: 30.37%

4 $\pi$  Efficiency: 11.61%

Calibration sticker attached? Yes

Comments : Married as a set with : Model : 2241-3 Serial # : 253356  
Calibrated with a 5' cable with plastic standoffs attached.

Date instrument is due for next calibration : 9/30/2022  
Performed by : Jacob Galyon Reviewed by : CHAD Date : 10/8/21  
Printed Name : Jacob Galyon



**Safety and Ecology Corporation** SEC PROCEDURE # SEC-IS-417 Rev 5  
10512 Lexington Drive, Suite 200, Knoxville, TN 37932  
**Calibration Certificate**

**Calibration Certificate for 43-37, Serial # PR281040, Bar Code # Orange, Property # Chase50**

Date: 09/30/21 Date Last Cal. Expires: 10/14/21 Technician: Jacob Galyon Reason For Calibration: Due for Calibration  
Temp RelHum: BP: CableLength 10 Ft

**EQUIPMENT USED DURING CALIBRATION** MODEL: 2241-3 SERIAL #: 253356 CAL DUE 09/30/22

NIST TRACEABLE SOURCES USED	SOURCE	ISOTOPE	ACTIVITY	2π	ASSAY DATE
<b>Efficiencies from last calibration</b>	4079-02	Pu-239	28992 dpm	14,696 cpm	1/20/2021
<b>Pu-239:</b> 18.30 %	4072-02	Tc-99	28299 dpm	17,699 cpm	1/20/2021
<b>Tc-99:</b> 24.92 %	4071-02	Th-230	40296 dpm	20,498 cpm	1/20/2021
<b>Th-230:</b> 15.19 %	4076-02	Sr-90	9539 dpm	6,693 cpm	1/20/2021
<b>SrY-90:</b> 36.74 %					

**AS FOUND DATA** AS FOUND Instrument Condition: UNSA  
Calibration Setpoints

HV (Alpha): 1275 V	HV (Beta): 1875 V	Threshold: 4 mV
Back ground:	Alpha	Beta
Pu-239:	5193 CPM	N/A
Tc-99:	N/A	7950 CPM
Th-230:	6497 CPM	N/A
SrY-90:	N/A	4814 CPM

**AS LEFT Instrument Condition: SAT**  
AS LEFT DATA after repair, HV adjust or Plateau

HV (Alpha): 1275 V	HV (Beta): 1875 V	Threshold: 4 mV
Back ground:	Alpha	Beta
Pu-239:	5193 CPM	N/A
Tc-99:	N/A	7950 CPM
Th-230:	6497 CPM	N/A
SrY-90:	N/A	4814 CPM

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

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

Reproducibility : Isotope: Sr-90 4708 4677 4757 Average: 4714.0 ☒ Are the individual counts within 10% of the average?

If the As Found data (even after repair) is within 10% of the last calibration, then the technician may N/A Plateau Data and go directly to Comments. Geometry of source = flush to surface, except gas proportional probes = 1/8" from surface unless otherwise specified.

**Alpha Source: Th-230**

Response	Background
HV CPM	CPM
(Alpha) A ch.	A ch. Net 4π Eff.
N/A	

**PLATEAU DATA**

**Beta Source: Tc-99**

Response	Background
HV CPM	CPM
(Beta) B ch.	B ch. Net 4π Eff.
N/A	

**2 Pi Efficiencies:**

<b>Pu-239</b>	<b>Tc-99</b>	<b>Th-230</b>	<b>SrY-90</b>
35.32%	39.38%	31.69%	57.27%

**Comments:** Married as a set with: Model: 2241-3 Serial #: 253356 Bar Code #: Orange

Replaced damaged mylar.

☒ Does Instrument Meet Final Acceptance Criteria?

☒ Calibration Sticker Attached?

Date Instrument is Due For Next Calibration: 09/30/22

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

The results in this report relate only to the item calibrated or tested.

Performed by: Jacob Galyon  
Printed Name: Jacob Galyon

Reviewed by: [Signature] Issue Date: 10/8/21





## SEC INSTRUMENTATION SERVICES

10512 Lexington Drive  
Suite 200  
Knoxville, TN 37932

### C-14 SOURCE CALIBRATION FORM

Probe Model Number : 43-37 Customer Name : Chase  
Probe Serial Number : PR281040 Technician : Jacob Galyon  
Date of Calibration : 9/30/2021

Instruments used during calibration			
Model Number:	2241-3	Serial Number:	253356
Model Number:		Serial Number:	

#### NIST Traceable Source(s) used :

#### Activity(s)

	Source S/N	Emission Rate	2 Pi (cpm)	uCi	4Pi (dpm)	Assay Date
1> C-14	DX 295	432	25,920	0.0305405	67,800	5/3/1994

#### Data

Instrument condition : Sat

High Voltage: 1875

Background: 981

C-14 Count: 9703

2 $\pi$  Efficiency: 33.65%

4 $\pi$  Efficiency: 12.86%

Calibration sticker attached? Yes

Comments : Married as a set with : Model : 2241-3 Serial # : 253356

Calibrated with plastic standoffs attached while using a 10' cable.

Date instrument is due for next calibration : 9/30/2022  
Performed by: Jacob Galyon Reviewed by: [Signature] Date : 10/8/21  
Printed Name : Jacob Galyon  
Entered in computer inventory by: \_\_\_\_\_ Date : \_\_\_\_\_

## SEC INSTRUMENTATION SERVICES

10512 Lexington Drive  
Suite 200  
Knoxville, TN 37932

Perma-Fix Environmental Services, Inc.  
1093 Commerce Park Drive, Suite 300  
Oak Ridge, TN, 37830



### Model 2241-3 CALIBRATION FORM

Serial number : 253363 Customer Name : Chase  
Previous due date : 7/30/2021 P.O Number :  
Date : 8/4/2021 Technician : Jacob Galyon

Reason For Calibration : Due For Calibration

INSTRUMENT(S) USED DURING CALIBRATION		
Model Number: 500-2	Serial Number: 268940	Calibration Due date: 6/9/2022
Model Number:	Serial Number:	Calibration Due date:

Instrument Condition	
As Found	As Left
OK	OK

Threshold	
As Found	As Left
4.0	4.0

Battery Indicator
SAT

SCA/RATE Switch
SAT

Detector #	Set Voltage		High Voltage Range	
	As Found	As Left	As Found	As Left
1	1700	1700	SAT	SAT
2	1775	1775	SAT	SAT
3	1150	1200	SAT	SAT
4	1275	1275	SAT	SAT

Digital Scaler				
Target	As Found	%Error	As Left	%Error
250	250	0.00%	250	0.00%
2,500	2,500	0.00%	2,500	0.00%
25,000	25,002	0.01%	25,002	0.01%
250,000	249,969	0.01%	249,969	0.01%

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

OK	Is the As Found Data within 20% of the set point?	OK	Audio Response
OK	Are the individual counts within 10% of the average?	OK	Push Buttons
OK	Fast / Slow response switch functions properly?	OK	RESET
OK	Does Instrument meet final Acceptance Criteria?	OK	Audio Switch
OK	Calibration sticker attached?	OK	Light

Married with:	1700V	DET 1	Model:	43-68	Serial Number:	PR190903
	1775V	DET 2	Model:	43-37	Serial Number:	PR265548
	1200V	DET 3	Model:	43-68	Serial Number:	PR190903
Comments :	1275V	DET 4	Model:	43-37	Serial Number:	PR265548

Instrument calibrated per SEC-IS-423.

5 foot cable used for the 43-68

10 foot cable used for the 43-37

Date instrument is due for next calibration : 8/4/2022

Performed by :

Date: 8/4/21

Reviewed by:

Date: 8/11/21

Printed name :

Jacob Galyon





**Safety and Ecology Corporation** SEC PROCEDURE # SEC-IS-417 Rev 5  
10512 Lexington Drive, Suite 200, Knoxville, TN 37932  
**Calibration Certificate**

**Calibration Certificate for 43-68, Serial # PR190903, Bar Code # ,Property # Chase48**

Date: 08/04/21 Date Last Cal. Expires: 07/30/21 Technician: Jacob Galyon Reason For Calibration: Due for Calibration

Temp RelHum: BP: CableLength 5 Ft

**EQUIPMENT USED DURING CALIBRATION** MODEL: 2241-3 SERIAL #: 253363 CAL DUE 08/04/22

NIST TRACEABLE SOURCES USED	SOURCE	ISOTOPE	ACTIVITY	2π	ASSAY DATE
<b>Efficiencies from last calibration</b>					
Pu-239: 19.58 %	4079-02	Pu-239	28992 dpm	14,696 cpm	1/20/2021
Tc-99: 24.02 %	4072-02	Tc-99	28299 dpm	17,699 cpm	1/20/2021
Th-230: 17.32 %	4071-02	Th-230	40296 dpm	20,498 cpm	1/20/2021
SrY-90: 36.87 %	4076-02	Sr-90	9539 dpm	6,693 cpm	1/20/2021

**AS FOUND DATA**

AS FOUND Instrument Condition: SAT

**Calibration Setpoints**

HV (Alpha): 1200 V HV (Beta): 1700 V Threshold: 4 mV

Back	Alpha	Beta	AF 4 π Efficiencies
ground:	0 CPM	265 CPM	
Pu-239:	5492 CPM	N/A	18.94%
Tc-99:	N/A	7158 CPM	24.36%
Th-230:	6797 CPM	N/A	16.87%
SrY-90:	N/A	3819 CPM	37.26%

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

AS LEFT Instrument Condition: SAT

**AS LEFT DATA after repair, HV adjust or Plateau**

HV (Alpha): 1200 V HV (Beta): 1700 V Threshold: 4 mV

Back	Alpha	Beta	AL 4 π Efficiencies
ground:	0 CPM	265 CPM	
Pu-239:	5492 CPM	N/A	18.94%
Tc-99:	N/A	7158 CPM	24.36%
Th-230:	6797 CPM	N/A	16.87%
SrY-90:	N/A	3819 CPM	37.26%

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

Reproducibility: Isotope: Sr-90 3758 3844 3828 Average: 3810.0 ☒ Are the individual counts within 10% of the average?

If the As Found data (even after repair) is within 10% of the last calibration, then the technician may N/A Plateau Data and go directly to Comments. Geometry of source = flush to surface, except gas proportional probes = 1/8" from surface unless otherwise specified.

Alpha Source: Th-230

**PLATEAU DATA**

Beta Source: Tc-99

HV	CPM	CPM
(Alpha)	A ch.	B ch.
N/A		

HV	CPM	CPM
(Beta)	B ch.	B ch.
N/A		

**2 Pi Efficiencies:** Pu-239 37.37% Tc-99 38.95% Th-230 33.16% SrY-90 53.10%

**Comments:** Married as a set with: Model: 2241-3 Serial #: 253363 Bar Code #:

☒ Does Instrument Meet Final Acceptance Criteria?

☒ Calibration Sticker Attached?

Date Instrument Is Due For Next Calibration: 08/04/22

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

The results in this report relate only to the item calibrated or tested.

Performed by: Jacob Galyon  
Printed Name: Jacob Galyon

Reviewed by: [Signature] Issue Date: 8/11/21





## SEC INSTRUMENTATION SERVICES

10512 Lexington Drive  
Suite 200  
Knoxville, TN 37932

### C-14 SOURCE CALIBRATION FORM

Probe Model Number : 43-68 Customer Name : Chase Environmental  
Probe Serial Number : PR190903 Technician : Jacob Galyon  
Date of Calibration : 8/4/2021

Instruments used during calibration			
Model Number:	2241-3	Serial Number:	253363 Calibration Due Date: 8/4/2022
Model Number:		Serial Number:	Calibration Due Date:

#### NIST Traceable Source(s) used :

Activity(s)

	Source S/N	Emission Rate	2 Pi (cpm)	uCi	4Pi (dpm)	Assay Date
1> C-14	DX 295	432	25,920	0.0305405	67,800	5/3/1994

#### Data

Instrument condition : Sat

High Voltage: 1700

Background: 265

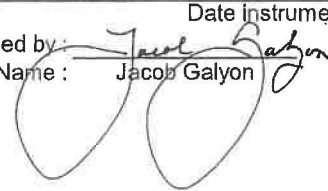

C-14 Count: 8099

2 $\pi$  Efficiency: 30.22%

4 $\pi$  Efficiency: 11.55%

Calibration sticker attached? Yes

Comments : Married as a set with : Model : 2241-3 Serial # : 253363  
Calibrated with plastic standoffs attached.

Date instrument is due for next calibration : 8/4/2022  
Performed by :  Reviewed by :  Date : 8/11/21  
Printed Name : Jacob Galyon



**Safety and Ecology Corporation** SEC PROCEDURE # SEC-IS-417 Rev 5  
10512 Lexington Drive, Suite 200, Knoxville, TN 37932

### Calibration Certificate

**Calibration Certificate for 43-37, Serial # PR265548, Bar Code #, Property # Chase47**

Date: 08/04/21 Date Last Cal. Expires: 07/30/21 Technician: Jacob Galyon Reason For Calibration: Due for Calibration

Temp RelHum: BP: CableLength 10 Ft

**EQUIPMENT USED DURING CALIBRATION** MODEL: 2241-3 SERIAL #: 253363 CAL DUE 07/30/21

NIST TRACEABLE SOURCES USED	SOURCE	ISOTOPE	ACTIVITY	2π	ASSAY DATE
<b>Efficiencies from last calibration</b>					
Pu-239: 17.61 %	4079-02	Pu-239	28992 dpm	14,696 cpm	1/20/2021
Tc-99: 22.44 %	4072-02	Tc-99	28299 dpm	17,689 cpm	1/20/2021
Th-230: 15.27 %	4071-02	Th-230	40296 dpm	20,498 cpm	1/20/2021
SrY-90: 33.98 %	4076-02	Sr-90	9539 dpm	6,693 cpm	1/20/2021

#### AS FOUND DATA AS FOUND Instrument Condition: SAT Calibration Setpoints

HV (Alpha): 1275 V	HV (Beta): 1775 V	Threshold: 4 mV
Back ground: 8 CPM	Alpha 753 CPM	Beta AF 4 π Efficiencies
Pu-239: 5173 CPM	N/A	17.82%
Tc-99: N/A	7112 CPM	22.47%
Th-230: 6246 CPM	N/A	15.48%
SrY-90: N/A	3835 CPM	32.31%

#### AS LEFT Instrument Condition: SAT AS LEFT DATA after repair, HV adjust or Plateau

HV (Alpha): 1275 V	HV (Beta): 1775 V	Threshold: 4 mV
Back ground: 8 CPM	Alpha 753 CPM	Beta AL 4 π Efficiencies
Pu-239: 5173 CPM	N/A	17.82%
Tc-99: N/A	7112 CPM	22.47%
Th-230: 6246 CPM	N/A	15.48%
SrY-90: N/A	3835 CPM	32.31%

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

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

Reproducibility: Isotope: Sr-90 3727 3726 3694 Average: 3715.7 ☒ Are the individual counts within 10% of the average?

If the As Found data (even after repair) is within 10% of the last calibration, then the technician may N/A Plateau Data and go directly to Comments. Geometry of source = flush to surface, except gas proportional probes = 1/8" from surface unless otherwise specified.

<b>Alpha Source: Th-230</b>			
Response Background			
HV CPM CPM			
(Alpha) A ch. A ch. Net 4π Eff.			
N/A			

#### PLATEAU DATA

<b>Beta Source: Tc-99</b>			
Response Background			
HV CPM CPM			
(Beta) B ch. B ch. Net 4π Eff.			
N/A			

**2 Pi Efficiencies:** Pu-239 35.15% Tc-99 35.93% Th-230 30.43% SrY-90 46.05%

**Comments:** Married as a set with: Model: 2241-3 Serial #: 253363 Bar Code #:

☒ Does Instrument Meet Final Acceptance Criteria?

☒ Calibration Sticker Attached?

Date Instrument is Due For Next Calibration: 08/04/22

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

The results in this report relate only to the item calibrated or tested.

Performed by: Jacob Galyon  
Printed Name: Jacob Galyon

Reviewed by: [Signature] Issue Date: 8/11/21





## SEC INSTRUMENTATION SERVICES

10512 Lexington Drive  
Suite 200  
Knoxville, TN 37932

### C-14 SOURCE CALIBRATION FORM

Probe Model Number : 43-37 Customer Name : Chase Environmental  
Probe Serial Number : PR265548 Technician : Jacob Galyon  
Date of Calibration : 8/4/2021

Instruments used during calibration			
Model Number:	2241-3	Serial Number:	253363
Model Number:		Serial Number:	

NIST Traceable Source(s) used : Activity(s)

	Source S/N	Emission Rate	2 Pi (cpm)	uCi	4Pi (dpm)	Assay Date
1> C-14	DX 295	432	25,920	0.0305405	67,800	5/3/1994

#### Data

Instrument condition : Sat  
High Voltage: 1775

Background: 753

C-14 Count: 8470

2 $\pi$  Efficiency: 29.77%

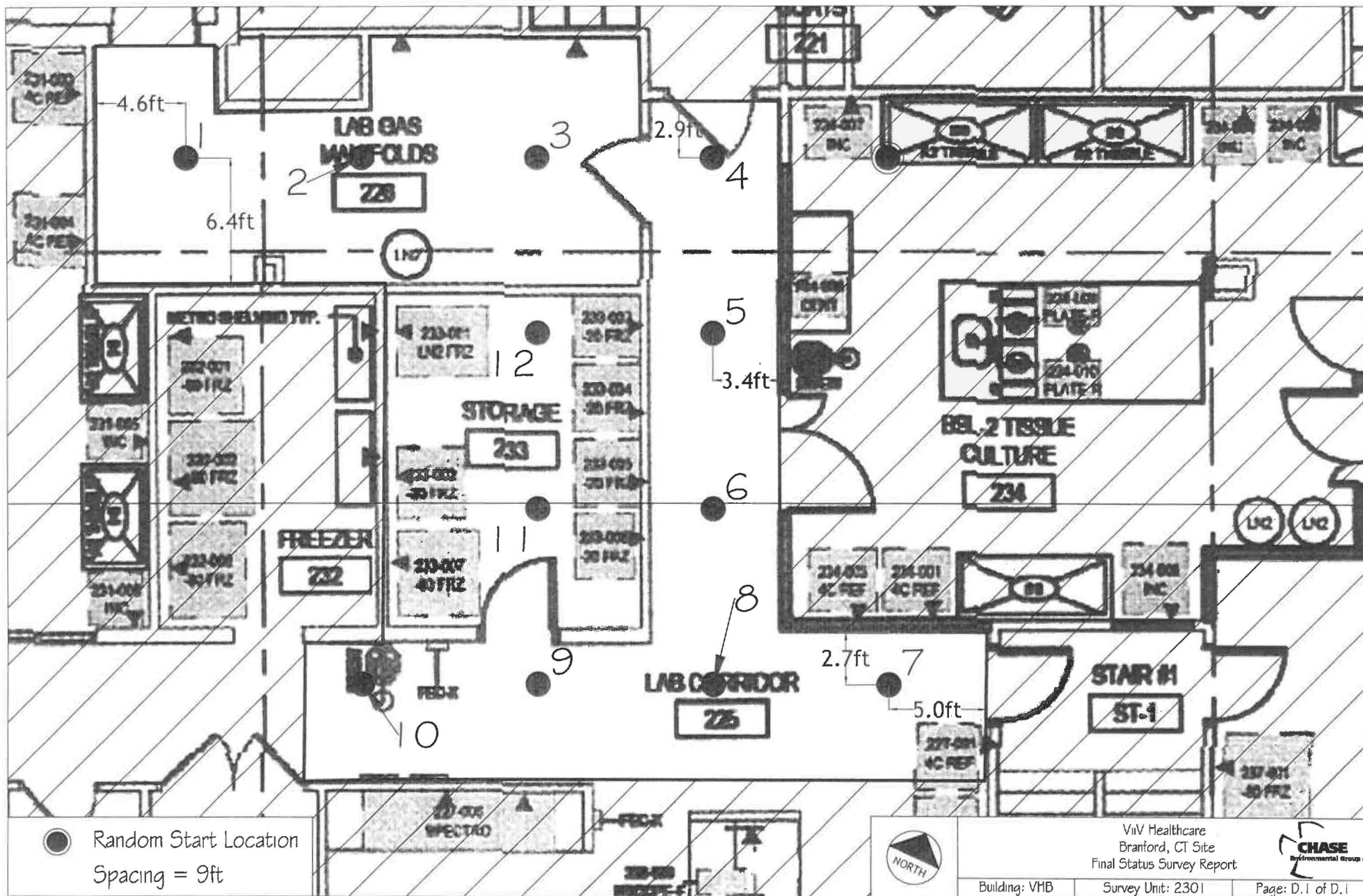
4 $\pi$  Efficiency: 11.38%

Calibration sticker attached? Yes

Comments : Married as a set with : Model : 2241-3 Serial # : 253363  
Calibrated with plastic standoffs attached.

Date instrument is due for next calibration : 8/4/2022  
Performed by : Jacob Galyon Reviewed by : [Signature] Date : 8/11/21  
Printed Name : Jacob Galyon

**Appendix D**  
**Final Status Survey**  
**Location Maps**

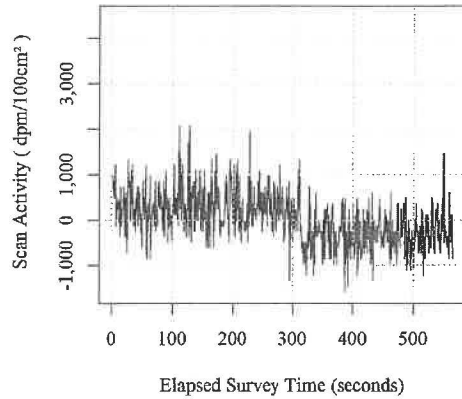


## **Appendix E**

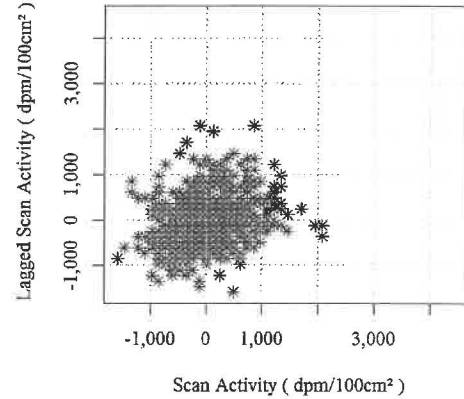
### **4-Plot Graphs**

Survey Unit: VHB-2301 Probe: PR281040\_Beta ( 43-37 )

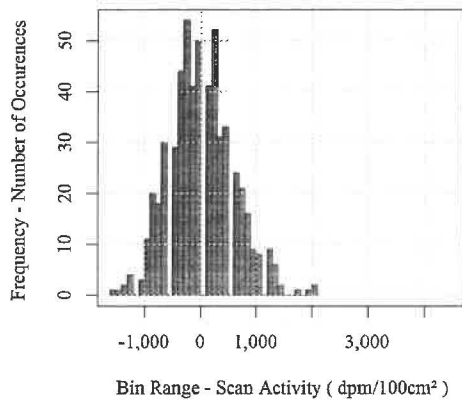
Scan Data



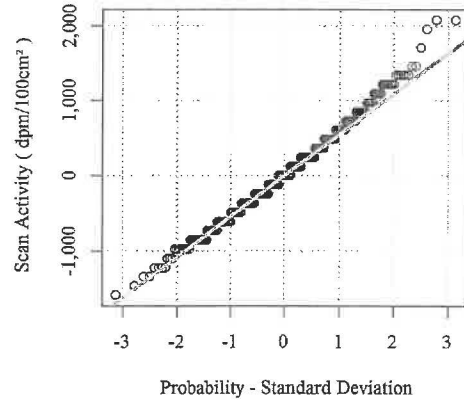
Lagged Scan Data



Histogram of Scan Data



Normal Probability Plot of Data





**Appendix F**  
**Structural Surfaces Final**  
**Status Survey Results**

## Survey Results

Building: VHB Survey Unit: 2301 Survey Type: Structural Class: 3

<u>Location Code</u>	<u>Total Activity Measurements</u>		<u>Removable Activity Measurements</u>					
	<u>Activity</u>	<u>MDC</u>	<u>H-3</u>	<u>MDC</u>	<u>C-14</u>	<u>MDC</u>	<u>OPEN</u>	<u>MDCR</u>
VHB-2301-F1-V-001	1,366 +/- 1,582	2,659	10	35	10	33	17	36
VHB-2301-F1-V-002	945 +/- 1,527	2,659	0	35	3	33	7	36
VHB-2301-F1-V-003	945 +/- 1,527	2,659	3	35	0	33	1	36
VHB-2301-F1-V-004	210 +/- 1,426	2,659	11	35	7	33	14	36
VHB-2301-F1-V-005	1,050 +/- 1,541	2,659	2	35	3	33	5	36
VHB-2301-F1-V-006	-420 +/- 1,334	2,659	4	35	0	33	0	36
VHB-2301-F1-V-007	0 +/- 1,396	2,659	14	35	15	33	20	36
VHB-2301-F1-V-008	735 +/- 1,499	2,659	4	35	3	33	5	36
VHB-2301-F1-V-009	1,050 +/- 1,541	2,659	6	35	3	33	9	36
VHB-2301-F1-V-010	1,261 +/- 1,568	2,659	0	35	12	33	13	36
VHB-2301-F1-V-011	210 +/- 1,426	2,659	5	35	6	33	5	36
VHB-2301-F1-V-012	315 +/- 1,441	2,659	0	35	10	33	6	36
<b>Static Count</b>	12	<b>Sample Count</b>	12		12		12	
<b>Average</b>	639		5		6		9	
<b>Minimum</b>	-420		0		0		0	
<b>Maximum</b>	1,366		14		15		20	
<b>Standard Deviation</b>	560		5		5		6	

Total surface activity results are reported in net dpm/100 cm<sup>2</sup>

H-3 and C-14 removable results reported in net dpm/100 cm<sup>2</sup>. OPEN removable results are reported in net cpm/100 cm<sup>2</sup>.

Results above MDC are in bold print. Results above Investigation Levels are in red bold print.

Removable Activity: H-3 = 0-18.6 keV, C-14 = 18.6-156 keV, OPEN = 0-2,000 keV.

**Appendix G**  
**Quality Assurance**  
**Survey Results**

## Survey Results

Building: VHB Survey Unit: QA01 Survey Type: QA Class: QA

<u>Location Code</u>	<u>Total Activity Measurements</u>		<u>Removable Activity Measurements</u>					
	<u>Activity</u>	<u>MDC</u>	<u>H-3</u>	<u>MDC</u>	<u>C-14</u>	<u>MDC</u>	<u>OPEN</u>	<u>MDCR</u>
VHB-QA01-F1-V-001	525 +/- 1,554	2,807	1	35	3	33	5	36
Static Count	1	Sample Count	1		1		1	
Average	525		1		3		5	
Minimum	525		1		3		5	
Maximum	525		1		3		5	
Standard Deviation								

Total surface activity results are reported in net dpm/100 cm<sup>2</sup>

H-3 and C-14 removable results reported in net dpm/100 cm<sup>2</sup>. OPEN removable results are reported in net cpm/100 cm<sup>2</sup>.

Results above MDC are in bold print. Results above Investigation Levels are in red bold print.

Removable Activity: H-3 = 0-18.6 keV, C-14 = 18.6-156 keV, OPEN = 0-2,000 keV.

APPROVED BY OMB: NO. 3150-0164. Estimated burden per response to comply with this information collection request: 45 minutes. This uniform manifest is required by NRC to meet reporting requirements of Federal and State Agencies for the safe transportation and disposal of low-level waste. Send comments regarding burden estimates to the FOIA, Library, and Information Collections Branch (7-6 A104), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by e-mail to [Infocollections@nrc.gov](mailto:Infocollections@nrc.gov), and OMB Reviewer at: OMB Office of Information and Regulatory Affairs, (3150-0164), Attn: Desk Officer for the Nuclear Regulatory Commission, 724 17th Street NW, Washington, D.C. 20503; e-mail [oin\\_submission@omb.eop.gov](mailto:oin_submission@omb.eop.gov). The NRC may not conduct or sponsor, and a person is not required to respond to, a collection of information unless the document requesting or requiring the collection displays a currently valid OMB control number.

FORM 540 EnergySolutions, Bear Creek Processing Operations UNIFORM LOW-LEVEL RADIOACTIVE WASTE MANIFEST SHIPPING PAPER		5. SHIPPER - NAME AND FACILITY ESI @ VIV Healthcare 36 E Industrial Rd. Branford, CT 06405		SHIPMENT ID NUMBER 0806-120621RN		7. FORM 540 AND 540A PAGE 1 OF 1 PAGE(S) FORM 541 AND 541A 1 PAGE(S) FORM 542 AND 542A 1 PAGE(S) ADDITIONAL INFORMATION NONE PAGE(S)		8. MANIFEST NUMBER (Use this number on all continuation pages) 0806-120621RN	
1. EMERGENCY TELEPHONE NUMBER (Include Area Code) 800-451-8346		USER PERMIT NUMBER T-MD004-L21		SHIPMENT NUMBER 0806-120621RN		9. CONSIGNEE - Name and Facility Address EnergySolutions, Bear Creek Processing Operations Operated By EnergySolutions 1560 Bear Creek Road Oak Ridge, TN 37830		CONTACT Brad Melton TELEPHONE NUMBER (Include Area Code) (865) 481-0222	
ORGANIZATION Verisk 3E (12489)		CONTACT Matthew Schilling		TELEPHONE NUMBER (Include Area Code) (860) 288-8234		SIGNATURE - Authorized consignee acknowledging waste receipt		DATE	
2. IS THIS AN "EXCLUSIVE USE" SHIPMENT? [ ] YES [X] NO		3. TOTAL NUMBER OF PACKAGES IDENTIFIED ON THIS MANIFEST 1		6. CARRIER - Name and Address Ecology Services, Inc. 9135 Guilford Road, Suite 200 Columbia, MD 21046		EPA I.D. NUMBER MDR000524712		10. CERTIFICATION This is to certify that the herein-named materials are properly classified, described, packaged, marked, and labeled and are in proper condition for transportation according to the applicable regulations of the Department of Transportation, the Commission, and equivalent state regulations. For materials that are consigned to a land disposal facility or waste collector, this certifies that the materials are classified per the applicable requirements of 10 CFR Part 61, meet the land disposal facility's waste acceptance criteria, and are in proper condition for disposal as described in accordance with the applicable requirements of 10 CFR Parts 20 and 61, or equivalent state regulations. A collector in signing this certification is certifying that nothing has been done to the collected waste which would invalidate the waste generator's certification.	
4. DOES EPA REGULATED WASTE REQUIRING A MANIFEST ACCOMPANY THIS SHIPMENT? If "Yes", provide Manifest Number		EPA MANIFEST NUMBER N/A		CONTACT Greg Keck		SHIPPING DATE 12/08/2021		TELEPHONE NUMBER (Include Area Code) 301-352-8700	
11. U.S. DEPARTMENT OF TRANSPORTATION DESCRIPTION (Including proper shipping name, hazard class, UN ID number, and any additional information)		12. DOT LABEL "RADIOACTIVE"		13. TRANSPORT INDEX		14. PHYSICAL AND CHEMICAL FORM		15. INDIVIDUAL RADIONUCLIDES	
Non-Radioactive per DOT DAW-THERMAL 1-5 GAL. POLY DRUM		NA		NA		SOLID/METAL OXIDES H-3		TOTAL PACKAGE ACTIVITY MBq (2.0000E-05) mCi (2.0000E-05)	
								17. TOTAL WEIGHT OR VOLUME (Use appropriate units) 0.88 ft <sup>3</sup> 6.00000 lb	
								18. IDENTIFICATION NUMBER OF PACKAGE VIV-2 (21-001378)	
FOR CONSIGNEE USE ONLY Tennessee "License For Delivery" No. _____ South Carolina Transport Permit No. _____ US Ecology Generator No. _____ US Ecology Permit No. _____				20. Generator Certification Statement A) Radioactive Materials. Certification is hereby made that this shipment of low-level radioactive waste has been prepared in accordance with a radioactive waste management program which has been approved by the Nuclear Regulatory Commission or an Agreement State regulatory agency and with the current revision of the site Material Acceptance Criteria. B) Hazardous Materials. Generator hereby certifies that this material does not contain a hazardous waste as defined in 40 CFR 261. C) Data. Generator hereby represents and warrants that all data set forth in this (UNIFORM LOW-LEVEL RADIOACTIVE WASTE MANIFEST) are true and correct in all respects and in accordance with all applicable governmental laws, rules, regulations and site Radioactive Material Licenses. D) INFECTIOUS SUBSTANCE. Generator hereby certifies that this material does not contain an infectious substance as defined in 49CFR 172.134 Matthew J. Schilling on behalf of VIV Healthcare 12/9/21					

APPROVED BY OMB: NO. 3150-0166 Estimated burden per response to comply with this information collection request: 3.3 hours. This uniform manifest is required by NRC to meet reporting requirements of Federal and State Agencies for the safe transportation and disposal of low-level waste. Send comments regarding burden estimate to the FDA, Library, and Information Collections Branch (1-8 A16M), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by e-mail to [infocollections@nrc.gov](mailto:infocollections@nrc.gov), and the OMB reviewer at: OMB Office of Information and Regulatory Affairs, (3150-0166), Attn: Desk Officer for the Nuclear Regulatory Commission, 1225 17th Street NW, Washington, DC 20033; e-mail: [ole\\_submission@omb-epa.gov](mailto:ole_submission@omb-epa.gov). The NRC may not conduct or sponsor, and a person is not required to respond to, a collection of information unless the document displays a currently valid OMB control number.

FORM 541 EnergySolutions, Bear Creek Processing Operations					1. MANIFEST TOTALS								2. MANIFEST NUMBER						
UNIFORM LOW-LEVEL RADIOACTIVE WASTE MANIFEST					NUMBER OF PACKAGES/ DISPOSAL CONTAINERS		NET WASTE VOLUME		NET WASTE WEIGHT		SPECIAL NUCLEAR MATERIAL (grams)				0808-120621RN				
CONTAINER AND WASTE DESCRIPTION					1		m <sup>3</sup> ft <sup>3</sup>		kg lb		U-233		U-235		Pu				
Additional Nuclear Regulatory Commission (NRC) Requirements for Control, Transfer and Disposal of Radioactive Waste					0.01926 0.68000		1.36077 3.00000		NP		NP		NP		NP				
					ACTIVITY (MBq/mCi) (LLD UNITS IN uCi/cc)		TRITIUM		C-14		Tc-99		I-129		SOURCE				
					ALL NUCLIDES		7.4000E-04		2.0000E-05		NP		NP		NP				
					mCi		2.0000E-04		NP		NP		NP		NP				
					SHIPMENT ID NUMBER		0808-120621RN												
DISPOSAL CONTAINER DESCRIPTION					WASTE DESCRIPTION FOR EACH WASTE TYPE IN CONTAINER												17. WASTE CLASSIFICATION		
5. CONTAINER IDENTIFICATION NUMBER/ GENERATOR NUMBER	6. CONTAINER DESCRIPTION (See Note 1) PROCESS REQUESTED (See Note 1A) BURIAL/DEPOSITION (See Note 2A)	7. VOLUME m <sup>3</sup> ft <sup>3</sup>	8. WASTE AND CONTAINER WEIGHT kg lb	9. WASTE WEIGHT kg lb	10. SURFACE RADIATION LEVEL mSv/hr mrem/hr	11. SURFACE CONTAMINATION MBq/100 cm <sup>2</sup> dpm/100 cm <sup>2</sup>		12. WASTE DESCRIPTION (See Note 2)	13. APPROXIMATE WASTE VOLUME(S) IN CONTAINER m <sup>3</sup> ft <sup>3</sup>	14. SOLIDIFICATION OR STABILIZATION MEDIA (See Note 3)	15. CHEMICAL DESCRIPTION CHEMICAL FORM/ CHELATING AGENT	16. RADIOLOGICAL DESCRIPTION INDIVIDUAL RADIONUCLIDES AND ACTIVITY AND CONTAINER TOTAL; OR CONTAINER TOTAL ACTIVITY AND RADIONUCLIDE PERCENT	RADIONUCLIDES		MBq		mCi		17. WASTE CLASSIFICATION AU - Class A Stable AU - Class A Unstable B - Class B C - Class C
					ALPHA BETA-GAMMA														
21-001378 (VIN-2) 806	3 INCINERATION O	0.01926 0.68000	2.72154 6.00000	1.36077 3.00000	< 5.0000E-03 < 5.0000E-01	< 4.0080E-06 < 2.4000E+02	< 4.0080E-05 < 2.4000E+03	39	0.01926 0.68000	100	SOLID METAL OXIDES / NP	H-3	7.4000E-04	2.0000E-05					AU
Sub Total													7.4000E-04	2.0000E-05					
Package Total													7.4000E-04	2.0000E-05					
Shipment Total		0.01926 0.68000	2.72154 6.00000	1.36077 3.00000								7.4000E-04	2.0000E-05						

NOTE 1: Container Description Codes. For containers/waste requiring disposal in approved structural overpacks, the numerical code must be followed by "OP."

NOTE 1A: Process Requested

NOTE 2: Waste Descriptor Codes. (Choose up to three which predominate by volume.)

NOTE 2A: Burial/Disposition Site

NOTE 3: Solidification and Stabilization Media Codes. (Choose up to three which predominate by volume.) For media meeting disposal via structural stability requirements, the numerical code must be followed by "S" and the media vendor and brand name must also be identified in Item 13. Code 100=None Required

APPROVED BY OMB: NO. 3150-0165 Estimated burden per response to comply with this information collection request: 45 minutes. This uniform manifest is required by NRC to meet reporting requirements of Federal and State Agencies for the safe transportation and disposal of low-level waste. --  
 EXPIRES: 01/31/2023 Send comments regarding burden estimate to the FOIA, Library, and Information Collections Branch (T-6 A10M), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by e-mail to [infocollections.Resource@nrc.gov](mailto:infocollections.Resource@nrc.gov), and the OMB reviewer at: [OMB-Office-of-Information-and-Regulatory-Affairs](mailto:OMB-Office-of-Information-and-Regulatory-Affairs), (3150-0165), Attn: Desk Officer for the Nuclear Regulatory Commission, 725 17th Street NW, Washington, DC 20503; e-mail: [omb\\_submission@omb.eop.gov](mailto:omb_submission@omb.eop.gov). The NRC may not conduct or sponsor, and a person is not required to respond to, a collection of information unless the document requesting or requiring the collection displays a currently valid OMB control number.

FORM 542 EnergySolutions, Bear Creek Processing Operations			1. WASTE COLLECTOR/PROCESSOR				2. MANIFEST NUMBER			
UNIFORM LOW-LEVEL RADIOACTIVE WASTE MANIFEST			NAME ESI @ VivV Healthcare		SHIPPER USE ONLY		0806-120621RN			
MANIFEST INDEX AND REGIONAL COMPACT TABULATION			IDENTIFICATION NUMBER 806				PAGE 1 OF 1 PAGE(S)			
List all original "PROCESSED WASTE" generators (if any) before "COLLECTED WASTE" generators			SHIPPING DATE 12/06/2021							
4. GENERATOR IDENTIFICATION NUMBER	5. GENERATOR NAME PERMIT NUMBER (IF APPLICABLE), AND TELEPHONE NUMBER	6. GENERATOR FACILITY ADDRESS	7. PREPROCESSED WASTE (OR MATERIAL) VOLUME m <sup>3</sup>	8. MANIFEST NUMBER(S) UNDER WHICH WASTE (OR MATERIAL) RECEIVED AND DATE OF RECEIPT	9. WASTE CODE P=PROCESSED C=COLLECTED	10. ORIGINATING COMPACT REGION OR STATE	11. AS PROCESSED/COLLECTED TOTAL			
							A. SOURCE MATERIAL (kg)	B. BNM (g)	C. ACTIVITY MBq	D. VOLUME m <sup>3</sup>
806	VivV Healthcare EPA #: CTR000516245 (860) 268-8234	38 E Industrial Rd. Branford, CT 06405	0.01926	Onsite Generation 11/30/2021	C	CT	NP	NP	7.4000E-04	0.01926
TOTALS OF ALL PAGES (FORMS 542 AND 542A)							NP	NP	7.4000E-04	0.01926