

DEPARTMENT OF HEALTH & HUMAN SERVICES

Public Health Service

Centers for Disease Control  
and Prevention (CDC)  
Atlanta GA 30333

August 24, 2016

**Re: Amendment Request for Materials License No. 10-06772-01**

REC RG 1 08 25 '16 AM 10:40

U.S. Nuclear Regulatory Commission  
Division of Nuclear Materials Safety  
Region I  
475 Allendale Road  
King of Prussia, PA 19406

*Br. 2*  
*03004001*

Dear Sir,

We request approval to decommission and demolish the Radioactive Waste (RAW) Building 1 located at the Chamblee, Georgia campus of the Centers for Disease Control and Prevention (CDC). We have completed and included as an enclosure the Final Status Survey Report for the RAW Building 1.

We request your review and approval of this license amendment so that we may decommission and demolish the RAW Building 1 in order to release this property for future use.

*Paul D. Simpson, Jr.*  
Paul D. Simpson, Jr., RSO  
Radiation Safety Team  
Office of Laboratory Safety

Enclosures:  
Final Status Survey Report  
Appendix A  
Appendix B  
Appendix C  
Appendix D  
Appendix E  
Appendix F  
Appendix H  
Appendix I

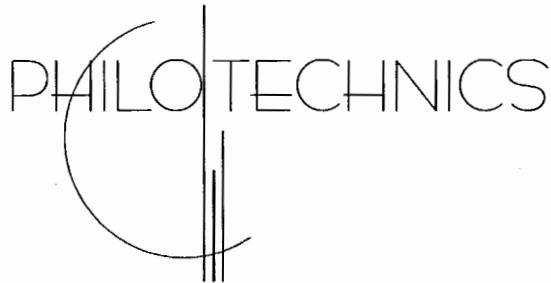
*Ref: mc # 588982*

*591780*  
NMSS/RGN1 MATERIALS-002

**Application for License Amendment**

**Control # 588982**

**Decommissioning Plan: Final Status Survey Report for RAW Room #1**

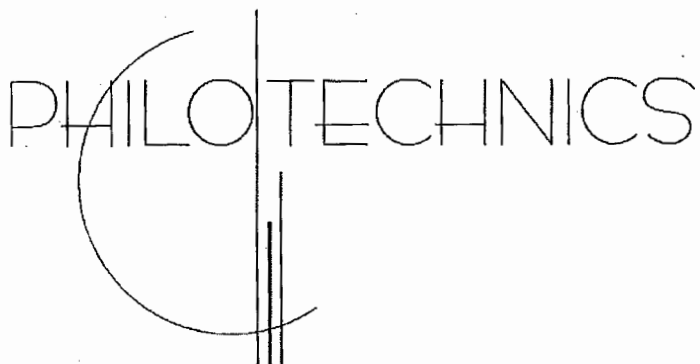


# **CDC RAW Room #1 Final Status Survey Report**



Prepared for:  
**U.S. Department of Health & Human Services  
Centers for Disease Control & Prevention  
4770 Buford Highway  
Chamblee, GA 30341  
Radioactive Materials License #10-06772-01**

Prepared by:  
**Philotechnics, Ltd.  
201 Renovare Blvd.  
Oak Ridge, TN 37830**

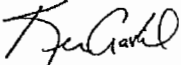

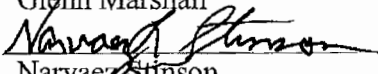


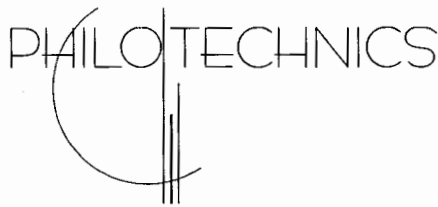
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<b>Prepared:</b>	<u></u> Ken Gavlik	<u>VP Radiological Services</u>	<b>Date:</b> <u>8/10/16</u>
<b>Technical Review:</b>	<u></u> Glenn Marshall	<u>Certified Health Physicist</u>	<b>Date:</b> <u>8/10/16</u>
<b>Approved:</b>	<u></u> Narvaez Stinson	<u>CDC RSO</u>	<b>Date:</b> <u>8/10/16</u>



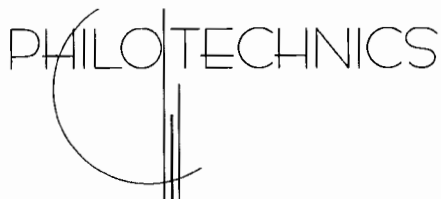
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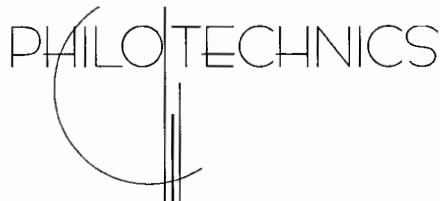
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**ACRONYM LIST**

ALARA	As Low As Reasonably Achievable
Bldg	Building
CDC	United States Department of Health and Human Services Centers for Disease Control and Prevention
CFR	Code of Federal Regulations
CPM	Counts Per Minute
CRSO	Corporate Radiation Safety Officer
D&D	Decontamination and Decommissioning
DP	Decommissioning Plan
DCGL <sub>w</sub>	Derived Concentration Guideline Level – Wilcoxon Rank Sum
DQO	Data Quality Objective
DPM	Disintegrations Per Minute
FSS	Final Status Survey
FSSR	Final Status Survey Report
HSA	Historical Site Assessment
HPT	Health Physics Technician
LBGR	Lower Bound of the Gray Region
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
MDC	Minimum Detectable Concentration
NIST	National Institute of Standards and Technology
NMSS	Nuclear Materials Safety and Safeguards
NRC	U.S. Nuclear Regulatory Commission
NUREG	Nuclear Regulatory Commission Guidance Document
ESHCO	Environment, Safety, and Health Compliance Office
PM	Project Manager
PPE	Personnel Protective Equipment
RAM	Radioactive Materials
RAW Room #1	Radioactive Waste Room #1
RSO	Radiation Safety Officer
RWP	Radiation Work Permit
TEDE	Total Effective Dose Equivalent



## GLOSSARY

*ALARA.* Acronym for “as low as is reasonably achievable,” which means making every reasonable effort to maintain exposures to radiation as far below the dose limits as is practical, consistent with the purpose for which the licensed activity is undertaken, and taking into account the state of technology, the economics of improvements in relation to the state of technology, the economics of improvements in relation to the benefits to the public health and safety, and other societal and socioeconomic considerations, and in relation to utilization of nuclear energy and licensed materials in the public interest (see 10 CFR 20.1003).

*Characterization survey.* A type of survey that includes facility or site sampling, monitoring, and analysis activities to determine the extent and nature of residual radioactivity. Characterization surveys provide the basis for acquiring necessary technical information to develop, analyze, and select appropriate cleanup techniques

*Decommission.* To remove a facility or site safely from service and reduce residual radioactivity to a level that permits (1) release of the property for unrestricted use and termination of the license or (2) release of the property under restricted conditions and termination of the license (see 10 CFR 20.1003).

*Decommissioning Plan (DP).* A detailed description of the activities that the licensee intends to use to assess the radiological status of its facility, to remove radioactivity attributable to licensed operations at its facility to levels that permit release of the site in accordance with NRC’s regulations and termination of the license, and to demonstrate that the facility meets NRC’s requirements for release. A DP typically consists of several interrelated components, including (1) site characterization information; (2) a remediation plan that has several components, including a description of remediation tasks, a health and safety plan, and a quality assurance plan; (3) site-specific cost estimates for the decommissioning; and (4) a final status survey plan (see 10 CFR 30.36(g)(4)).

*Decontamination.* The removal of undesired residual radioactivity from facilities, soils, or equipment prior to the release of a site or facility and termination of a license. Also known as remediation, remedial action, and cleanup.

*Derived Concentration Guideline Levels (DCGLs).* Radionuclide-specific concentration limits used by the licensee during decommissioning to achieve the regulatory dose standard that permits the release of the property and termination of the license. The DCGL applicable to the average concentration over a survey unit is called the DCGLW. The DCGL applicable to limited areas of elevated concentrations within a survey unit is called the DCGLEMC.

*Dose (or radiation dose).* A generic term that means absorbed dose, dose equivalent, effective dose equivalent, committed dose equivalent, committed effective dose equivalent, or total effective dose equivalent, as defined in other paragraphs of 10 CFR 20.1003 (see 10 CFR 20.1003). In this NUREG report, dose generally refers to total effective dose equivalent (TEDE).



*Final Status Survey (FSS).* Measurements and sampling to describe the radiological conditions of a site or facility, following completion of decontamination activities (if any) and in preparation for release of the site or facility.

*Final Status Survey Plan (FSSP).* The description of the final status survey design.

*Final Status Survey Report (FSSR).* The results of the final status survey conducted by a licensee to demonstrate the radiological status of its facility. The FSSR is submitted to NRC for review and approval.

*Historical Site Assessment (HSA).* The identification of potential, likely, or known sources of radioactive material and radioactive contamination based on existing or derived information for the purpose of classifying a facility or site, or parts thereof, as impacted or non-impacted (see 10 CFR 50.2).

*Historical Site Assessment (HSA).* The identification of potential, likely, or known sources of radioactive material and radioactive contamination based on existing or derived information for the purpose of classifying a facility or site, or parts thereof, as impacted or non-impacted (see 10 CFR 50.2).

*Impact.* The positive or negative effect of an action (past, present, or future) on the natural environment (land use, air quality, water resources, geological resources, ecological resources, aesthetic and scenic resources) and the human environment (infrastructure, economics, social, and cultural).

*Impacted Areas.* The areas with some reasonable potential for residual radioactivity in excess of natural background or fallout levels (see 10 CFR 50.2).

*Leak Test.* A test for leakage of radioactivity from sealed radioactive sources. These tests are made when the sealed source is received and on a regular schedule thereafter. The frequency is usually specified in the sealed source and device registration certificate and/or license.

*MARSSIM.* The Multi-Agency Radiation Site Survey and Investigation Manual (NUREG-1575) is a multi-agency consensus manual that provides information on planning, conducting, evaluating, and documenting building surface and surface soil final status radiological surveys for demonstrating compliance with dose- or risk-based regulations or standards.

*Monitoring.* Monitoring (radiation monitoring, radiation protection monitoring) is the measurement of radiation levels, concentrations, surface area concentrations, or quantities of radioactive material and the use of the results of these measurements to evaluate potential exposures and doses (see 10 CFR 20.1003).

*Non-impacted Areas.* The areas with no reasonable potential for residual radioactivity in excess of natural background or fallout levels (see 10 CFR 50.2).



*Residual Radioactivity.* Radioactivity in structures, materials, soils, ground water, and other media at a site resulting from activities under the licensee's control. This includes radioactivity from all licensed and unlicensed sources used by the licensee, but excludes background radiation. It also includes radioactive materials remaining at the site as a result of routine or accidental releases of radioactive material at the site and previous burials at the site, even if those burials were made in accordance with the provisions of 10 CFR Part 20 (see 10 CFR 20.1003).

*RESRAD Code.* A computer code developed by the U.S. Department of Energy and designed to estimate radiation doses and risks from RESidual RADioactive materials in soils.

*RESRAD-BUILD Code.* A computer code developed by the U.S. Department of Energy and designed to estimate radiation doses and risks from RESidual RADioactive materials in BUILDings.

*Scoping Survey.* A type of survey that is conducted to identify (1) radionuclide contaminants, (2) relative radionuclide ratios, and (3) general levels and extent of residual radioactivity.

*Site Characterization.* Studies that enable the licensee to sufficiently describe the conditions of the site, separate building, or outdoor area to evaluate the acceptability of the decommissioning plan.

*Survey Unit.* A geographical area consisting of structures or land areas of specified size and shape at a site for which a separate decision will be made as to whether or not the unit attains the site-specific reference-based cleanup standard for the designated pollution parameter. Survey units are established to facilitate the survey process and the statistical analysis of survey data.

## **SECTION 1.0 – EXECUTIVE SUMMARY**

### **1 EXECUTIVE SUMMARY**

The U.S. Department of Health and Human Services Centers for Disease Control and Prevention (CDC) decided to cease all operations and permanently decommission its Radioactive Waste facility located in Chamblee Building 1, radioactive waste room #1 (RAW Room #1) at the CDC facility located at 4770 Buford Highway. RAW Room #1 had previously served as a facility for radioactive waste materials collection, storage, classification, and packaging prior to shipment for disposal. As a result of the completion and occupation of Chamblee Building 164 (Chamblee Material Handling Facility), Philotechnics, Ltd. (Philotechnics) was contracted to perform all decontamination and decommissioning (D&D) activities to attain release for unrestricted use of the facility. Upon release of RAW Room #1, the CDC will demolish RAW Room #1 and dispose of the contents.

The CDC and Philotechnics conducted a Historical Site Assessment (HSA) documenting radiological operations from the beginning to the termination of licensed operations in RAW Room #1. A thorough review of the historical utilization of RAW Room #1 enclosure reveals that it was used to collect, store, classify, and process CDC licensed radioactive materials (RAM) stored at the facility. RAM consisted of: H-3, C-14, P-32, P-33, S-35, Mn-54, Co-60, Zn-65, Sr-90, Y-90, I-125, Cs-137, Po-209, Po-210, U-235, U-238, Np-237, Pu-239, Pu-242, Am-241, natural thorium (Th-nat) and natural uranium (U-nat).

Philotechnics performed scoping surveys of RAW Room #1 on March 10 & 11, 2014, included in the CDC RAW Room #1 Decommissioning Plan (CDC DP), dated April 20, 2016, and approved by Monica Ford, Acting Branch Chief Commercial, Industrial, R&D, and Academic Branch Division of Nuclear Materials Safety for the U.S. Nuclear Regulatory Commission (NRC) on May 17, 2016. Scoping surveys included scans, direct/static measurements for total activity, and 100 cm<sup>2</sup> smears for removable activity.

Philotechnics performed all D&D activities in accordance with the CDC DP developed following the requirements and guidance provided in Chapter 16 and 17 of NUREG 1757 Volume 1, Revision 2. The CDC DP followed the guidance and recommendations provided in NUREG 1757, “Consolidated NMSS Decommissioning Guidance”; and NUREG 1575, “Multi-Agency Radiation Survey and Site Investigation Manual” (MARSSIM). This provided the approach, methods, and techniques for the radiological D&D of RAW Room #1. To demonstrate compliance with site-specific Derived Concentration Guideline Levels (DGGLs) generated using RESRAD-BUILD dose modeling software, Final Status Surveys (FSS) implemented the protocols and guidance provided in MARSSIM to ensure technically defensible data were generated to release the facility for unrestricted use in accordance with the criterion of 10 CFR 20.1402, “A site will be considered acceptable for unrestricted use if the residual radioactivity that is distinguishable from background radiation results in a Total Effective Dose Equivalent (TEDE) to an average member of the critical group that does not exceed 25 mrem (0.25 mSv) per year, including that from groundwater sources of drinking water, and that the residual radioactivity has been reduced to levels that are as low as reasonably achievable (ALARA). Determination of the levels which are ALARA must take into account consideration of any detriments, such as deaths from transportation accidents, expected to potentially result from decontamination and waste disposal”

## **SECTION 2.0 – FACILITY OPERATING HISTORY**

### **2 FACILITY OPERATING HISTORY**

The decommissioning process evaluated the property's environmental status for release of impacted areas to allow unrestricted use by current or future tenants. Philotechnics and the CDC performed a HSA to review facility operations as they pertained to RAM storage to identify potential residual radioactive contamination. This assessment was performed prior to commencing Scoping surveys. The purpose was to determine the status of the facility including potential, likely, or known sources of radioactive contamination by gathering data from various sources. This included physical characteristics of the site, as well as information found in site operating records. Assessment activities related to the decommissioning of the facility included the following tasks:

- A visual survey of historic RAM storage areas in order to identify potential contamination and/or presence of RAM;
- Interviews with client personnel regarding the historical use of RAM at the facility;
- Review of existing documentation, as provided, regarding prior inspections, investigations, events or conditions at the facility related to RAM use, including: Radioactive materials license (RML), applications, amendment requests, incident reports, records of RAM delivered to and shipped from Building 1, RAM inventories and facility renovation records, radiological surveys of the facility and records of RAM shipments into an out of the facility, laboratories on the Chamblee campus and the RSO provided relevant records;
- Direct surveys of all impacted areas with the use of portable hand-held radiation detection equipment to identify the presence of RAM;
- Indirect surveys to test for removable contamination with the use of a scintillation counter and wipes taken throughout the impacted areas; and
- Dose estimates for alpha sources using the entire on-hand quantities to determine if they can be excluded from consideration.

#### **2.1 Licensed Operations**

Mr. Dave Aguero and Mr. Ken Gavlik Philotechnics, interviewed Mr. Paul Simpson, the Radiation Safety Officer (RSO) at CDC. The interview and document reviews revealed RAW Room #1 was under the operation of the former CDC Office of Safety, Health and Environment (OSHE) from 1986 until May 2013 where it served as a storage facility for the collection, storage, classification, and packaging of radioactive waste materials prior to shipment. As part of a CDC program reorganization, OSHE became the Environment, Safety, and Health Compliance Office (ESHCO), and maintained the same program and NRC RML responsibilities over RAW Room #1. Since 1986, the enclosure supported solid (dry), liquid, and scintillation vial waste received from the radiation laboratories located on the Chamblee campus. No waste was received at RAW Room #1 prior to 1986. From the beginning, the focus at the facility was to follow strict procedures to maintain the space free of radiological contamination. During the first ten years of operation, pure beta emitters, H-3, C-14, S-35, P-32 and I-125, at millicuries levels or less, were the primary radioisotopes in storage. Following this period, a wider range of radioisotopes, including actinides in microcurie or smaller activity levels were stored in RAW ROOM #1 (limited by the sensitivities needed for R&D studies). Licensed RAM consisted of: H-3, C-14, P-

## **SECTION 2.0 – FACILITY OPERATING HISTORY**

32, P-33, S-35, Mn-54, Co-60, Zn-65, Sr-90, Y-90, I-125, Cs-137, Po-209, Po-210, U-235, U-238, Np-237, Pu-239, Pu-242, Am-241, Th-nat, U-nat.

- The NRC added Th-nat and U-nat to the RML in 2001 by amendment #39. The purpose was to meet requirements in 10 CFR Part 40 for the physical protection of import, export, and transient shipments of natural uranium that might “endanger life or property or the common defense and security.”
- The NRC removed Th-nat and U-nat from the RML in 2007 by amendment #44. The quantities of Th-nat and U-nat possessed by CDC were not an endangerment, and as such, were exemptable from licensing based on the specific exemptions in 10 CFR Part 40.14 (regarding no endangerment potential) and in 10 CFR Part 40.22 (which exempts the CDC possession quantities from specific licensing).
- The quantities of Th-nat and U-nat that CDC possessed were exemptable from specific licensing during 2001-2007. Therefore, it is considered that they were not relevant to this decommissioning and were excluded from the assessment of residual activity in Building 1 RAW Room #1; **however, for added conservatism in the survey design, they were included.**

Additionally, leak test records and historical radiological survey results indicated that radioactivity would be several orders of magnitude less than the DCGLs.

Radioactive wastes were only stored in RAW Room #1, and no other area in Chamblee Building 1, as summarized in **Table 2-1 - Restricted Area Summary** below, and identified on the building diagrams in **Appendix A**. The Scoping survey was developed and implemented to detect all relevant radionuclides. Philotechnics performed 100% scan surveys of all accessible areas of RAW Room #1 during the initial Scoping, as well as FSS. Access to RAW Room #1 was only from the external dock, and no access existed from Chamblee Building 1 directly. Additionally, all waste packages were sealed and leak tested upon delivery and prior to shipment; routine surveys of the room were performed each time waste was packaged into 55 gallon drums that were resident in the storage area. In addition, wipe surveys were conducted minimally once every four months. The results of the CDC radiation meter and wipe surveys indicated all items were free from any residual contamination and at natural background levels. Additionally, according to the CDC RSO, there were never any spills, leaks, container deterioration/breakage, or other contamination events in RAW Room #1; although contamination in RAW Room #1 was identified and remediated during Philotechnics Scoping surveys. A detailed description of the contamination identified is provided in **Section 4.1 – Contaminated Structures** and **Section 9.2 – Decontamination/Dismantelment and Remedial Action Surveys**.

As part of their public health modernization program, the CDC relocated all radioactive waste to a newly completed radioactive waste building on the Chamblee campus.

**Table 2-1 - Restricted Area Summary**

4770 Buford Highway		
Area	Room	Historical Radionuclide Usage
RAW Room	1	H-3, C-14, P-32, P-33, S-35, Cr-51, Mn-54, Co-57, Co-60, Zn-65, Y-88, Sr-90, Y-90, Cd-109, Sn-113, I-125, Cs-137, Ce-139, Po-209, Po-210, U-235, U-238, Np-237, Pu-239, Pu-242, Am-241, Th-nat, U-nat.

## **SECTION 2.0 – FACILITY OPERATING HISTORY**

### **2.2 License Number/Status/Authorized Activities**

The CDC was authorized to possess the following radionuclides as summarized in **Table 2-2 - RAM License Possession Limits** below as referenced by amendment number 48 of Radioactive Materials License 10-06772-01:

**Table 2-2 - RAM License Possession Limits**

	<b>Nuclide</b>	<b>Form</b>	<b>Possession Limit</b>
<b>A.</b>	Any byproduct material with atomic numbers 1 through 83, except as specified below	Any	100 millicuries per radionuclide and 5 curies total
<b>B.</b>	Any byproduct material with atomic numbers 84 through 96, except as specified below	Any	2 millicuries per radionuclide and 25 millicuries total
<b>C.</b>	Hydrogen 3	Any	250 millicuries
<b>D.</b>	Phosphorus 32	Any	350 millicuries
<b>E.</b>	Sulfur 35	Any	350 millicuries
<b>F.</b>	Chromium 51	Any	350 millicuries
<b>G.</b>	Iodine 125	Any	220 millicuries
<b>H.</b>	Thorium 228	Any	1 millicurie
<b>I.</b>	Thorium 230	Any	1 millicurie
<b>J.</b>	Uranium 233	Any	1 millicurie
<b>K.</b>	Uranium 234	Any	1 millicurie
<b>L.</b>	Uranium 235	Any	0.7 millicurie
<b>M.</b>	Uranium 236	Any	1 millicurie
<b>N.</b>	Plutonium 238	Any	1 millicurie
<b>O.</b>	Plutonium 239	Any	1 millicurie
<b>P.</b>	Plutonium 240	Any	1 millicurie
<b>Q.</b>	Plutonium 242	Any	1 millicurie
<b>R.</b>	Californium 252	Any	1 millicurie
<b>S.</b>	Nickel 63	Foil or plated sources registered either with the U.S. NRC under 10 CFR 32.210 or with an Agreement State	400 millicuries
	Natural thorium (on NRC license in 2001-2007)	Any	0.151 millicurie
	Natural uranium (on NRC license in 2001-2007)	Any	0.453 millicurie

#### **2.2.1 Authorized Use**

- A. - R. Research and development as defined in 10 CFR 30.4, and calibration and quality control standards for the licensee's instruments
- S. To be used for sample analysis in compatible gas chromatography devices that has been registered with the U.S. Nuclear Regulatory Commission under 10 CFR 32.210 or with an Agreement State.



## **SECTION 2.0 – FACILITY OPERATING HISTORY**

### **2.3 Licensed Radionuclides Stored at RAW Room #1**

**Table 2-3 - Nuclides Stored at the RAW Room #1**

Nuclide	Half-life	Half-Life >120 Days	Predominant Emissions
H-3	1.2E+01	YES	Beta
C-14	5.7E+03	YES	Beta
Na-22	2.6E+00	YES	Beta
P-32	3.9E-02	NO	Beta
P-33	7.0E-02	NO	Beta
Cr-51	7.7E-02	NO	Beta
Mn-54	8.6E-01	YES	Gamma (ε)
Co-57	7.4E-01	YES	Beta
Co-60	5.3E+00	YES	Beta/Gamma
Zn-65	6.78E-01	YES	Gamma (ε)
Sr-85	1.8E-01	NO	Gamma (ε)
Sr-89	1.5E-01	NO	Beta
Sr-90	2.9E+01	YES	Beta
Y-88	3.0E-01	NO	Gamma (ε)
Cd-109	1.3E+00	YES	Beta
Sn-113	3.2E-01	NO	Gamma (ε)
I-125	1.6E-01	NO	Low E Beta
I-131	2.2E-02	NO	Beta
Cs-134	2.0E+00	YES	Beta
Cs-137	3.0E+01	YES	Beta/Gamma
Ba-133	1.0E+01	YES	Gamma (ε)
Ce-139	3.8E-01	YES	Beta
Eu-152	1.3E+01	YES	Beta
Ir-192	2.0E-01	NO	Beta
Hg-203	1.3E-01	NO	Beta
Tl-204	3.8E+00	YES	Beta
Po-209	1.1E+02	YES	Alpha
Po-210	3.8E-01	YES	Alpha
Ra-226	1.6E+03	YES	Alpha
Th-232	1.4E+10	YES	Alpha
U-233	1.56E+05	YES	Alpha
U-235	7.1E+08	YES	Alpha
U-236	2.4E+07	YES	Alpha
U-238	4.5E+09	YES	Alpha
Pu-238	8.6E+01	YES	Alpha
Pu-239	2.4E+04	YES	Alpha
Pu-240	6.6E+03	YES	Alpha
Pu-242	3.8E+05	YES	Alpha
Am-241	4.3E+02	YES	Alpha
Am-243	7.9E+03	YES	Alpha

## **SECTION 2.0 – FACILITY OPERATING HISTORY**

The radionuclides P-32, P-33, Cr-51, Sr-85, Sr-89, Y-90, Sn-113, I-125, I-131, Ir-192, and Hg-203 were eliminated as radionuclides of concern due to short half-lives.

### **2.4 Previous Decommissioning Activities**

Based on interviews with the RSO and document reviews, there were no records of previous decommissioning activities performed at RAW Room #1.

### **2.5 Radioactive Materials Spills**

One contaminated area measuring approximately 1 ft<sup>2</sup> on the concrete floor was found to have gross total activity levels of 7,323 dpm/100 cm<sup>2</sup> beta/gamma as indicated by direct static measurement during Scoping Surveys. The area was decontaminated four separate times for ALARA; however, no additional activity was removed after the third remedial Activity. Large area wipes were obtained in that area and the surrounding area. The residual fixed contamination was measured at 1,464 dpm/100 cm<sup>2</sup>, as addressed above. Total activity post-remediation, utilizing the instruments stated efficiency was 1,464 dpm/100 cm<sup>2</sup> and ALARA. Surveys of the area were performed during FSS using the ISO 7503-1, 1988 methods to determine field concentrations for final status data; no static location was greater than 3,620 dpm/100 cm<sup>2</sup> for gamma emissions and 3,391 beta dpm/100 cm<sup>2</sup> beta emissions based on the use of ISO-7503-1 efficiencies. Routine and task specific contamination surveys were included in the historical review of the license and there were no indications of contamination levels over the DCGLs for release of the impacted areas included.

### **2.6 Prior On-site Burials**

There was no record of any on-site burials at RAW Room #1.

## **SECTION 3.0 – FACILITY DESCRIPTION**

### **3 FACILITY DESCRIPTION**

Chamblee Building 1 was constructed in the 1940's as part of World War II mobilization. With the addition of the RAW Room #1 enclosure, the current total building footprint was 850 ft<sup>2</sup>, with a covered loading dock adding an additional 275 ft<sup>2</sup>.

#### **3.1 Lower Level**

At the time of its original construction, the site of Building 1 was partially excavated to create a 22' x 9' basement level, with a 10-ft high ceiling at the east end of the building provided in **Appendix A**. However this Lower Level was left entirely unfinished, with no lighting and no ventilation. A variety of plumbing pipes were left exposed within the space. Initially it was used as a medical waste incinerator, constructed utilizing firebrick, for the adjacent military hospital. The incinerator was never utilized to process RAM or radioactive waste. In the early days, the Lower Level provided access to the incinerator pit and the ash dumps, which occupy most of this area. During FSS it was entirely abandoned due to its dilapidated condition. There was a paved court outside the door to the Lower Level, bounded on one side by the building and on two other sides by concrete retaining walls. The third side, facing the building to the east, was bounded by a later reinforced-earth retaining wall installed as part of a temporary access route for the construction of Building 107. On the north side of the building there was a narrow area way open to the aforementioned court. In 1981, the upper level was transformed into a chemical waste storage facility and the lower level was abandoned.

#### **3.2 Upper Level**

The construction primarily consisted of a concrete floor supported by reinforced concrete beams over a crawl space, exterior masonry walls, and a gable wooden roof on steel purlins, covered with asphalt shingles. The assemblies also included a metal enclosure and a small wood framed building extension provided in **Appendix A**. The exterior doors were hollow metal, except one wood door at the Lower Level. Most windows along the perimeter walls were removed, and their openings filled solid with concrete masonry or with wood for what would be an interior wall, during building renovations in 1981. During FSS, only two windows remained, both of which were uninsulated and in disrepair. Several electric space heaters, mounted to the wall or ceiling, kept the building interior warm during the winter months. A wall air-conditioning unit provided cool air to the chemical waste storage in the summer. However, there was a lack of cooling equipment inside the metal enclosure where the radioactive waste was stored. This room had no cooling or ventilation equipment, except 4 louvers on the perimeter walls – which were not insulated. Electrical services were fed from a single phase, 120/240 V, 200 amp main breaker panelboard located inside Building 1, which was in turn fed from a transformer between Building 1 and Building 107. There was domestic water supply and sanitary drain serving both the building proper and the RAW Room #1 enclosure.

## **SECTION 3.0 – FACILITY DESCRIPTION**

In 1986, a metal enclosure, RAW Room #1, was added to the northwest corner to provide a space for radioactive waste storage. RAW Room #1 was characterized by three metal walls with a fourth wall of concrete. The smooth concrete floor had dimensions of 8' x 17' = 136 ft<sup>2</sup>, according to information provided by the CDC RSO. Descriptions and dimensions are provided in **Table 3-1- Building 1 Room 1 Description** below.

Table 3-1- Building 1 Room 1 Description

**Table 3-1- Building 1 Room 1 Description**

Measurement Type	Building	Room	Area
Actual Field Measurement	1	RAW Room #1	(9'9" x 19'10") = 194 ft <sup>2</sup>

There were no chemical and/or radiological fume hoods in RAW Room #1. Disposal of liquid radioactive waste via the sewer was generally performed in other laboratories and was limited to small total activities or radionuclides that had decayed at least 10 half-lives. There were no in-house vacuum or ventilation systems.

### **3.3 Ownership**

The facility was owned by the CDC. The facility will be demolished after unrestricted release.

### **3.4 Population Distribution**

Not Applicable – all impacted areas indoors.

### **3.5 Current/Future Land Use**

Not applicable – all impacted areas indoors.

### **3.6 Meteorology and Climatology**

Not applicable – all impacted areas indoors.

### **3.7 Geology and Seismology**

Not applicable – all impacted areas indoors.

### **3.8 Surface Water Hydrology**

Not applicable – all impacted areas indoors.

### **3.9 Ground Water Hydrology**

Not applicable – all impacted areas indoors.

### **3.10 Natural Resources**

Not applicable – all impacted areas indoors.

## **SECTION 4.0 – RADIOLOGICAL STATUS OF THE FACILITY**

### **4 RADIOLOGICAL STATUS OF THE FACILITY**

RAW Room #1, a metal enclosure provided for radioactive waste storage was located at the CDC Chamblee campus at 4770 Buford Highway, Atlanta, GA 30341. Prior to Philotechnics' initial Scoping surveys of the facility on March 10 & 11, 2014, the room was vacated, any unneeded and potentially contaminated items were surveyed and all items were found to be free of any residual contamination. There were no chemical and/or radiological fume hoods, no in-house vacuum or ventilation systems in the enclosure, but there was a small shallow sink. The sink was removed and disposed of. Diposal of liquid radioactive waste via the sewer at RAW Room #1 should not have occurred, and on campus was generally limited to small total activities or radionuclides that had decayed at least 10 half-lives. Only one area of elevated activity was identified as discussed in **Section 2.5 – Radioactive Materials Spills** above. The area identified was an approximate 1 ft<sup>2</sup> area on the concrete floor. **Scoping survey results are provided in Table 4-1 – RAW Room #1 Floors and Lower Walls Scoping Survey Results and Table 4-2 – RAW Room #1 Ceiling and Upper Walls Scoping Survey Results below, and survey unit location maps are provided in Figure 4-1– RAW Room #1 Floor and Lower Walls and Figure 4-2 – RAW Room #1 Ceiling and Upper Walls below:**

**Table 4-1 – RAW Room #1 Floors and Lower Walls Scoping Survey Results**

<b>Result Description</b>	<b>Alpha dpm/100cm<sup>2</sup></b>	<b>Beta dpm/100cm<sup>2</sup></b>	<b>Gamma dpm/100cm<sup>2</sup></b>
<i>Average</i>	<i>4</i>	<i>360</i>	<i>-98</i>
<i>Standard Deviation</i>	<i>10.5</i>	<i>775</i>	<i>953</i>
<i>Minimum</i>	<i>-14</i>	<i>-591</i>	<i>-1,818</i>
<i>Maximum</i>	<i>25</i>	<i>3,391</i>	<i>3,620</i>

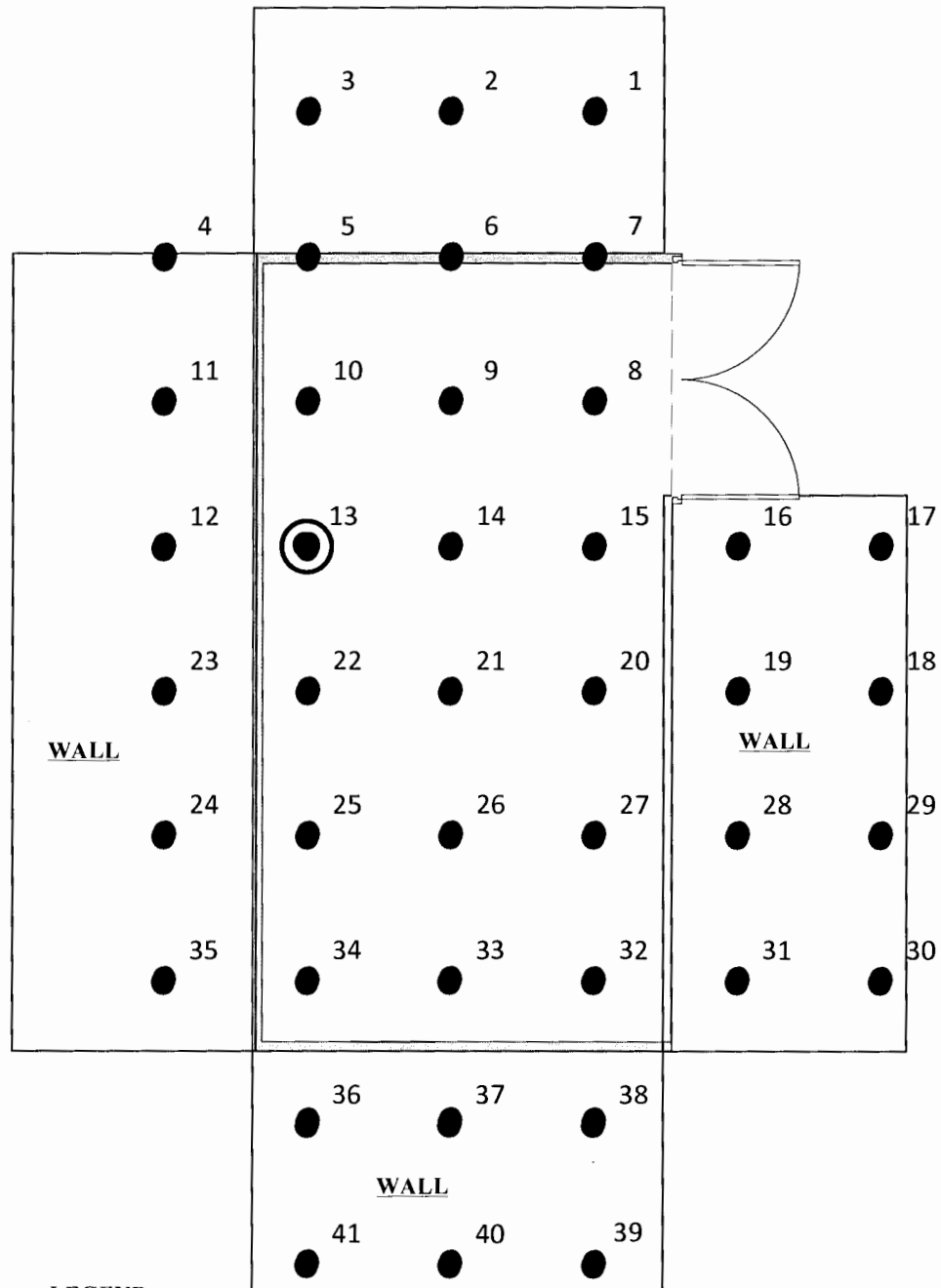
**Table 4-2 – RAW Room #1 Ceiling and Upper Walls Scoping Survey Results**

<b>Result Description</b>	<b>Alpha dpm/100cm<sup>2</sup></b>	<b>Beta dpm/100cm<sup>2</sup></b>	<b>Gamma dpm/100cm<sup>2</sup></b>
<i>Average</i>	<i>0</i>	<i>-141</i>	<i>-956</i>
<i>Standard Deviation</i>	<i>8.3</i>	<i>313</i>	<i>703</i>
<i>Minimum</i>	<i>-14</i>	<i>-658</i>	<i>-2,160</i>
<i>Maximum</i>	<i>25</i>	<i>394</i>	<i>119</i>

Note: Total instrument efficiency used for all alpha and beta measurements for floors, ceilings, lower and upper walls were performed in accordance with ISO-7503-1 using a surface efficeincy of 0.25 ( $E_{Total} = E_{Instrument} * E_{Surface}$  ).

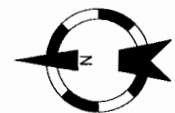
## SECTION 4.0 – RADIOLOGICAL STATUS OF THE FACILITY

Figure 4-1– RAW Room #1 Floor and Lower Walls



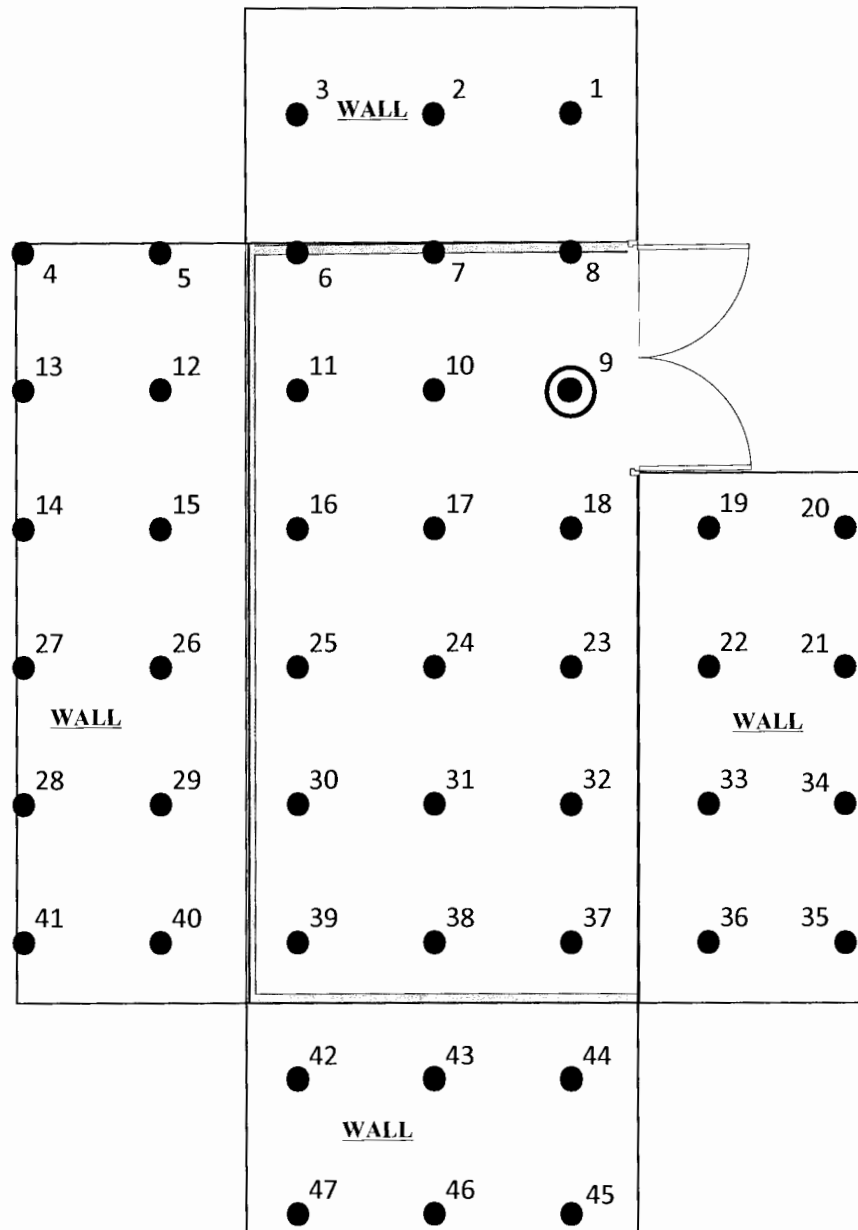
### LEGEND

- ⊙ - Random Starting Point from  
Random Number Generation  
X-Axis Start Location 1'  
Y-Axis Start Location 13'  
Typical Spacing = 1.18 m (3'7")  
Area ~ 18.02 m<sup>2</sup> (194 ft<sup>2</sup>)



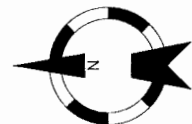
## SECTION 4.0 – RADIOLOGICAL STATUS OF THE FACILITY

Figure 4-2 – RAW Room #1 Ceiling and Upper Walls



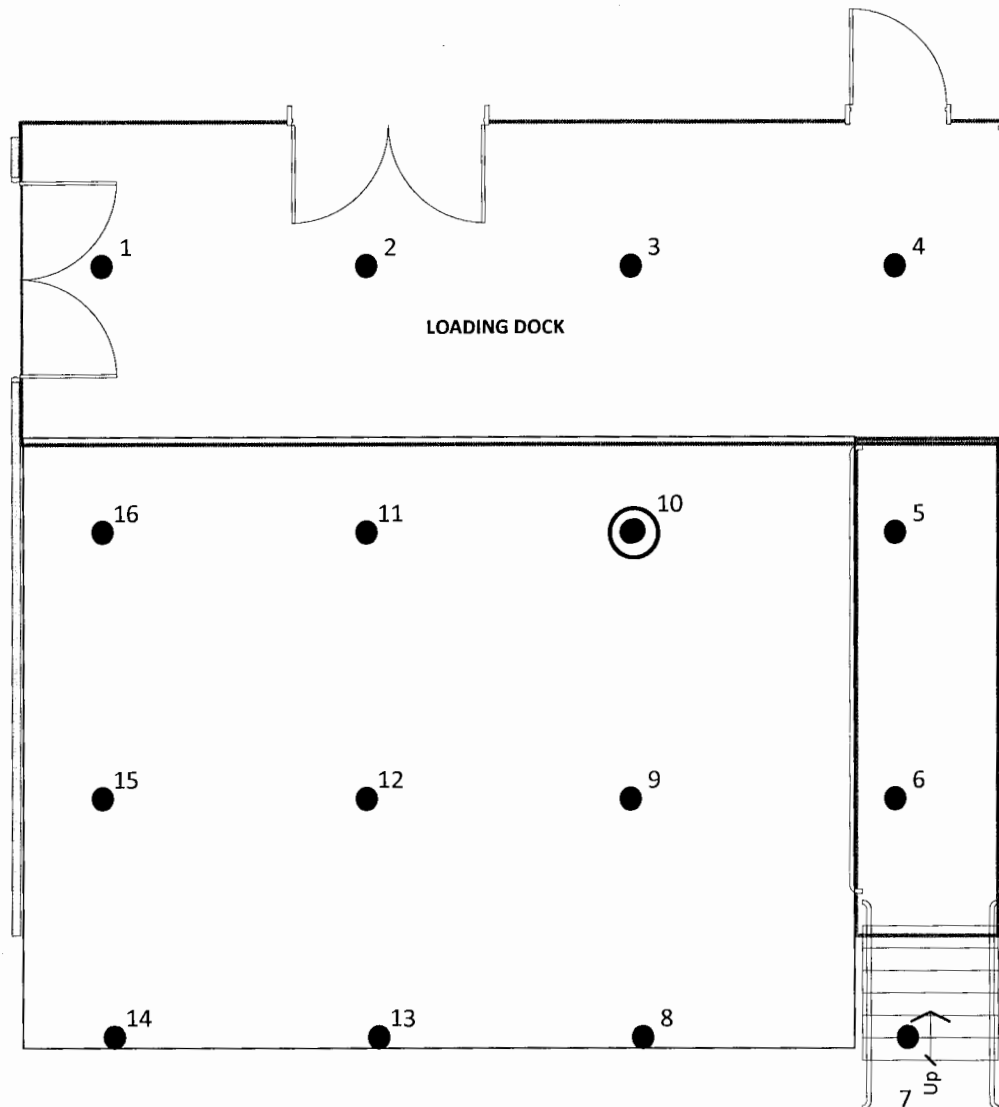
### LEGEND

- ⊙ - Random Starting Point from Random Number Generation
- X-Axis Start Location 7'
- Y-Axis Start Location 15'
- Typical Spacing = 1.18 m (3'7")
- Area ~ 18.02 m<sup>2</sup> (194 ft<sup>2</sup>)



## SECTION 4.0 – RADIOLOGICAL STATUS OF THE FACILITY

Figure 4-3 – Loading Dock and Ramp

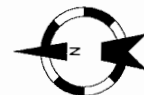


### LEGEND

- ⊙ - Random Starting Point from  
Random Number Generation  
X-Axis Start Location 17'  
Y-Axis Start Location 14'

Typical Spacing = 2.07 m (6'10"), Plus Judgmental

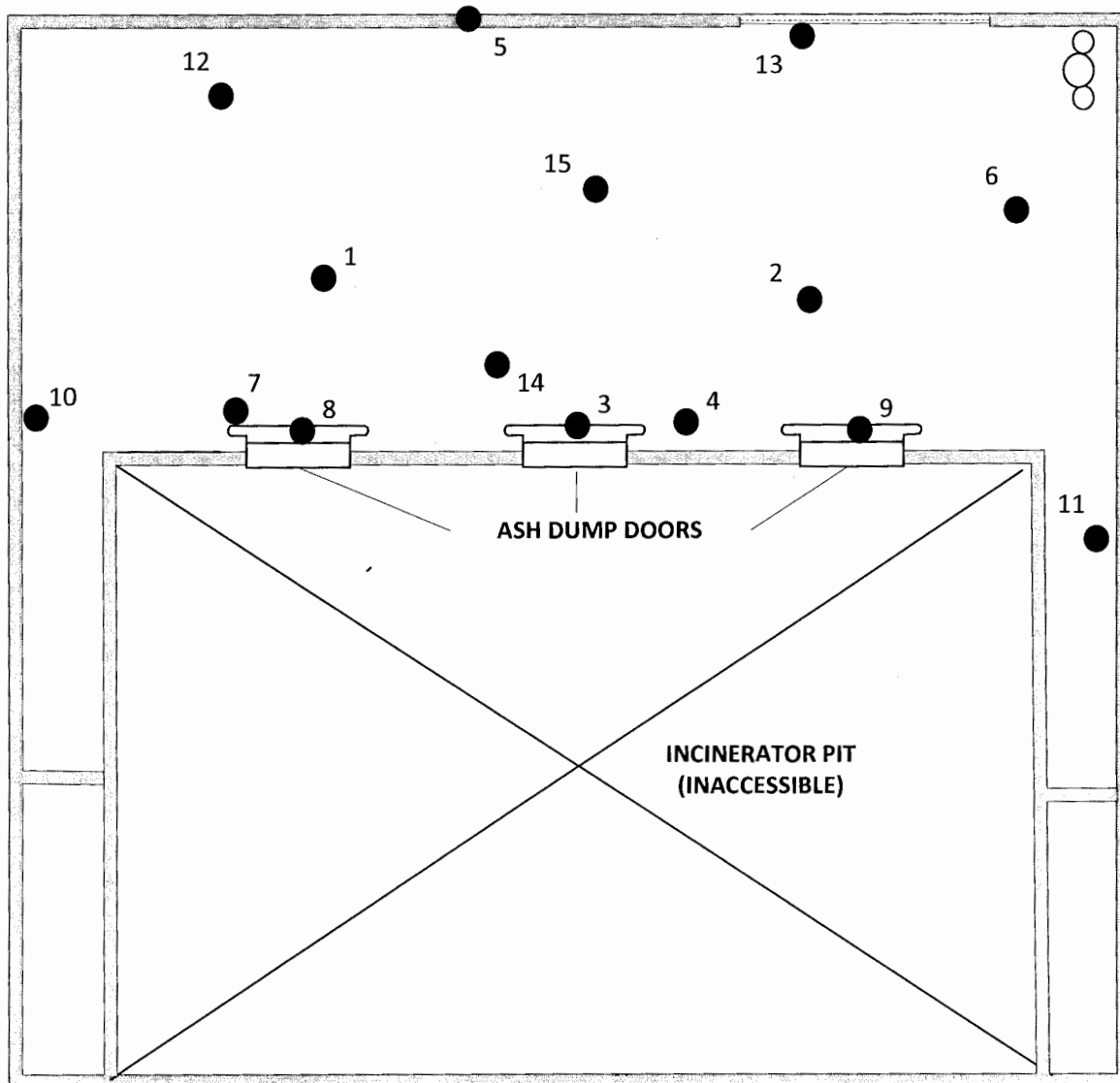
Area ~ 55.74 m<sup>2</sup> (600 ft<sup>2</sup>)





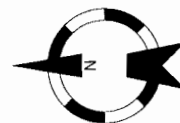
## SECTION 4.0 – RADIOLOGICAL STATUS OF THE FACILITY

Figure 4-4 – Incinerator Basement



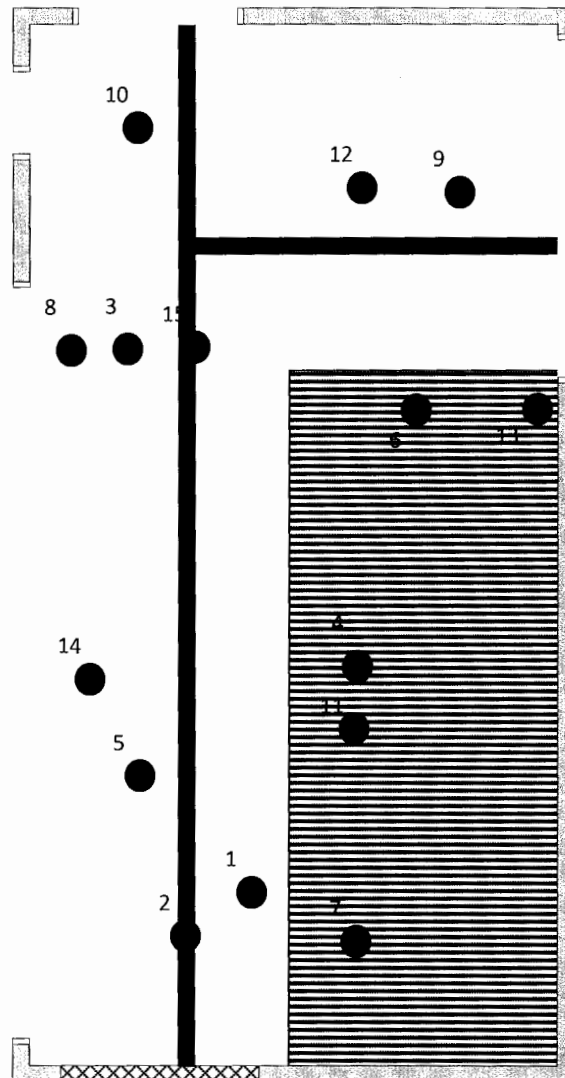
### LEGEND


*Typical Spacing = Random, Random, Plus Judgmental*



## SECTION 4.0 – RADIOLOGICAL STATUS OF THE FACILITY

Figure 4-5 – RAW Room #1 Crawlspace

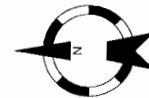


 - Aluminum crawlspace ceiling  
(Concrete ceiling elsewhere)

### LEGEND

- Random Starting Point from  
Random Number Generation

Typical Spacing = Random, Random, Plus Judgmental



## **SECTION 4.0 – RADIOLOGICAL STATUS OF THE FACILITY**

### **4.1 Contaminated Structures**

One contaminated area measuring approximately 1 ft<sup>2</sup> on the concrete floor was identified as described in **Section 2.5 – Radioactive Materials Spills** above.

### **4.2 Contaminated Systems and Equipment**

No contaminated systems or equipment were identified.

### **4.3 Surface Soil Contamination**

Not applicable – all impacted areas indoors.

### **4.4 Subsurface Soil Contamination**

Not applicable – all impacted areas indoors.

### **4.5 Surface Water**

Not applicable – all impacted areas indoors.

### **4.6 Ground Water**

Not applicable – all impacted areas indoors.

## **SECTION 5.0 – DCGL DEVELOPMENT**

### **5 DERIVED CONCENTRATION GUIDELINE LEVEL DEVELOPMENT**

The Derived Concentration Guideline Level (DCGL) is the radionuclide-specific surface area concentration that could result in a dose equal to the release criterion for unrestricted use specified in 10 CFR 20.1402. The building structural surfaces DCGLs for this project were developed utilizing a RESRAD-BUILD Dose Model. Most default parameters were accepted; however, site specific parameter values were used for some critical parameters where compelling reasons existed.

#### **5.1 Dose Model**

Dose modeling was performed to develop site specific DCGLs for unrestricted release of building structural surfaces, and to determine the final TEDE based on two models. The first model used 1% removable fraction consistent with the initial models with a TEDE result of 6 mrem/year. The second model used 100% removable fraction with a TEDE result of 19 mrem/year as detailed in **Section 19 – FINAL RESRAD MODELING** below. Because the purpose of the surveys was to release a single room from radiological controls, only residual surface radioactivity was considered; however, Philotechnics performed additional surveys of the travel path, loading dock, and crawlspace area as a conservative measure and to verify this assumption. User's Manual for RESRAD-BUILD Version 3, Table 3.1, and NUREG/CR 6755, Table 4.1 were used where appropriate to assign site-specific building parameters. RESRAD-BUILD was developed at Argonne National Laboratory and recognized by the NRC as a tool for estimating annual doses to a member of the critical group.

The radiological release criteria of 10 CFR 20 Subpart E for unrestricted use were used. Specifically, the facility was surveyed in accordance with MARSSIM to demonstrate compliance with the criteria of 10 CFR 20.1402. The criteria were that residual radioactivity results in a TEDE to an average member of the critical group that does not exceed 25 mrem per year and had been reduced to levels that were ALARA.

A site specific dose model was used **primarily because DandD did not include dose modeling for some of the ROC present at the CDC and the excessive conservatism in the NRC's dose modeling software for alpha emitters.** Scoping surveys were performed at the Chamblee, Georgia campus of the U.S. Centers for Disease Control in March 2014. The purpose of the surveys was to attempt to quantify and bound the site-specific radiological status of the facility. In order to develop site-specific DCGLs, a RESRAD-BUILD model was run after surveys were completed. Typically, RESRAD-BUILD is run after the Scoping of the site but before final decontamination and FSS. In such cases, the mixture and relative abundances of radionuclides present were known. All radionuclides, then, can be entered into a single model using the highest contamination levels. RESRAD-BUILD then calculates the expected dose to a member of the critical group at the present time and in the future.

Even though the RESRAD-BUILD was run after the scoping surveys were completed, the relative abundances of radionuclides present in RAW Room #1 were not known. The model was run multiple times—once for each radionuclide present. The surface contamination level for each radionuclide to deliver a projected dose of 25 mrem was

## **SECTION 5.0 – DCGL DEVELOPMENT**

calculated. All alpha/beta/gamma activity measured was compared to the lowest alpha/beta/gamma limit determined by RESRAD-BUILD to assign a alpha/beta/gamma DCGL. It is important to note, these were conservative assumptions.

### **5.2 Determination of Nuclides of Concern**

The relative abundances of radionuclides present in RAW Room #1 were not known. Nuclides of concern (NOC) and impacted rooms were determined by the following process (a brief overview is provided below, followed by a detailed description):

- CDC RSO reviews of limited nuclide receipt records for RAW Room #1
- Exclude receipts of non-dispersible and gaseous forms
- Decay-correct receipts
- Determine the resulting surface activity concentration in dpm/100 cm<sup>2</sup>
- Determine site-specific DCGLs using RESRAD-BUILD version 3.5
- Multiple runs of the model

The model was run independently for each NOC in order to determine the limiting radionuclide for each decay mode: alpha, beta, gamma (electron capture), and low-energy beta. The limiting radionuclides were determined to be Th-232 plus decay products, Co-60, Mn-54, and tritium (H-3). After running uncertainty, the DCGL corresponding to 25 mrem/year was determined for each limiting radionuclide. Most default parameter values of the scenario were accepted. However, site-specific parameter values were used for some critical parameters where there were compelling reasons to justify a site-specific value. DCGLs were derived based on the highest 90th percentile dose from the probability distributions of each of the evaluation times.

#### **5.2.1 Radionuclides evaluated:**

**Error! Reference source not found.** of the CDC DP lists all the radionuclides considered and the surface contamination level of each that produced a dose of  $\leq 25$  mrem/year. Contamination limits shown were for the parent radionuclide only. Decay of parent and ingrowth of daughter activity was included in all dose calculations.

### **5.3 DCGL Development**

The DCGL was the radionuclide-specific surface activity concentration that could result in a dose equal to the release criterion. DCGL<sub>w</sub> was the concentration limit if the residual activity was 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 DCGL<sub>EMC</sub>. Due to the radiological cleanliness of the facility relative to the DCGLs, the desire to maintain simplicity of the FSS, and to assist in achieving ALARA goals, the DCGL<sub>w</sub> was used as a maximum value and small areas of elevated activity were not considered in this survey design.

Site-specific dose modeling was performed, not because of the complexity of the site, but because nuclides were received that are not supported by the DandD dose model and because of excessive conservatism in the DandD model for some alpha emitters. As such, the building occupancy scenario was modeled using RESRAD BUILD, Version 3.4 to determine site-specific DCGLs.

## **SECTION 5.0 – DCGL DEVELOPMENT**

The goal was to develop a simple, conservative model for ease of review and implementation. Higher criteria could have been obtained by refining critical parameters, but the effort required for justification would not be worthwhile. Some critical parameters had a significant amount of uncertainty. This uncertainty was offset by conservatism of the site conceptual model. Accepting extra conservatism had little impact on schedule due to cleanliness of site. Conservatism was a common theme throughout selection of site-specific parameter values and development of DCGLs. This conservatism was used frequently to offset uncertainty such that qualitative statements were used to justify site-specific parameter values.

### **5.3.1 RAW Room #1 Model Description**

Room size was 18 m<sup>2</sup>. Dimensions were 5.6 m x 3.2 m with a ceiling height of 4 m. Only natural ventilation was assumed.

#### **5.3.1.1 Individual Radionuclide-Specific Trials**

The user may accept default values or replace them with more realistic values to provide an accurate depiction of the building design characteristics, assumed future use and occupancy, radioactive contamination levels and behavior. RESRAD-BUILD contains a number of default parameters. Parameters that apply to all radionuclides are described in **Error! Reference source not found.** and **Table 5-1 – RESRAD-BUILD Dose Details for Radionuclides** of the CDC DP.

Po-209 was not supported by either DandD or RESRAD-BUILD, and was therefore not analyzed. A review of decay energy, half-life, and decay products indicated its dose potential would be much less than Th-232. Federal Guidance Reports 11 and 12 were consulted in an effort to compare Po-209 with other alpha-emitting radionuclides using dose tables. Th-232 remains the limiting alpha emitter.

#### **5.3.1.2 Uncertainty**

Th-232 was run using Deposition Velocity values of  $1.0 \times 10^{-2}$ ,  $1.0 \times 10^{-4}$ , and  $1.1 \times 10^{-6}$ . There was no effect on the final dose.

Th-232 was run again using Resuspension Rate values of  $1.3 \times 10^{-5}$ ,  $3.7 \times 10^{-6}$ ,  $4.7 \times 10^{-7}$ , and  $1.0 \times 10^{-9}$ . Again, there was no effect on the final dose.

### **5.3.2 Uncertainty and Selection of Final Values**

Because deposition velocity and resuspension rate had little to no effect on the final outcome, a single uncertainty trial was run with uncertainty analyses on Breathing Rate and Receptor Ingestion Rate. It was thought the values selected in the First Trial would estimate higher doses at the 90<sup>th</sup> percentile, so the contamination levels were altered. Input values for each radionuclide are provided in

## **SECTION 5.0 – DCGL DEVELOPMENT**

**Table 5-1 – RESRAD-BUILD Input Values for Each Radionuclide below:**

## SECTION 5.0 – DCGL DEVELOPMENT

**Table 5-1 – RESRAD-BUILD Input Values for Each Radionuclide**

Radionuclide	Value in First Model (dpm/100 cm <sup>2</sup> )	Conservatively chosen Value (dpm/100 cm <sup>2</sup> )	Input (dpm/m <sup>2</sup> )
Th-232	$4.7 \times 10^2$	$3.0 \times 10^2$	$3.0 \times 10^4$
Co-60	$1.5 \times 10^4$	$1.0 \times 10^4$	$1.0 \times 10^6$
Mn-54	$6.0 \times 10^4$	$4.0 \times 10^4$	$4.0 \times 10^6$
H-3	$1.5 \times 10^7$	$1.0 \times 10^7$	$1.0 \times 10^9$

Doses from Co-60, Mn-54, and H-3 were well below 25 mrem, even at the 90<sup>th</sup> percentile. Th-232, however, produced 24 mrem at the 50<sup>th</sup> percentile and 29 mrem at the 90<sup>th</sup> percentile, as shown in **Table 5-2 – RESRAD-BUILD Percentile Output Doses** below:

**Table 5-2 – RESRAD-BUILD 90<sup>th</sup> Percentile Output Doses (mrem/year)**

	Th-232	Co-60	Mn-54	H-3
Time = 0	2.51E+01	1.64E+01	1.61E+01	2.04E+00
Time = 1 y	2.55E+01	1.43E+01	7.14E+00	1.85E+00
Time = 3 y	2.65E+01	1.08E+01	1.40E+00	1.54E+00
Time = 10y	2.94E+01	4.16E+00	0	0

A final Resrad-BUILD trial was run for each of the four radionuclide; the values shown above were used for all, except Th-232 was again reduced to 150 dpm/100 cm<sup>2</sup>. Results are displayed in **Appendix H.1 & H.2** and **Table 5-3 – RESRAD-BUILD Dose Details for Limiting Radionuclides** below:

**Table 5-3 – RESRAD-BUILD Dose Details for Limiting Radionuclides**

Th-232							
Uniform contamination level is $1.5 \times 10^2$ dpm/100 cm <sup>2</sup> .							
Time, years	0	1	3	10	12	15	30
Dose, mrem	6.5	6.6	6.9	7.8	7.9	8.0	1.3

Co-60							
Uniform contamination level is $1.0 \times 10^4$ dpm/100 cm <sup>2</sup>							
Time, years	0	1	3	10	12	15	30
Dose, mrem	16.3	14.2	10.8	4.2	3.2	2.1	0.3

Mn-54							
Uniform contamination level is $4.0 \times 10^4$ dpm/100 cm <sup>2</sup>							
Time, years	0	1	3	10	12	15	30
Dose, mrem	16.1	7.2	1.4	0	0	0	0

H-3							
Uniform contamination level is $1.0 \times 10^7$ dpm/100 cm <sup>2</sup>							
Time, years	0	1	3	10	12	15	30
Dose, mrem	18.8	2.5	0.5	0	0	0	0



## SECTION 5.0 – DCGL DEVELOPMENT

### 5.3.2.1 RESRAD-BUILD Limiting Nuclides

The limits used for FSS are provided in **Table 5-4 – RESRAD-BUILD Limiting Radionuclides**. Error! Reference source not found. below:

**Table 5-4 – RESRAD-BUILD Limiting Radionuclides**

Type of Emission	Limiting Radionuclide	Gross DCGL, dpm/100 cm <sup>2</sup>	Removable Activity, dpm/100 cm <sup>2</sup>
Alpha	Th-232	150	15
Beta	Co-60	10,000	1000
Gamma	Mn-54	40,000	4000
Low-E beta <sup>1</sup>	H-3	1.0x10 <sup>7</sup>	1.0x10 <sup>6</sup>

### 5.3.2.2 Hard to Detect Nuclides

Hard-to-detect nuclides (H-3) could not be adequately surveyed using direct field measurements and were evaluated by removable activity only as analyzed by liquid scintillation counting (LSC). The Scoping survey indicated all tritium smears were less than minimum detectable activity (MDA). A liquid scintillation counter was not available on the CDC site. For these reasons, tritium was not considered in this survey design. To verify this assumption, smears were evaluated on the Philotechnics LSC in Oak Ridge, TN upon return from the Project site. These results are included in **Appendix G** of this Final Status Survey Report.

### 5.3.3 Unity Calculations

Unity was applied to each sample location using the following equation to determine compliance.

$$\frac{C_{Alpha}}{DCGL_{Alpha}} + \frac{C_{Beta}}{DCGL_{Beta}} + \frac{C_{Gamma}}{DCGL_{Gamma}} < 1$$

Where:

$$\begin{aligned} C_{Alpha} &= \text{Gross alpha result in dpm/100cm}^2 \\ C_{Beta} &= \text{Gross beta result in dpm/100cm}^2 \\ C_{Gamma} &= \text{Gross gamma result in dpm/100cm}^2 \\ DCGL_{Alpha} &= \text{Gross alpha result in dpm/100cm}^2 \\ DCGL_{Beta} &= \text{Gross beta result in dpm/100cm}^2 \\ DCGL_{Gamma} &= \text{Gross gamma result in dpm/100cm}^2 \end{aligned}$$

This method ensured that, regardless of the radionuclide distribution in a particular location, **the dose limit of 25 mrem per year would not be exceeded** as long as the sum of fractions shown above was less than 1.

## **SECTION 6.0 – ENVIRONMENTAL INFORMATION**

### **6 ENVIRONMENTAL INFORMATION**

This project did not affect quality of the human environment, species listed in Section 7 of the Endangered Species Act, or historic properties.

## **SECTION 7.0 – ALARA ANALYSIS**

### **7 ALARA ANALYSIS**

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.” Based on the levels indicated during the Scoping survey, a quantitative ALARA analysis was not required.

## **SECTION 8.0 – SURVEY INSTRUMENTATION**

### **8 SURVEY INSTRUMENTATION**

#### **8.1 Instrument Calibration**

Laboratory and portable field instruments were calibrated at least annually with National Institute of Standards and Technology (NIST) traceable sources, where feasible, and to radiation emission types and energies that provided detection capabilities and sensitivities required for the NOCs. Records of instrument calibration included with the final status survey report are provided in **Appendix C**.

#### **8.2 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. Reference background readings were taken in an adjoining non-impacted area as part of the daily instrument check and compared with the acceptance range for instrument and site conditions. If an instrument failed a functional check, all data obtained with the instrument since the last satisfactory check would be evaluated for usability by the PM or designee and unusable data discarded. All instrumentation passed its respective functional check.

#### **8.3 Determination of Counting Times and 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 criteria specified in the CDC DP. MARSSIM equations relative to building surfaces were modified to convert to units of dpm/100cm<sup>2</sup>. Count times and scanning rates were determined using the following equations:

##### **8.3.1 Static Counting**

Static counting MDC at a 95% confidence level was calculated using the following equation, which was 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): Examples **Equation 8-1 – Beta Total Activity Example**, **Equation 8-2 – Alpha Total Activity Example**, and **Equation 8-3 – Gamma Total Activity Example** were prepared using background count rates, background and sample count times, total detector efficiencies (including surface efficiencies guidance provided in ISO-7503-1), and detector probe areas utilized in the FSS, to ensure they were consistent with actual field conditions at the project site.

## SECTION 8.0 – SURVEY INSTRUMENTATION

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

Where:

- $MDC_{static}$  = minimum detectable concentration level in dpm/100cm<sup>2</sup>  
 $B_r$  = background count rate in counts per minute  
 $t_b$  = background count time in minutes  
 $t_s$  = sample count time in minutes  
 $E_{tot}$  = total detector efficiency for radionuclide emission of interest  
 (includes combination of instrument efficiency and surface  
 efficiency from ISO-7503-1  $E_{Total} = (E_{Instrument} * E_{Surface})$   
 $A$  = detector probe area in cm<sup>2</sup>

### Equation 8-1 – Beta Total Activity Example

$$MDC_{static} = \frac{3 + 3.29 \sqrt{468 \cdot 1 \cdot (1 + \frac{1}{1})}}{1 \cdot (.4128 * .25) \cdot \frac{100}{100cm^2}}$$

$$MDC_{static} = \frac{3 + 3.29 \sqrt{936}}{.1032}$$

$$MDC_{static} = \frac{103.65}{.1032}$$

$$MDC_{static} = 1,004 \text{dpm}/100\text{cm}^2$$

### Equation 8-2 – Alpha Total Activity Example

$$MDC_{static} = \frac{3 + 3.29 \sqrt{3 \cdot 3 \cdot (1 + \frac{3}{3})}}{3 \cdot (.3004 * .25) \cdot \frac{100}{100cm^2}}$$

$$MDC_{static} = \frac{3 + 3.29 \sqrt{18}}{.2253}$$

$$MDC_{static} = \frac{16.96}{.2253}$$

$$MDC_{static} = 75 \text{dpm}/100\text{cm}^2$$

## SECTION 8.0 – SURVEY INSTRUMENTATION

### Equation 8-3 - Gamma Total Activity Example

$$MDC_{static} = \frac{3 + 3.29 \sqrt{9009 \cdot 1 \cdot (1 + \frac{1}{1})}}{1 \cdot (.5090 \cdot .50) \cdot \frac{100}{100cm^2}}$$

$$MDC_{static} = \frac{3 + 3.29 \sqrt{18,018}}{.2545}$$

$$MDC_{static} = \frac{444.62}{.2545}$$

$$MDC_{static} = 1,747 dpm/100cm^2$$

### 8.3.2 Beta/Gamma Ratemeter Scanning

Scan MDC was determined based on the guidance described in MARSSIM Section 6.7.2 – *Scanning Sensitivity* and Decommissioning Health Physics, Second Edition, **Section 9.3 – Scan MDC**. Scanning was performed to identify areas of elevated activity in the survey unit. The scan MDC depended on many of the same factors that influence the detection of contamination under static conditions: the level of the background radiation levels; the nature (type and energy of emissions) and relative distribution of potential contamination (point versus distributed source and depth of contamination; the intrinsic characteristics of the detector (efficiency, physical probe area, etc.); the desired level of confidence (type I and type II); and the surveyor's skill in recognizing an increase in the audible or display output of an instrument. If one assumes constant parameters for each of the above variables, with the exception of the specific radionuclide of interest, the scan MDC was reduced to a function of the radionuclide alone. These calculations were provided in Section 6 of MARSSIM.

The scan MDCs were determined based upon site-specific background data from the FSS, using the equations below.

The number of source counts required for a specific time interval was calculated by MARSSIM Equation 6-8:

$$s_i = d' \sqrt{b_i}$$

Where:

- $d'$  = The performance factor based on required true and false positives rates. It was assumed that at the first scanning stage a high rate (95%) of correct detections was required, and that a correspondingly rate of false positives (60%) would be tolerated. From MARSSIM Table 6.5, the value representing the performance goal was 1.38.
- $b_i$  = The number of background counts in the observation interval

## **SECTION 8.0 – SURVEY INSTRUMENTATION**

Assuming that the source remains under the detector for 1.385 seconds (e.g.,  $i=1.385$ ) and the background count rate was the site-specific background of 468 cpm for beta and 9,009 cpm for gamma, the value for  $b_i$  was then calculated:

$$b_i (\text{counts}) = (\text{Background (cpm)}) \times (i (\text{sec.})) \times (1 \text{ min}/60 \text{ sec})$$

The scan minimum detectable count rate (MDCR) was then calculated using the number of source counts required for a specific time interval was calculated by MARSSIM Equation 6-8:

$$s_i = d' \sqrt{b_i}$$

MARSSIM Equation 6-9:

$$\text{MDCR (cpm)} = (d') \times (\sqrt{b_i (\text{counts})}) \times (60 \text{ sec}/1\text{min})$$

The  $\text{MDCR}_{\text{surveyor}}$  is calculated assuming a surveyor efficiency ( $p$ ) of 0.5 (see MARSSIM page 6-45):

$$\text{MDCR}_{\text{SURVEYOR}} (\text{cpm}) = \text{MDCR (cpm)} / (\sqrt{p})$$

Using the above input parameters, the scan MDC necessary to yield the MDC was calculated using MARSSIM Equation 6-10 for structures and surfaces.

An example of the surface and structures scanning MDC at a 95 percent confidence level was calculated for Ludlum 2350-1 with a 43-93 probe for beta and Ludlum 2350-1 with a GP-13A probe for gamma using the following equation, which is a combination of MARSSIM Equations 6-8, 6-9 and 6-10:

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

Where

- $d'$  = minimum detectable concentration level in dpm/100  $\text{cm}^2$
- $b_i$  = background counts during the observation interval
- $i$  = observation interval
- $p$  = surveyor efficiency (0.5)
- $\epsilon_{\text{tot}}$  = total detection efficiency for radionuclide emission of interest (includes combination of instrument and surface efficiencies)
- $A$  = active area of the detector in  $\text{cm}^2$

### **8.3.2.1 Small Area Probe Beta Ratemeter Scanning MDC**

Assuming that the source remained under the detector for 1.385 seconds (e.g.,  $i=1.385$ ) and the background count rate was the site-specific ambient background rate of 468, the value for  $b_i$  was then calculated for beta as:

## **SECTION 8.0 – SURVEY INSTRUMENTATION**

### **Equation 8-4 – Small Area Probe Beta Ratemeter Scanning Background Counts during Observation Interval Example**

$$b_i (\text{counts}) = 468 \text{cpm} \times 1.385 \text{ sec.} \times (1 \text{ min}/60 \text{ sec})$$

$$b_i = 10.809 \text{ counts}$$

The scan minimum detectable count rate (MDCR) was then calculated using the number of source counts required for a specific time interval was calculated by MARSSIM Equation 6-8:

### **Equation 8-5 – Small Area Probe Beta Ratemeter Scanning Specific Interval Example**

$$s_i = d' \sqrt{b_i}$$

$$S_i = 1.38 \times \sqrt{10.80 \text{ counts}}$$

$$S_i = 4.54 \text{ counts}$$

The scan minimum detectable count rate (MDCR) was then calculated using MARSSIM Equation 6-9:

### **Equation 8-6 – Small Area Probe Beta Ratemeter Scanning MDCR Example**

$$\text{MDCR (cpm)} = S_i \times (60/i)$$

$$\text{MDCR} = 4.54 \text{ counts} \times (60/1.385)$$

$$\text{MDCR} = 196.68 \text{ cpm}$$

The  $\text{MDCR}_{\text{Surveyor}}$  was calculated assuming a surveyor efficiency ( $p$ ) of 0.5 (see MARSSIM page 6-45):

### **Equation 8-7 – Small Area Probe Beta Ratemeter Scanning $\text{MDCR}_{\text{Surveyor}}$ Example**

$$\text{MDCR}_{\text{Surveyor}} (\text{cpm}) = 196.68/(\sqrt{0.5})$$

$$\text{MDCR}_{\text{Surveyor}} (\text{cpm}) = 139.07 \text{ cpm}$$

The scan MDC was then calculated using MARSSIM Equation 6-10:

$$\text{Scan MDC} = \text{MDCR}/(\sqrt{p}) * (\epsilon_{\text{tot}}) * (\text{probe area}/100 \text{cm}^2)$$

$$\text{Scan MDC} = 196.68/(\sqrt{0.5}) \times (41.28\% * .25) \times (100 \text{ cm}^2/100 \text{cm}^2)$$

$$\text{Scan MDC} = 2,695 \text{ dpm}/100 \text{ cm}^2$$

Where

- $\text{MDCR}$  = minimum detectable count rate
- $\epsilon_{\text{tot}}$  = Instrument efficiency ( $\epsilon_i$ ) x surface efficiency ( $\epsilon_s$ )  
Per ISO-7503-1 1988  $\epsilon_s = 0.25$  for [beta-emitters (0,15 MeV < EBmax < 0,4 MeV) and alpha-emitters]
- $p$  = surveyor efficiency (0.5)



## **SECTION 8.0 – SURVEY INSTRUMENTATION**

### **Equation 8-8 – Small Area Probe Beta Ratemeter Scanning MDC<sub>Scan</sub> Example**

Utilizing the combination of MARSSIM Equations 6-8, 6-9 and 6-10 from above:

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

$$MDC_{scan} = 1.38 * (\sqrt{10.80}) * (60/1.385) / (\sqrt{0.5}) * (41.28\% * .25) * (100 \text{ cm}^2 / 100 \text{ cm}^2)$$

$$MDC_{scan} = 2,695 \text{ dpm}/100 \text{ cm}^2$$

***2,695 dpm/100 cm<sup>2</sup> > 25% of the DCGL or 2,500 dpm/100cm<sup>2</sup> for small area beta scanning; therefore, only large area probe was utilized for beta ratemeter scanning.***

#### **8.3.2.2 Large Area Probe Beta Ratemeter Scanning MDC**

Assuming that the source remained under the detector for 1.25 seconds (e.g., i=1.25) and the background count rate was the estimated typical site-specific ambient background rate of 1,550, the value for b<sub>i</sub> was then calculated for beta as:

#### **Equation 8-9 – Large Area Probe Beta Ratemeter Scanning Background Counts during Observation Interval Example**

$$b_i (\text{counts}) = 1,550 \text{ cpm} \times 1.25 \text{ sec.} \times (1 \text{ min}/60 \text{ sec})$$

$$b_i = 32.291 \text{ counts}$$

The scan minimum detectable count rate (MDCR) was then calculated using the number of source counts required for a specific time interval was calculated by MARSSIM Equation 6-8:

#### **Equation 8-10 – Large Area Probe Beta Ratemeter Scanning Specific Interval Example**

$$s_i = d' \sqrt{b_i}$$

$$S_i = 1.38 \times \sqrt{32.291 \text{ counts}}$$

$$S_i = 7.84 \text{ counts}$$

The scan minimum detectable count rate (MDCR) was then calculated using MARSSIM Equation 6-9:

#### **Equation 8-11 – Large Area Probe Beta Ratemeter Scanning MDCR Example**

$$\text{MDCR (cpm)} = S_i \times (60/i)$$

$$\text{MDCR} = 7.84 \text{ counts} \times (60/1.25)$$

$$\text{MDCR} = 376.32 \text{ cpm}$$

## **SECTION 8.0 – SURVEY INSTRUMENTATION**

The  $MDCR_{Surveyor}$  was calculated assuming a surveyor efficiency ( $p$ ) of 0.5 (see MARSSIM page 6-45):

### **Equation 8-12 – Large Area Probe Beta Ratemeter Scanning $MDCR_{Surveyor}$ Example**

$$MDCR_{Surveyor} \text{ (cpm)} = 376.32/(\sqrt{0.5})$$

$$MDCR_{Surveyor} \text{ (cpm)} = 532.197 \text{ cpm}$$

The scan MDC was then calculated using MARSSIM Equation 6-10:

$$Scan \text{ MDC} = MDCR/(\sqrt{p}) \cdot (\epsilon_{tot}) \cdot (probe \text{ area}/100cm^2)$$

$$Scan \text{ MDC} = 376.41/(\sqrt{0.5}) \times (39.05\% \cdot 0.25) \times (821 \text{ cm}^2/100cm^2)$$

$$Scan \text{ MDC} = 661 \text{ dpm}/100 \text{ cm}^2$$

Where

$MDCR$  = minimum detectable count rate

$\epsilon_{tot}$  = Instrument efficiency ( $\epsilon_i$ ) x surface efficiency ( $\epsilon_s$ )  
Per ISO-7503-1 1988  $\epsilon_s = 0.25$  for [beta-emitters (0,15 MeV < EBmax < 0,4 MeV) and alpha-emitters]

$p$  = surveyor efficiency (0.5)

Utilizing the combination of MARSSIM Equations 6-8, 6-9 and 6-10 from above:

### **Equation 8-13 – Large Area Probe Beta Ratemeter Scanning $MDC_{Scan}$ Example**

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

$$MDC_{scan} = 1.38 \cdot (\sqrt{32.291}) \cdot (60/1.25) / (\sqrt{0.5}) \cdot (39.05\% \cdot 0.25) \cdot (821 \text{ cm}^2/100cm^2)$$

$$MDC_{scan} = 661 \text{ dpm}/100 \text{ cm}^2$$

#### **8.3.2.3 Gamma Ratemeter Scanning MDC**

Assuming that the source remained under the detector for 1.385 seconds (e.g.,  $i=1.385$ ) and the background count rate was the site-specific ambient background rate of 9,009, the value for  $b_i$  was then calculated for gamma as:

### **Equation 8-14 – Gamma Ratemeter Scanning Background Counts during Observation Interval Example**

$$b_i \text{ (counts)} = 9,009 \text{ cpm} \times 1.25 \text{ sec.} \times (1 \text{ min}/60 \text{ sec})$$

$$b_i = 187.68 \text{ counts}$$

The scan minimum detectable count rate (MDCR) was then calculated using the number of source counts required for a specific time interval was calculated by MARSSIM Equation 6-8:

## **SECTION 8.0 – SURVEY INSTRUMENTATION**

### **Equation 8-15 – Gamma Ratemeter Scanning Specific Interval Example**

$$s_i = d' \sqrt{b_i}$$

$$S_i = 1.38 \times \sqrt{187.68 \text{ counts}}$$

$$S_i = 18.91 \text{ counts}$$

The scan minimum detectable count rate (MDCR) was then calculated using MARSSIM Equation 6-9:

### **Equation 8-16 – Gamma Ratemeter Scanning MDCR Example**

$$\text{MDCR (cpm)} = S_i \times (60/i)$$

$$\text{MDCR} = 18.91 \text{ counts} \times (60/1.25)$$

$$\text{MDCR} = 907.46 \text{ cpm}$$

The  $\text{MDCR}_{\text{surveyor}}$  was calculated assuming a surveyor efficiency ( $p$ ) of 0.5 (see MARSSIM page 6-45):

### **Equation 8-17 – Gamma Ratemeter Scanning $\text{MDCR}_{\text{Surveyor}}$ Example**

$$\text{MDCR}_{\text{SURVEYOR}} (\text{cpm}) = 907.46 / (\sqrt{0.5})$$

$$\text{MDCR}_{\text{SURVEYOR}} (\text{cpm}) = 641.67 \text{ cpm}$$

The scan MDC was then calculated using MARSSIM Equation 6-10:

### **Equation 8-18 – Gamma Ratemeter Scanning $\text{MDC}_{\text{Scan}}$ Example**

$$\text{Scan MDC} = \text{MDCR} / (\sqrt{p}) \cdot (\epsilon_{\text{tot}}) \cdot (\text{probe area} / 100 \text{ cm}^2)$$

$$\text{Scan MDC} = 907.46 / (\sqrt{0.5}) \times (50.90\% \cdot 0.5) \times (100 \text{ cm}^2 / 100 \text{ cm}^2)$$

$$\text{Scan MDC} = 5,043 \text{ dpm} / 100 \text{ cm}^2$$

Where

$$\begin{aligned} \text{MDCR} &= \text{minimum detectable count rate} \\ \epsilon_{\text{tot}} &= \text{Instrument efficiency } (\epsilon_i) \times \text{surface efficiency } (\epsilon_s) \\ &\quad \text{Per ISO-7503-1 1988 } \epsilon_s = 0.25 \text{ for } [\text{beta-emitters } (0.15 \text{ MeV} < \text{EBmax} < 0.4 \text{ MeV}) \text{ and alpha-emitters and } 0.5 \text{ for } > 0.4 \text{ MeV}] \\ p &= \text{surveyor efficiency } (0.5) \end{aligned}$$

Utilizing the combination of MARSSIM Equations 6-8, 6-9 and 6-10 from above:

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

$$\text{MDC}_{\text{scan}} = 1.38 \cdot (\sqrt{187.68}) \cdot (60/1.385) / (\sqrt{0.5}) \cdot (50.90\% \cdot 0.5) \cdot (100 \text{ cm}^2 / 100 \text{ cm}^2)$$

$$\text{MDC}_{\text{scan}} = 5043 \text{ dpm} / 100 \text{ cm}^2$$

## **SECTION 8.0 – SURVEY INSTRUMENTATION**

### **8.3.3 Alpha Ratemeter Scanning**

Scanning for alpha emitters differs significantly from scanning for beta and gamma emitters in that the expected background response of most alpha detectors was very close to zero. The following covers scanning for alpha emitters. Since the time a contaminated area was under the probe varied and the background count rate of some alpha instruments was less than 1 cpm, it was not reasonable to determine a fixed MDC for scanning. Instead, it was more practical to determine the probability of detecting an area of contamination at a predetermined DCGL for given scan rates. For alpha survey instrumentation with backgrounds ranging from less than 1 to 3 cpm, a single count provided a surveyor sufficient cause to stop and investigate further and therefore the probability of detecting given levels of alpha surface contamination was calculated by use of Poisson summation statistics. MARSSIM, section 6.7.2.2 and Appendix J, contained the guidance for scanning for alpha emitters having low release limits. MARSSIM provided derivations, formulas and probability concepts in Appendix J.

#### **8.3.3.1 Count Detection Probability 100 cm<sup>2</sup> Probe**

Alpha scan rates were calculated using the Poisson summation statistics and selected from the probability charts in Appendix J to achieve a 95% probability. Given a known scan rate and a surface contamination release limit, the probability of detecting a single count while passing over the contaminated area was given using the following equation in

**Equation 8-19 – Count Detection Probability Single Count Equation below.**

**Equation 8-19 – Count Detection Probability Single Count Equation Example**

$$P(n \geq 1) = 1 - e^{-Ged/60v}$$

Where:

- P(n≥2) = Probability of observing a single count
- G = Contamination activity (dpm)
- E = Detector efficiency (4π)
- D = Width of detector in direction of scan (cm)
- v = Scan speed (cm/s)

Once a count was recorded and the guideline level of contamination was present, the surveyor stopped and waited until the probability of getting another count was at least 90 percent. This time interval was calculated using the following equation in Equation 8-20 – Count Detection Probability Time Interval Equation below.

**Equation 8-20 – Count Detection Probability Time Interval Equation Example**

$$t = 13,800/CAE$$

Where:

- t = Time period for static count(s)
- C = Contamination guideline (dpm/100 cm<sup>2</sup>)
- A = Physical probe area (cm<sup>2</sup>)

## **SECTION 8.0 – SURVEY INSTRUMENTATION**

$E =$  Detector efficiency ( $4\pi$ )

**The probability of detecting a single count while passing over the contaminated area for 100 cm<sup>2</sup> probe was not possible due to the limitations on probe size, background and detector efficiency; therefore, only the larger (821 cm<sup>2</sup>) gas-proportional detectors was used for alpha scans.**

### **8.3.3.2 Count Detection Probability 821 cm<sup>2</sup> Probe**

The larger (821 cm<sup>2</sup>) gas-proportional detectors had alpha background count rates on the order of 20 cpm, and a single count would not cause a surveyor to investigate further. A counting period long enough to establish that a single count indicated elevated contamination level would be prohibitively inefficient. For these types of instruments, the surveyor needed to get at least two counts while passing over the source area before stopping for further investigation, and therefore the probability of getting two or more counts was calculated using the following equation in

**Equation 8-21 – Count Detection Probability Two or More Counts Equation below.**

**Equation 8-21 – Count Detection Probability Two or More Counts Equation  
Example**

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

Where:

- $P(n \geq 2)$  = Probability of observing at least 2 counts
- $C$  = Contamination Guideline in dpm/100 cm<sup>2</sup>,
- $A$  = Physical probe area (cm<sup>2</sup>)
- $G$  = Contamination activity (dpm), 75 dpm/100 cm<sup>2</sup> (50% of DCGL to meet DQOs) adjusted for detector at 100 cm<sup>2</sup> from 821 cm<sup>2</sup> = 615.75
- $E$  = Detector efficiency ( $4\pi$ ) including ISO 7503 surface efficiency of 0.25 for alphas = 10.90%
- $B$  = Background in dpm/100cm<sup>2</sup> = 9.5
- $t$  =  $D/v$ , dwell time over the source (15.9 cm/ 4 cm/sec) = ~4 sec
- $v$  = Scan speed (cm/s) = 4 cm/sec or ~1.5 inches/sec
- $D$  = Width of detector in direction of scan (cm)

## SECTION 8.0 – SURVEY INSTRUMENTATION

$$G = C \cdot A / 100$$

$$G = (75 \cdot 821) / 100$$

$$G = 615.75$$

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

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

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

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

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

The scan rate to achieve a  $\geq 95\%$  probability of detection while passing over the contaminated area of 75 dpm/100 cm<sup>2</sup> was **1.5 inches/second**. If the surveyor detected two counts while performing the alpha scan surveys, the surveyor stopped, acquired a timed count, and investigated to determine if an area of elevated activity exists, or if the error was erroneous.

### 8.3.4 100 cm<sup>2</sup> Smear Counting

Smear counting Minimum Detectable Concentration at a 95% confidence level was 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 in dpm/smear
- $B_r$  = background count rate in counts per minute
- $t_b$  = background count time in minutes
- $t_s$  = sample count time in minutes
- $E$  = instrument 4 $\pi$  efficiency for radionuclide emission of interest

## **SECTION 8.0 – SURVEY INSTRUMENTATION**

### **8.4 Efficiency Determination**

Field instruments for determination of total surface activity by scans and static measurements had an efficiency determined by a licensed calibration facility using NIST traceable sources. In addition, ISO 7503-1, 1988 methods were used to determine field concentrations for final status data and calculation of resultant doses from residual radioactivity from beta emitters greater than 0.15 MeV (which excludes H-3). ISO 7503-1 recommends that a conservative surface efficiency of 0.25 be used for beta particles in the energy range of 150 keV to 400 keV ( $0.15 \text{ MeV} < E_{\beta\text{max}} < 0.4 \text{ MeV}$ ) and alpha emitters, and a surface efficiency of 0.50 for all beta emitters greater than 400 keV ( $E_{\beta\text{max}} > 0.4 \text{ MeV}$ ). Philotechnics used the recommended ISO-7503 conservative surface efficiencies for all beta particles (as C-14 is a ROC), and all alpha emitters, within the purview of the FSS, for both total and removable activity measurements.

Radionuclides used for efficiency determination were:

Beta: Tc-99 and/or C-14; Alpha: Th-230 and/or Pu-239; Gamma: I-129

### **8.5 Instrumentation Specifications**

The instrumentation used for decommissioning surveys are summarized in the tables below. 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 MDC. Alternate or additional instrumentation with similar detection capabilities may be utilized as needed for survey requirements with RSO approval.

## **SECTION 8.0 – SURVEY INSTRUMENTATION**

**Table 8-1 - Instrument Specifications**

<b>Detector Model</b>	<b>Detector Type</b>	<b>Detector Area (cm<sup>2</sup>)</b>	<b>Meter Model</b>	<b>Typical Total Efficiency (%)</b>
<b>43-93<sup>1</sup> Small Area Probe Alpha</b>	<b>Alpha Scintillation</b>	<b>100</b>	<b>Ludlum 2350-1</b>	<b>7.5</b>
<b>43-93<sup>2</sup> Small Area Probe Beta</b>	<b>Beta Scintillation</b>	<b>100</b>	<b>Ludlum 2350-1</b>	<b>10.3</b>
<b>43-37-1 Large Area Probe Alpha</b>	<b>Gas Flow Proportiona l</b>	<b>821</b>	<b>Ludlum 2350-1</b>	<b>11.3 /20</b>
<b>43-37-1 Large Area Probe Beta</b>	<b>Gas Flow Proportiona l</b>	<b>821</b>	<b>Ludlum 2350-1</b>	<b>9.8</b>
<b>GP-13A Small Area Probe Gamma</b>	<b>Gamma Scintillation</b>	<b>100</b>	<b>Ludlum 2350-1</b>	<b>7.1 (I-125)</b>
<b>2200CA TriCarb (or Equivalent)</b>	<b>Liquid Scintillation</b>	<b>N/A</b>	<b>N/A</b>	<b>70 (H-3) 63 (C-14) Open</b>
<b>Protean</b>	<b>ZnS+Dual Phosphor</b>	<b>N/A</b>	<b>N/A</b>	<b>8 (Th-230) 6 (Tc-99)</b>

<sup>1</sup> Or equivalent, to include 43-89 or 43-68, with similar detector areas and efficiencies.

<sup>2</sup> Or equivalent, to include 43-89 or 43-68, with similar detector areas and efficiencies.



## **SECTION 8.0 – SURVEY INSTRUMENTATION**

**Table 8-2 - Typical Operating Parameters and Sensitivities**

Measurement Type	Detector Model	Scan Rate (in/s)	Count Time (s)	Bkg. Time (s)	Bkg. (cpm)	MDC/DCGL (dpm/100cm <sup>2</sup> )	MDC Percent DCGL (%)
Surface Scans Small Area Probe Beta	BP-19DD	2.5	N/A	60	468	2,695 /10,000	27
Surface Scans Small Area Probe Gamma	GP-13A	2.5	N/A	60	9,009	18,152/40,000	45.4
Surface Scans Large Area Probe Alpha	43-37-1	1.5	N/A	60	23	40/150	26.7
Surface Scans Large Area Probe Beta	43-37-1	5	N/A	60	1,534	661/10,000	6.6
Total Surface Activity Small Area Probe Alpha	43-93 <sup>3</sup>	N/A	180	180	3	75/150	50
Total Surface Activity Small Area Probe Beta	BP-19DD	N/A	60	60	256	1,005/10,000	10.1
Total Surface Activity Small Area Probe Gamma	GP-13A	N/A	60	60	9,009	6,289/40,000	15.7
Removable Activity	2200CA TriCarb	N/A	60	60	25 (H-3) 15 (C-14) Open	44 (H-3)/ 10000000 26 (C-14)/10000 Open/10000	<.01% For all three channels
Gross Alpha Removable Activity	Protean	N/A	900	3,600	0.1	6.6/15	44
Gross Beta Removable Activity	Protean	N/A	120	3,600	65	124.5/250	49.8

### **8.6 Minimum Detectable Concentration (MDC) Calculations**

Philotechnics analytical sheets are included as **Appendix D, E, F, and G**, which show calculations for the static MDC for the scintillation counter, static MDC, and scanning MDC for hand-held instruments. The MDC's were calculated using the most conservative background values. These calculations follow the guidance in NUREG-1575 and NUREG-1507 and the information is used to verify the effectiveness of the instrumentation used in units of dpm/100 cm<sup>2</sup>.

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<sup>3</sup> Or equivalent, to include 43-89 or 43-68, with similar detector areas and efficiencies

## **9 SCOPING SURVEY AND REMEDIAL ACTIVITIES**

### **9.1 Radiological Scoping Surveys**

On March 10 & March 11, 2014, Philotechnics completed a comprehensive wipe and meter survey in specified impacted areas, which included walls, floors, and a sink. Survey maps depicting these areas were included in the CDC DP.

Radiological Scoping was designed to identify areas of elevated activity that required remediation. Scoping consisted of scans and smears for building structural surfaces and smears for removable activity measurements on the drains internal surface. Scoping surveys were designed to meet the same Data Quality Objectives (DQOs) FSS such that Scoping data could be used as FSS data where possible.

Scoping included:

- 100% scans for alpha and beta emitters of all accessible areas, with some instrument detector overlap, of RAW Room #1 including heaters, ceiling, louvers, and peripheral areas. Although scans for gamma emitters were also performed, due to insufficient instrument source check data, gamma scans will be repeated in their entirety;
- Total activity scans of the structural surfaces of the entire room based on the conservative initial survey unit classifications of Class 1 and required percentages;
- Removable activity measurements of the structural surfaces of the entire building based on the conservative initial survey unit classifications of Class 1 and required percentages;
- Removable activity measurements in the drain system, and;
- Static measurements and smears at areas of elevated activity.

#### **9.1.1 Building Structural Surfaces**

In order to identify locations of elevated activity, the building surfaces Scoping survey protocol consisted of performing scan surveys of 100% of all accessible surfaces, with judgmental smears and static measurements on areas with the highest probability areas for residual radioactivity.

#### **9.1.2 Building Systems**

The building systems Scoping survey protocol consisted of removable contamination measurements of internal surfaces of the drain system. 100% of accessible openings in the drain system were surveyed. Geometric configuration made direct measurements impossible. Philotechnics used convenient locations to obtain measurements where there is the highest probability of residual radioactivity, such as low flow areas and elbows where impingement of particulates could occur.

## **SECTION 9.0 – PLANNED DECOMMISSIONING ACTIVITIES**

### **9.2 Decontamination/Dismantlement and Remedial Action Surveys**

#### **9.2.1 Decontamination/Dismantlement**

Decontamination is the physical or chemical process of reducing and preventing the spread or potential exposure from contamination. Decontamination options included the use of commercially available materials and/or equipment that will effectively remove radioactive materials from surface areas so the contamination could be collected and properly disposed. During scoping survey phase, decontamination was required on a 1 ft<sup>2</sup> area on the floor with gross beta/gamma total activity of 7,323 dpm/100 cm<sup>2</sup> as identified as described in **Section 2.5 – Radioactive Materials Spills** above. The area was remediated by CDC personnel and the affected area was scanned again.

#### **9.2.2 Remedial Action Surveys**

Remedial action surveys consisted of scan surveys and direct measurements. These were conducted following remediation activities to establish the success or failure of the efforts to decontaminate the applicable area. Results of the survey were the decision basis for continued remediation. Remedial action surveys were designed to meet the objectives of the FSS.

## **SECTION 10.0 – MANAGEMENT ORGANIZATION**

### **10 PHILOTECHNICS MANAGEMENT ORGANIZATION**

The following management structure was utilized for administration and implementation of this plan.

Equation – Team Experience on Similar Work

**Project Manager - Ken Gavlik, VP Radiological Services and RSO for State of North Dakota RML:** A veteran of the U.S. Navy Nuclear Power Program with a B.S. in Nuclear Engineering Technology and Radiation Protection, an MBA, is MARSSIM certified, and is a member of the Conference of Radiation Control Program Directors and the NYC Radiological Advisory Committee. More than 18 years' experience in radiation protection and radiological services. Personally designed, planned and managed over 50 radiological services projects, including facility release for unrestricted use of facilities within the State of Pennsylvania, with many of the facilities released without question or comment from various regulatory authorities, Agreement States and the NRC. Projects include License Termination and release for unrestricted use of two of the largest R&D facilities in the US, containing in excess of two million square feet of impacted areas each.

**Field Supervisor/Radiological Controls Supervisor – Kevin Banks, Health Physicist:** A B.S. in Radiation Physics with over four years of practical and operational experience in the comprehensive practice of health physics. He has a comprehensive knowledge of regulatory requirements and recommendations in the field of decommissioning based upon NUREG 1757, NUREG 1575 (MARSSIM) and Nuclear Regulatory Commission (NRC) regulations. Mr. Banks has managed several projects under California Department of Health Radiologic Health Branch (CDPH-RHB) guidelines.

**Radiation Safety Officer - Glenn Marshall, CHP, RRPT, Corporate RSO:** An experienced RSO for NRC and Agreement States. Over 30 years of experience in supervisory and management in applied health physics, licensing, procedure/program development, sealed source encapsulation, radioactive materials waste management, ALARA and dosimetry. A CHP, who has been certified by the ABHP since 2003, and the NRRPT since 1994, including serving on the panel of examiners. He was the Corporate RSO for over a decade of MARSSIM facility release projects.

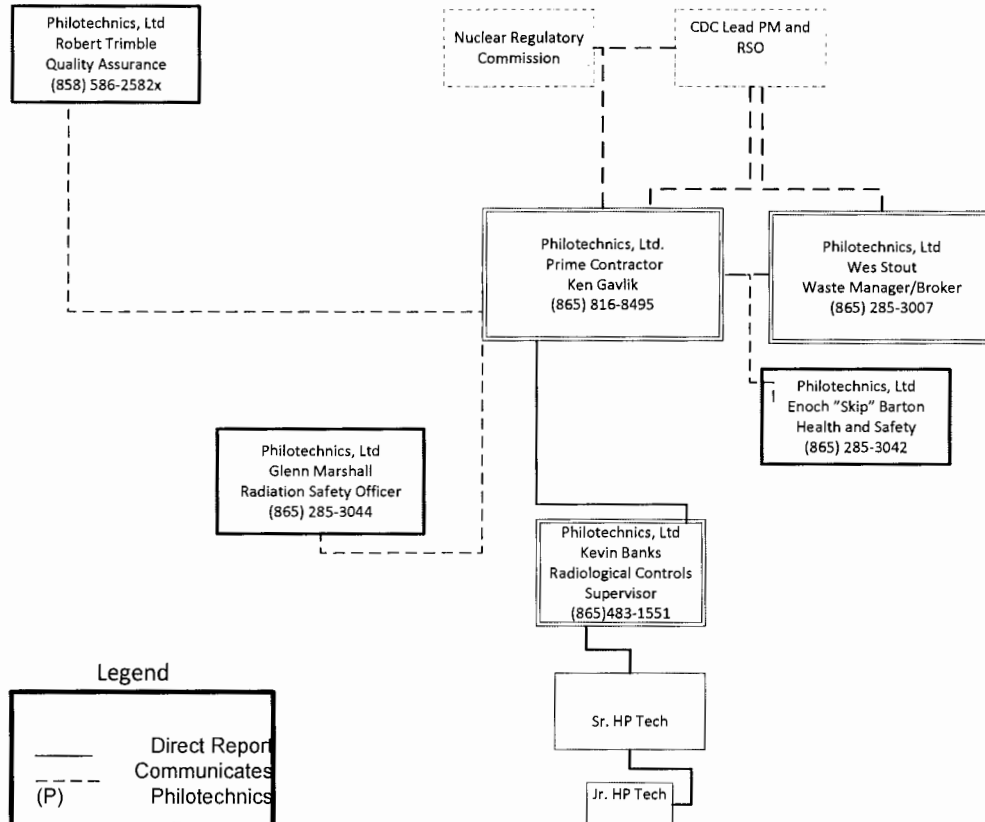
**Quality Assurance - Robert Trimble, Director of West Coast Operations and RSO of Philotechnics State of California RML:** A B.S. in Physics and an M.S. in Radiological Health Physics. Over 19 years of practical experience in the comprehensive practice of health physics. Mr. Trimble has provided radiological oversight and engineering expertise for decommissioning projects in California in accordance with MARSSIM and CDPH criteria, releasing over 50 facilities for unrestricted use in the last 5 years. A comprehensive knowledge of NRC regulations and regulatory requirements, and has provided radiological oversight and engineering expertise for dozens of radiological services and waste management in accordance with EPA, DOT, NRC or Agreement State regulations. Provides health physics and environmental consultation services to clients including annual program reviews, dose assessments, chemical audits, and general support of their safety programs.

**Waste Management - Wesley Stout, Director of Radiological Engineering and Waste Brokerage:** A veteran of the U.S. Navy Nuclear Power Program with a B.S. Degree. Over 25 years of experience as a project manager with experiences in radiological D&D, industrial safety, and waste management. He is the Radiological lead for characterization of waste streams, identification of viable treatment/disposal alternatives and for federal client waste management technical support.

Additionally, the CDC management organization described in Section 11.0, provided relevant data and support, and made final decisions for the decommissioning effort:

## SECTION 10.0 – MANAGEMENT ORGANIZATION

### Center for Disease Control and Prevention RAW Room #1 Radiological Decommissioning/ License Termination Project - Organizational Chart



### **11 CDC DECOMMISSIONING TASK MANAGEMENT**

Decommissioning was conducted in accordance with the CDC DP. All contractor activities were approved and overseen by the CDC to ensure compliance with the facility NRC RML. Decommissioning tasks were performed according to written plans and procedures to ensure they provided adequate worker protection and complied with the CDC NRC RML.

The following CDC management organization provided relevant data and support, and made final decisions for the decommissioning effort:

- CDC Radiation Safety Officer (RSO) – Narvaez Simpson is the OSSAM Senior Health Physicist and the current CDC RSO. Prior to Narvaez taking this position, Paul Simpson OSSAM Senior Health Physicist held this position as RSO at CDC from 1981 until 2016. The RSO keeps and provides access to records relevant to this decommissioning effort, and is the final decision maker for releasing Building 1, RAW Room #1 for unrestricted use.
- CDC Project Manager – Kenneth Bryson is an architect who represents the CDC Projects and Construction Management Services Office (PCMSO) as project manager for this decommissioning.
- CDC MARSSIM consultant – Sam Keith is a Certified Health Physicist and an author of the NUREG 1575 MARSSIM Manual. He has conducted several MARSSIM decommissionings of CDC facilities on the Chamblee and Roybal Campuses, and is a consultant to the CDC RSO for this decommissioning effort.

Radiation Work Permits (RWP)s were used to accomplish remediation activities. The RWP contained the location and description of the task to be performed, expected contamination and radiation levels, posting requirements, radiological monitoring requirements, Personnel Protective Equipment (PPE) requirements, and special work instructions necessary to complete the work in a safe and compliant manner.

Survey packages were developed for each survey unit that contained specific survey instructions. Survey package preparation and completion were approved by the PM and RSO to ensure all survey requirements and DQOs were met.

### **12 PROJECT TRAINING REQUIREMENTS**

The CDC provided personnel with site specific Contractor Orientation Training.

#### **12.1 Radiological Training**

Basic Radiation Worker training was completed and documented prior to arrival on site for Philotechnics personnel. The PM maintained a copy of each individual's certification on site in the project file.

#### **12.2 Project Specific Training**

Prior to project start-up, personnel attended an initial project-specific training session conducted by the PM. The training session included the following items:

- Review of the DP
- Project security control and operational work zones
- Emergency response and site evacuation procedures
- Project communications
- General safe work practices
- Data quality and chain of custody procedures, and
- Review of applicable regulatory standards as applied to project operations

#### **12.3 General Safety Briefings**

General safety meetings were held at the beginning of the work shift. The purpose of this meeting was to discuss project status, potential problem areas, general safety concerns, and to reiterate CDC DP requirements.

#### **12.4 Visitor Orientation**

The project had no visitors.

#### **12.5 Transportation Training**

The project had no transportation required.

**SECTION 13.0 – RPP AND HASP**

**13 RADIATION SAFETY AND HEALTH AND SAFETY  
PROJECT PLANS**

Site-specific Radiation Protection Plan (RPP) and ssHASP were prepared and implemented for all on-site activities.



**14 ENVIRONMENTAL MONITORING AND CONTROL**

All licensed project activities were performed indoors, under strict controls, and in a manner that did not present an elevated risk of environmental releases above normal operations.

## **SECTION 15.0 – RADIOACTIVE WASTE MANAGEMENT PLAN**

### **15 RADIOACTIVE WASTE MANAGEMENT PLAN**

Although no waste was generated, as a conservative measure a site specific Waste Management Plan was prepared for all on-site activities.

**16 QUALITY ASSURANCE PROJECT PLAN**

A site specific Quality Assurance Project Plan (QAPP) was prepared for all on-site activities.

## **SECTION 17.0 – FINAL STATUS SURVEYS**

### **17 FINAL STATUS SURVEYS**

Final status surveys (FSS) were performed to demonstrate that residual radioactivity in each survey unit satisfied the predetermined criteria for release for unrestricted use. FSS were conducted by performing the appropriate combination of scan surveys, total activity measurements and removable activity measurements as discussed further in this section. Scoping and remedial action survey data was used as FSS data to the maximum extent possible in order to minimize overall project costs.

#### **17.1 Background Determination**

A suitable reference background area was available and selected for determining ambient background for the radiological surveys of RAW Room #1. This decision was based on the guidance provided in NUREG-1505, "A Nonparametric Statistical Methodology for the Design and Analysis of Final Decommissioning Surveys."

For the FSS, based on the results of the scoping surveys, the use of reference background measurements or paired background was not necessary, as material and ambient background levels were not present in significant levels in comparison to the DCGLs. Therefore, for conservatism in the survey design, ambient background levels were determined by taking ten (10) one-minuted timed counts for beta and gamma, and ten (10) two-minute counts for alpha, and calculating the mean of the ten (10) timed counts to provide an ambient background level for each radiation type.

The mean ambient background was determined by taking the requisite timed counts for each radiation type in the center of a non-impacted area of the facility at waist level. The mean ambient background was subtracted from gross measurement count rates (in cpm) to determine the net measurement count rate. The mean ambient background was also used to calculate the actual survey MDCs and the associated count errors. The number of measurements required for each material type was calculated for the Sign test.

For total surface activity measurements, ambient background levels were generally determined by performing a sixty-second timed count with the probe at waist level and away from survey unit surfaces. Reference background was subtracted from each total activity gross measurement. Material background, the contribution from naturally-occurring radioactivity in building structural materials, was part of the ambient background in the matched reference background areas and survey units.

Background corrections were performed for removable activity measurements. The liquid scintillation counter was set up to report results in net dpm in each channel, and all removable activity results were reported in net dpm/100cm<sup>2</sup>.

## **SECTION 17.0 – FINAL STATUS SURVEYS**

### **17.2 Data Quality Objectives (DQO)**

The following is a list of the major DQOs for the survey design described in this report:

- Static measurements were taken to achieve an  $MDC_{static}$  of less than 25% of the DCGL or 2,500 dpm/100cm<sup>2</sup> Beta, 25% of the DCGL or 10,000 dpm/100cm<sup>2</sup> Gamma, and 50% of the DCGL or 75 dpm/100cm<sup>2</sup> Alpha.
- Scanning was conducted at a rate to achieve an  $MDC_{scan}$  of less than 25% of the DCGL or 2,500 dpm/100cm<sup>2</sup> Beta, 25% of the DCGL or 10,000 dpm/100cm<sup>2</sup> Gamma, and 50% of the DCGL or 75 dpm/100cm<sup>2</sup> Alpha.
- Smear counting was conducted to achieve an MDC of less than 250 dpm/100cm<sup>2</sup> Beta, 1,000 dpm/100cm<sup>2</sup> Gamma, and 7.5 dpm/100cm<sup>2</sup> Alpha.
- 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 alternate null 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
- Scoping and remedial action support surveys were conducted under the same quality assurance criteria as final status surveys such that the data may be used as final status survey data to the maximum extent possible.
- Quality Assurance Surveys were conducted at a rate of 5%.

### **17.3 Area Classifications**

Based on the results of the HSA, facility areas were classified as impacted or non-impacted areas. Non-impacted areas are areas with no potential residual radioactivity from licensed activities. Impacted areas are those areas that may have some level of potential residual radioactivity from licensed activities.

Impacted areas are typically divided into Class 1, 2, or 3 areas. Class 1 areas have the greatest potential for contamination and therefore receive the highest degree of survey effort for FSS, followed by Class 2 and then by Class 3. **Table 17-1 - Recommended Maximum Survey Unit Size Limits** below lists the recommended maximum survey unit sizes based on floor area. It should be noted that these limits are recommended and were not absolute.

#### **17.3.1 Class 1 Areas**

Areas with the highest potential for contamination, and met 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.

- For conservatism, the CDC chose to classify RAW Room #1, including the ceiling, as Class 1

## **SECTION 17.0 – FINAL STATUS SURVEYS**

### **17.3.2 Class 2 Areas**

Areas that meet the following criterion: (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.

- For conservatism, the CDC chose to classify the loading dock, the parking pad, and the walk ramp as Class 2

### **17.3.3 Class 3 Areas**

Areas that meet the following criterion: (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.

- For conservatism, the CDC chose to classify the crawlspace area under RAW Room #1 as Class 3

## **17.4 Non-impacted**

Building exterior, outside grounds, indoor areas other than those identified as restricted areas by the licensee, and the roof.

**Table 17-1 - Recommended Maximum Survey Unit Size Limits**

Survey Unit	Class 1	Class 2	Class 3
Structures	Up to 100 m <sup>2</sup>	100 m <sup>2</sup> to 1,000 m <sup>2</sup>	No limit
Land	Up to 2,000 m <sup>2</sup>	2,000 m <sup>2</sup> to 10,000 m <sup>2</sup>	No limit

**Table 17-2 - Classification** below lists the survey units and their final classification. During the survey none of the data collected during the scans, static or removable measurements warranted re-classifying any of the survey units. Each previously impacted area in the building was made its own survey unit.

**Table 17-2 - Classification**

4770 Buford Highway	Survey Unit	Initial Classification
RAW Room #1 Lower Walls and Floor	1	Class 1
RAW Room #1 Upper Walls, Ceiling, heater and ventilation louvers	2	Class 1
RAW Room #1 Loading Dock, Parking Pad and Walkway	3	Class 2
Incinerator Basement Area	4	Class 3
RAW Room #1 Crawlspace	5	Class 3

## **17.5 Survey Methodology**

Determination of Class 1 survey unit sample locations was accomplished by first determining sample spacing and then systematically plotting the sample locations from a randomly generated start location. The random starting point of the grid provided an unbiased method for obtaining measurement locations used in the statistical tests. Class 1 survey units had the highest potential for small areas of elevated activity so the areas between measurement locations was adjusted to ensure that these areas could be detected by scanning techniques.

## **SECTION 17.0 – FINAL STATUS SURVEYS**

All of RAW Room #1 was classified as Class 1 for conservatism and the potential for radioactive contamination although it did not initially exceed the DCGL<sub>w</sub> during Scoping surveys. Philotechnics utilized a square grid system for the Class 1 area. Judgmental sample locations were taken. For FSS, the starting point was determined using a random number generator.

For FSS, similar systematic spacing methods are used for Class 2 survey units because there is an increased probability of small areas of elevated activity. The use of a systematic grid allowed the decision-maker to draw conclusions about the size of the potential areas of elevated activity based on the area between measurement locations. The loading dock, the parking pad, and the walkway were classified as Class 2 for conservatism due to the potential for leaks during RAM transport.

For Class 3 survey units MARSSIM guidance recommended simple random measurement patterns to ensure the measurements were independent and supported the assumptions of the statistical tests. For conservatism, even though 6 mil plastic lined the RAW Room #1 floor and the CDC could find no evidence of spills, the crawlspace under RAW Room #1 was classified as Class 3 for conservatism due to the potential for leaks during RAM transport. In addition, even though historical records indicate only medical waste was burned in the incinerator, for conservatism, due to lapses in records, the incinerator basement area was classified as a Class 3.

### **17.6 Surface Scans**

Scanning was used to identify locations within the survey unit that exceeded the DCGL. These locations were marked and receive additional investigations to determine the concentration, area, and extent of the contamination. None were identified with the exception of the Scoping survey effort identification. For Class 1 areas, scanning surveys were designed to detect small areas of elevated activity that were not detected by the measurements using the systematic pattern. The percentage of actual accessible building structural surfaces to be scanned compared to MARSSIM recommendations are presented in **Table 17-3 - Scan Survey Coverage**.

**Table 17-3 - Scan Survey Coverage**

<b>Classification</b>	<b>Percentage of Surface Area Requiring Scan Coverage (MARSSIM)</b>	<b>CDC's Surface Area Scan Coverage</b>
<b>1</b>	<b>100%</b>	<b>100% of all accessible areas (holders/casing for the instrument detectors normally prevent direct scans along the intersection of walls, floors and ceiling )</b>
<b>2</b>	<b>10 – 100% (Judgmental)</b>	<b>50% of all accessible areas</b>
<b>3</b>	<b>Judgmental</b>	<b>25% of all accessible areas</b>

## SECTION 17.0 – FINAL STATUS SURVEYS

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

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

The floor, the louvers and the ventilation of the room and all other surfaces and structures were scanned using a Ludlum 2350-1 (serial# 186180) with a GP13A (100 cm<sup>2</sup> Gamma probe) and a Ludlum 2224 (serial# 187286) with a 43-93 (100 cm<sup>2</sup> Alpha/Beta probe). Our data shows that ***all scan surveys were below the established DCGLs.***

Based on the Scoping data, the minimum number of samples for FSS is calculated below.

### 17.7 Total Activity Direct or Static Measurements

Static measurements for total surface activity were completed using a timed count on the surface to be measured at each specified sample location. A systematic grid with a random starting point was used to determine the survey locations in the Class 1 areas. The probe was held as close to the surface as practicable to determine a count rate in counts per minute. Scaler count times were determined to achieve the detection sensitivities stated in the DQOs. Gross alpha and gross beta field measurements are converted to activity concentrations using the following equation:

$$\text{Activity (dpm/100cm}^2\text{)} = \frac{cpm_{\text{sample}} - cpm_{\text{background}}}{E_{\text{total}} \cdot \frac{A}{100\text{cm}^2}}$$

Where:

- $cpm_{\text{sample}}$  = sample count rate in counts per minute
- $cpm_{\text{background}}$  = background count rate in counts per minute
- $E_{\text{tot}}$  = total detector efficiency for radionuclide emission of interest (includes combination of instrument efficiency and surface efficiency)
- $A$  = active area of detector



## **SECTION 17.0 – FINAL STATUS SURVEYS**

### **17.7.1 Determining the Minimum Number of Samples**

In accordance with Section 5 of MARSSIM, the minimum number of samples required for the Sign Test was calculated using the following equations. The maximum alpha and beta/gamma standard deviations of total surface activity from the Scoping data were used for calculations. The LBGR was set at 50% of the DCGL and then adjusted to provide a relative shift between one and three as described in Section 5.5.2 of MARSSIM. The calculation performed to determine the required number of samples is provided below.

### **17.7.2 Determination of the Relative Shift**

The number of required samples depends on the ratio of the activity level to be measured relative to the variability in the concentration. This ratio 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 for each specific radiation type, 150 dpm/100 cm<sup>2</sup> alpha, 10,000 dpm/100 cm<sup>2</sup> beta, 40,000 dpm/100 cm<sup>2</sup> gamma
- LBGR = Lower bound of the gray region. MARSSIM recommended the LBGR was initially set arbitrarily to 1/2 the DCGL<sub>w</sub>. Therefore LBGR was initially set to 75 dpm/100 cm<sup>2</sup> alpha, 5,000 dpm/100 cm<sup>2</sup> beta, 20,000 dpm/100 cm<sup>2</sup> gamma .
- $\sigma_s$  = An estimate of the standard deviation of the residual radioactivity in the survey unit Arbitrarily set to 19 dpm/100 cm<sup>2</sup> alpha, 882 dpm/100 cm<sup>2</sup> beta, 625 dpm/100 cm<sup>2</sup> gamma, for conservatism based on the largest standard deviation of each radiation type from the Scoping Surveys

Utilizing the inputs from above, example Relative Shifts for each radiation type are provided in the figures below using the largest standard deviation, between Floor and Lower Wall, and Ceiling and Upper Wall Scoping Survey results, and a .25 surface efficiency for all alpha and beta measurement results, for added conservatism in the survey design. The largest standard deviations were:

- Alpha: 19 dpm/100 cm<sup>2</sup> Floors and Lower Walls
- Beta: 1,765 dpm/100 cm<sup>2</sup> Floors and Lower Walls
- Gamma: 625 dpm/100 cm<sup>2</sup> Floors and Lower Walls

#### **Equation 17-1 – Relative Shift Alpha**

$$\Delta/\sigma_s = \frac{150 - 75}{10.5}$$

$$\Delta/\sigma_s = 7.14$$

#### **Equation 17-2 – Relative Shift Beta**

$$\Delta/\sigma_s = \frac{10,000 - 5,000}{774.9}$$

$$\Delta/\sigma_s = 6.45$$

## **SECTION 17.0 – FINAL STATUS SURVEYS**

### **Equation 17-3 – Relative Shift Gamma**

$$\Delta / \sigma_s = \frac{40,000 - 20,000}{5,712}$$

$$\Delta / \sigma_s = 3.5$$

The most conservative value for Relative Shift, using the most conservative inputs from the FSS, was 3.5 for the Gamma Relative Shift value. The value for Relative Shift was not between one (1) and three (3), therefore relative shift was adjusted to three (3).

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

A decision error was the probability of making an error in the decision on a survey unit by failing a unit that should pass ( $\beta$  decision error) or passing a unit that should fail ( $\alpha$  decision error). MARSSIM uses the terminology  $\alpha$  and  $\beta$  decision errors; this is the same as the more common terminology of Type I and Type II errors, respectively. The applicable decision errors (Type I Type II errors) were selected in accordance with the established DQOs.

#### **17.7.4 Determination of Number of Data Points**

For the purposes of FSS, it was assumed that the contaminant was not present in background at significant levels compared to the DCGLs. Therefore, material-specific background was ignored and was not subtracted from the total surface activity measurements. Using this methodology, the Sign Test was chosen for the statistical evaluation of survey data.

The number of direct measurements for a survey unit, employing the Sign Test, was determined from MARSSIM Table 5.5, based 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

Utilizing the inputs from above, the calculation for Number of Samples was as follows in **Equation 17-4 – Number of Samples Required per Survey Unit** below.

#### **Equation 17-4 – Number of Samples Required per Survey Unit**

$$N = \frac{(1.645 + 1.645)^2}{4(0.998650 - 0.5)^2}$$

$$N = 10.88$$

## SECTION 17.0 – FINAL STATUS SURVEYS

*Note: Percentiles  $Z_{1-\alpha}$  and  $Z_{1-\beta}$  were determined from MARSSIM Table 5.2. SignP was determined from MARSSIM Table 5.4 using the most conservative Relative Shift noted above, and rounding down for conservatism to a Relative Shift of 3.0.*

MARSSIM recommended increasing the calculated number of measurements by 20% to ensure sufficient power of the statistical tests and to allow for possible data losses. Therefore, the number of samples needed for the structural surfaces of the survey for planning purposes was 14 using the calculation above, and 14 using MARSSIM Table 5.5. So to ensure the conservatism of the survey design, the number of samples the survey design required was 14 sample locations per survey unit, and the spatial independence of the sample distribution included floor area only for Class 1 areas, and not walls, thereby increasing the number of samples and sample density in the survey unit. This, in turn, increased the number of samples on the areas with the highest probability of contamination - horizontal surfaces. The Class 1 areas included a minimum of 41 total samples, and increase of over 100% of the number of sample locations required.

### 17.7.5 Determination of Sample Locations

Determination of Class 1 survey unit sample locations was accomplished by first determining sample spacing and then systematically plotting the sample locations from a randomly generated start location. The random starting point of the grid provided an unbiased method for obtaining measurement locations to be used in the statistical tests. Random starting location was accomplished by utilizing maximum “x” and maximum “Y” coordinates from survey location maps. Using the random number generator function in Excel, the random number generated was multiplied by maximum “x” and maximum “Y” coordinates from survey location maps to provide the “x” and “y” coordinates for the random start location.

Class 1 survey units had the highest potential for small areas of elevated activity, so the areas between measurement locations could be adjusted to ensure that these areas can be detected by scanning techniques.

Similar systematic spacing methods were used for Class 2 survey units because there was an increased probability of small areas of elevated activity. The use of a systematic grid allowed the decision-maker to draw conclusions about the size of the potential areas of elevated activity based on the area between measurement locations.

Class 3 survey locations were determined from computer selected randomly generated x and y coordinates. The crawl space was the only Class 3 survey unit in this survey.

Survey protocols for all areas are summarized in

**SECTION 17.0 – FINAL STATUS SURVEYS**

**Table 17-4 - Survey Sample Placement Overview below.**

## **SECTION 17.0 – FINAL STATUS SURVEYS**

**Table 17-4 - Survey Sample Placement Overview**

Survey Unit Classification		DCGL <sub>w</sub> Comparison	Elevated Measurement Comparison	Measurement Locations
Impacted	Class 1	Yes	N/A	Systematic Random
	Class 2	Yes	N/A	Systematic Random
	Class 3	Yes	N/A	Random
Non-Impacted		None	None	None

### **17.7.5.1 Determining Class 1 and Class 2 Sample Locations**

In Class 1 survey units, the sampling locations were established in a unique pattern beginning with the random start location and the determined sample spacing. After determining the number of samples needed in the survey unit, sample spacing was determined from MARSSIM equation 5-8:

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

Where:

L = sample spacing interval

A = the survey unit area

N = number of samples needed in the survey unit

Maps of the survey unit were generated and a random starting point determined on the floor using computer-generated random numbers coinciding with the x and y coordinates of the survey unit and was plotted across the survey unit surfaces based on the random start point and determined sample spacing. A measurement location was plotted at each intersection of the grid plot.

#### **Equation 17-5 – Sample Spacing Interval per Survey Unit**

$$L = \sqrt{\frac{194}{15}} \text{ for a square grid}$$

$$L = \sqrt{12.93} \text{ for a square grid}$$

$$L = 3.6 \text{ for a square grid}$$

-or 3'7" spacing for square grid

Note: For conservatism, to increase sample distribution, only floor area square footage was used to calculate sample spacing intervals for Class 1 and Class 2 areas in the survey design, thereby increasing the number of sample locations in excess of 100%.

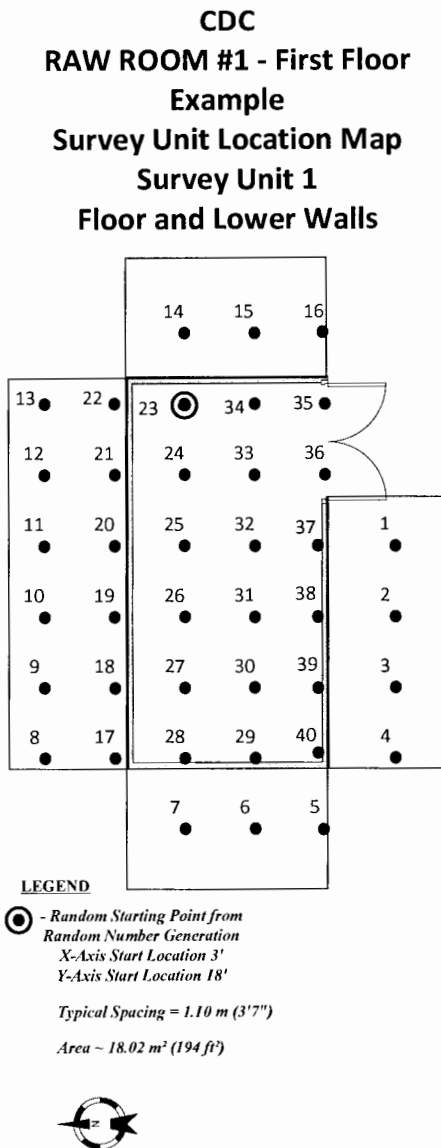
See example of Class 1 Survey Unit 1 sample locations provided in

## **SECTION 17.0 – FINAL STATUS SURVEYS**

**Figure 17-1 – Example Survey Unit 1 Floor and Lower Walls Location Map below.**

## SECTION 17.0 – FINAL STATUS SURVEYS

**Figure 17-1 – Example Survey Unit 1 Floor and Lower Walls Location Map**



### 17.7.5.2 Determining Class 3 Sample Locations

For the only Class 3 area (the crawl space), a map was generated of the survey unit's surfaces included in the statistical tests and shows the room's footprint and support pilings folded out in a 2-dimensional view. Sample locations were determined using computer generated random *x* and *y* coordinates for each sample location. Each location was plotted on the applicable survey map. Due to the inaccessible areas of the incinerator, the survey locations were adjusted to include only those outside the confines of the incinerator. In addition, all accessible surfaces of the incinerator were scanned, and a sample of the incinerator material was acquired and analyzed. All accessible surfaces of the RAW Room #1 crawlspace were scanned, and sample locations measured.

## **SECTION 17.0 – FINAL STATUS SURVEYS**

### **17.8 Removable Measurements Building Structures and Systems**

Removable contamination measurements (smears) were collected on building structural surfaces at each sample location. Each smear encompassed an area of approximately 100cm<sup>2</sup>. If an area of less than 100cm<sup>2</sup> was wiped, a comment is added to the survey data sheet estimating the surface area wiped to allow for area correction of the results. The total efficiency was determined from the reported emission rate on the calibration trace form for the source and the surface efficiency set to approximate dirt loading on the smear paper. Most smears were from “clean” surfaces due to Philotechnics pre-survey cleaning. Per McFarland’s data for filter paper, alpha particle counting efficiency was lowered by approximately 15% from dirt loading of 5 mg on filter paper. “Clean” surfaces typically contain 1-3 mg of dirt. However, ISO 7503-1 recommends that a conservative surface efficiency of 0.25 be used for beta particles in the energy range of 150 keV to 400 keV and alpha emitters. Therefore, the ISO 7503-1 efficiency was used.

$$\text{Activity (dpm/100cm}^2\text{)} = \frac{cpm_{\text{sample}} - cpm_{\text{background}}}{E_{\text{total}}}$$

Where:

- $cpm_{\text{sample}}$  = sample count rate in counts per minute
- $cpm_{\text{background}}$  = background count rate in counts per minute
- $E_{\text{tot}}$  = total detector efficiency for radionuclide emission of interest  
(includes combination of instrument efficiency and surface efficiency)

All of the smear samples taken at the CDC were counted on a Tri-Carb Liquid Scintillation Counter (LSC) for one minute and a Protean Gross Alpha/Beta Counter. The channels for the LSC were set up so H-3 would be detected in Channel A, C-14 in Channel B, and a wide open Channel C. Scintillation standards were used to determine if the scintillation counter was operating within normal parameters. The efficiencies for the scintillation counter were 61% for H-3 and 96% for C-14 for the scoping survey, and efficiencies current at the time of the FSS were used. For Channel C (wide open) we reported the data in cpm/100cm<sup>2</sup> to show no other ROC were detected.

#### **17.8.1 Survey of Building Mechanical System Internals**

Survey design for systems was out of the scope of MARSSIM. In addition, the sink was surveyed during the scoping survey process, released and removed; therefore, no systems existed at the time of FSS. According to interviews with the RSO, no RAM was released to the sanitary sewer system at RAW Room #1. Although there was previously a sink in RAW Room #1, sanitary sewer disposal on campus was generally limited to small total activities or radionuclides that had decayed at least 10 half-lives. Results are provided in the scoping survey results in the approved DP.

### **17.9 Survey Investigation Levels**

Investigation levels were used to flag locations that required special attention and further investigation to ensure areas were properly classified and adequate surveys were performed. No locations were identified. The survey investigation level for each type of measurement is listed by classification in **Table 17-5 - Survey Investigation Levels** below.



## SECTION 17.0 – FINAL STATUS SURVEYS

**Table 17-5 - Survey Investigation Levels**

Survey Unit Classification	Flag Direct Measurement Result When:	Flag Scanning Measurement Result When:	Flag Removable Measurement Result When:
1	>50% of DCGL	>MDC	> 50% of DCGL
2	>25% of DCGL	>MDC	> 25% of DCGL
3	>MDC	>MDC	>MDC

### 17.10 Unity Calculations

Unity was applied to each sample location using the following equation to determine compliance.

$$\frac{C_{Alpha}}{DCGL_{Alpha}} + \frac{C_{Beta}}{DCGL_{Beta}} + \frac{C_{Gamma}}{DCGL_{Gamma}} < 1$$

Where:

- $C_{Alpha}$  = Gross alpha result in dpm/100cm<sup>2</sup>
- $C_{Beta}$  = Gross beta result in dpm/100cm<sup>2</sup>
- $C_{Gamma}$  = Gross gamma result in dpm/100cm<sup>2</sup>
- $DCGL_{Alpha}$  = Gross alpha result in dpm/100cm<sup>2</sup>
- $DCGL_{Beta}$  = Gross beta result in dpm/100cm<sup>2</sup>
- $DCGL_{Gamma}$  = Gross gamma result in dpm/100cm<sup>2</sup>

This method ensured that, regardless of the radionuclide distribution in a particular location, the dose limit of 25 mrem per year would not be exceeded as long as the sum of fractions shown above was less than 1.

## **SECTION 18.0 – DATA QUALITY ASSESSMENT AND INTERPRETATION OF RESULTS**

### **18 DATA QUALITY ASSESSMENT AND INTERPRETATION OF RESULTS**

The statistical guidance contained in Section 8 of MARSSIM was used to determine if areas were below cleanup criteria or additional surveys or sample measurements were required.

#### **18.1 Preliminary Data Review**

A preliminary data review was performed for each survey unit to identify any patterns, relationships or anomalies. Additionally, measurement data was reviewed and compared with the DCGLs and investigation levels to confirm the correct classification of survey units. All calculations of means, standard deviations, minimum and maximum values and comparisons between survey data and investigation levels are presented in **Table 18-1 – Calculated Values for FSS Mean, Standard Deviation, Min and Max.**

#### **18.2 Survey Documentation**

Each survey unit was surveyed under survey instructions from the PM which specified the survey protocol to be followed. The survey instructions ensured the DQOs were met:

- Survey protocol instructions such as the number of samples, sample spacing, sample locations, areas to be scanned, etc.
- General survey requirements
- Random number generations to determine survey locations
- Instrumentation to be used and associated MDCs, count times, and scan rates
- Scaled survey unit maps detailing survey locations and placement methodology
- Recommended survey sequence
- Survey data sheets

To ensure proper data management and organization, each static and removable contamination measurement location was assigned a unique alpha-numeric location code consisting of a sequence of identifiers to indicate specific information about its location, such as the building, survey unit, structural surface (floor, wall, benchtop, etc.), structural material (concrete, cinderblock, sheetrock, etc.) and a numerically sequenced location number within the survey unit. Breakdowns of the location code and specific code components are provided below. Each sample will be identified as follows:

***WWW: Up to 3-character designation of the facility (for example, “CDC”)***

***XX: Up to 2-character designation of the survey unit (for example, “01”)***

***YYYY: Up to 4-character designation of the surface type (for example, “CON” represents concrete, “TER” for terracotta tile/fire brick, etc.)***

***ZZZ: 3-character designation of consecutive sample number (for example, 004)***

For example, in the sample identification number CDC-01-CON-004, “CDC” represents the facility (Centers for Disease Control and Prevention), “01” represents the survey unit, “CON” represents concrete material and “004” represents the sample collected at location 4.

## **SECTION 18.0 – DATA QUALITY ASSESSMENT AND INTERPRETATION OF RESULTS**

### **18.3 Data Validation**

Field data will be reviewed 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 FSS data was entered into the FSS data sheets. This provided the means to sort survey data, verify activity calculations and to compute MDC and counting errors.

### **18.4 Nuclide Verification**

As an additional check on assumptions made during the planning phase, removable samples were specifically analyzed for energies of carbon-14 and H-3. Added to these was a conservative qualitative check for the presence of all nuclides of interest to this project. Essentially this third channel of the LSC encompassed energies from 0-2000 keV. The area of interest for the third channel included the peak energies of all nuclides above the 156keV. Increased count values in this range could indicate the presence of additional nuclides. For purposes of the FSS, no removable activity measurement result for H-3, C-14, or beta or alpha emitters from the planchet counter exceeded the DCGL of **250 dpm/100 cm<sup>2</sup> or 15 dpm/100 cm<sup>2</sup> respectively**, and no removable contamination was detected inside the facility.

### **18.5 Determining Compliance for Surfaces and Structure Surveys**

Scan surveys were completed for all survey units at the prescribed coverage. Removable activity measurements were compared directly to the applicable investigation levels and DCGLs to determine if an area required further actions or surveys. All removable activity measurements collected during the FSSs were less than the applicable investigation levels and significantly less than the established DCGL. Elevated activity detected during characterization surveys was remediated as discussed in **Section 9.2 “Decontamination/Dismantlement”**. These locations were not included in the FSS unless a random or systematic location fell on these locations.

All total surface activity measurements were compared directly to the DCGLs and investigation levels to determine if an area required further surveillance. All total surface activity measurements collected during FSSs were less than the DCGLs for total surface activity. No FSS measurements exceeded the investigation level for the applicable DCGLs, with the exception of the Class 3 Basement Incinerator Area. Investigation identified the areas in question were firebrick, see analytical laboratory report in **Appendix I**. Due to the use of ambient backgrounds for all FSS results for conservatism, and not utilizing materials specific backgrounds, results were artificially elevated. Consequently, it was determined that these areas were properly classified and no further action was necessary.

## **SECTION 18.0 – DATA QUALITY ASSESSMENT AND INTERPRETATION OF RESULTS**

The table below details the calculated values for the mean, standard deviation, minimum, and maximum values for the surface and structures survey units.

**Table 18-1 – Calculated Values for FSS Mean, Standard Deviation, Min and Max**

Survey Unit	Alpha dpm/100cm <sup>2</sup>				Beta dpm/100cm <sup>2</sup>				Gamma dpm/100cm <sup>2</sup>			
	Mean	Std Dev	Min	Max	Mean	Std. Dev	Min.	Max.	Mean	Std. Dev	Min.	Max.
1	4	10.5	-14	25	360	775	-591	3,391	-347	3,369	-6,426	12,796
2	0	8.3	-14	25	-141	313	-658	394	-3,380	2,484	-7,635	421
3	-6	8.2	-22	9	216	256	-178	607	-1,184	2,068	-5,538	1,532
4	-4	8	-22	9	287	324	-258	621	6,014	5,712	-2,163	14,740
5	-8	9.4	-22	9	1066	309	461	1513	1,368	5,898	-10,885	11,976
QA	-9	8.7	-22	2	617	716	-272	1500	1,908	7,349	-6,444	12,149

**Table 18-2 – Calculated Values for Unity Mean, Standard Deviation, Min and Max**

Survey Unit	Unity			
	Mean	Std Dev	Min	Max
1	0.05	0.13	-0.17	0.57
2	-0.10	0.09	-0.23	0.10
3	-0.05	0.09	-0.29	0.04
4	0.16	0.14	-0.04	0.46
5	0.09	0.15	-0.18	0.38
QA	0.07	0.20	-0.14	0.42

## **SECTION 18.0 – DATA QUALITY ASSESSMENT AND INTERPRETATION OF RESULTS**

### **18.6 Verification of Number of Samples for Surface & Structures**

A minimum number of samples were needed to obtain sufficient statistical confidence that the conclusions drawn from the samples were correct. The number of samples depended on the relative shift (the ratio of the concentration to be measured relative to the statistical variability of the contaminant concentration). The minimum number of samples is obtained from MARSSIM tables or calculated using equations in Section 5 of MARSSIM. For this project, we used the data from Philotechnics scoping and characterization surveys to estimate the relative shift. To calculate the actual relative shift, data from the FSS was used. Once the actual relative shift was calculated, the number of samples required by MARSSIM was compared to the actual number of samples collected. The number of samples required was greatly increased by Philotechnics as an ALARA measure.

### **18.7 Assessment and Interpretation of Survey Results**

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

#### **18.7.1 Preliminary Data Review**

A preliminary data review was performed to identify any patterns, relationships or potential anomalies. Additionally, measurement data was reviewed and compared with the DCGLs and investigation levels to identify areas of elevated activity.

The following preliminary data reviews were performed:

- Calculations of the survey unit mean, median, maximum, minimum, and standard deviation for each type of reading and for unity.
- 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.

### **18.8 Determining Compliance**

For Class 1, 2, and 3 areas, if it is determined that all total activity results are less than the applicable DCGL, then no further statistical tests are required. If any of the total activity measurements are greater than the DCGL<sub>w</sub>, then the survey unit fails and the null hypothesis is not rejected.

The Sign test is used to determine the minimum number of sample locations. However, the Sign test is not performed in this survey design because the total activity DCGL is used as a maximum. If all measurements were less than the DCGL, performance of the Sign test was not necessary because the survey unit will pass the Sign test.

## **SECTION 18.0 – DATA QUALITY ASSESSMENT AND INTERPRETATION OF RESULTS**

Removable contamination measurements were compared directly to the applicable DCGL. No contingency was established for elevated removable contamination. Therefore, if any removable contamination was detected which exceeded the removable contamination DCGL, the survey unit was determined not to meet the release criterion. However, if all removable contamination measurements were less than the removable contamination DCGL, then compliance was based on total activity measurements.

Additionally, to demonstrate compliance with site-specific DGGLs generated using a RESRAD-BUILD dose model, a site-specific RESRAD-BUILD dose model was developed using FSS results for relative abundances of as left radionuclide concentrations to determine the peak TEDE of 5.91 mrem/year associated with each survey unit.

### **18.9 Mechanical System Survey Data Analysis**

Survey design for systems was out of the scope of MARSSIM. In addition, the sink was surveyed during the scoping survey process, released and removed; therefore, no systems existed at the time of FSS..

## **SECTION 19.0 – FINAL RESRAD MODELING**

### **19 FINAL RESRAD MODELING**

#### **19.1 Summary of Approved Limits**

The CDC contracted with Philotechnics to decommission RAW Room #1 and release it from radiological control. Final and complete results of the RESRAD-BUILD is provided in **Appendix H.1 & H.2** of this report.

NRC criterion pertaining to release of a facility for unrestricted use in 10 CFR 20.1402 states, *“A site will be considered acceptable for unrestricted use if the residual radioactivity that is distinguishable from background radiation results in a Total Effective Dose Equivalent (TEDE) to an average member of the critical group that does not exceed 25 mrem (0.25 mSv) per year, including that from groundwater sources of drinking water, and that the residual radioactivity has been reduced to levels that are as low as reasonably achievable (ALARA). Determination of the levels which are ALARA must take into account consideration of any detriments, such as deaths from transportation accidents, expected to potentially result from decontamination and waste disposal”*

Prior to decommissioning, Philotechnics used RESRAD-BUILD to determine radionuclide endpoint limits that would satisfy the decommissioning criteria based on the scoping surveys. Philotechnics performed scoping surveys on March 10 & 11, 2014, and FSS on June 22, 2016. FSS results indicate residual radioactivity is far below the limits established prior to decommissioning. A final RESRAD-BUILD model was to calculate the potential dose to an average member of the critical group.

The RESRAD-BUILD model demonstrates the potential dose to an average member of the critical group is much less than 25 mrem per year, even using the most conservative assumptions, and the most conservative maximum results which did not take into account material background for the concrete or firebrick in the facility. Ambient background, the most conservativew background was used for all FSS survey result calculations.

#### **19.2 RESRAD-BUILD Model Parameter Description**

The decommissioning process evaluates a property's environmental status for release of impacted areas to allow unrestricted use by current or future tenants. Philotechnics and the CDC performed an HSA to review facility operations as they pertained to radioactive materials use and storage to identify potential residual radioactive materials.

RESRAD-BUILD was run as a final check to estimate potential future doses from residual radioactivity to site users and/or occupants. The ROCs, filtering criterion, parameters and release criteria from the initial RESRAD-BUILD model for DCGL development were used for this RESRAD BUILD model with the exception of those parameters identified in **Table 19-1 – Revised RESRAD BUILD Parameters**. The model was run twice. Both used the maximum values for Co-60 (3,391 dpm/100 cm<sup>2</sup> beta); Mn-54 (14,740 dpm/100 cm<sup>2</sup> gamma), H-3 (9 dpm/100 cm<sup>2</sup> H-3), and Th-232 (25 dpm/100 cm<sup>2</sup> alpha). The first model used 1% removable fraction consistent with the initial models with a TEDE result of 6 mrem/year. The second model used 100% removabe fraction with a TEDE result of 22 mrem/year. The complete RESRAD-BUILD model is provided in **Appendix H.1 & H.2**.

## **SECTION 19.0 – FINAL RESRAD MODELING**

### **19.3 Conservative Assumptions**

These maximum concentrations were measured only in one small location, and the maximum alpha level was not in the same location as the maximum beta-gamma level. The model, however, was run using the assumption that the maximum measured concentrations of both alpha and beta-gamma emitting radionuclides existed uniformly over all surfaces of the room.

- The beta-gamma concentration was calculated using the instrument's total efficiency for detecting C-14 beta emissions, whereas the limiting radionuclide was Sr-90, which emits a much higher energy beta particle.
- All alpha contamination was assumed to be Th-232, the most limiting alpha emitter.
- All beta-gamma activity is assumed to be from Co-60, the most limiting beta emitter.
- Nearly all removable contamination measurements were less than MDA; however, a removable fraction of 1 percent and 100 percent were used for the model.
- Ambient background, not material specific backgrounds, were used for all FSS result calculations.

**Table 19-1 – Revised RESRAD-BUILD Parameters**

<b>PARAMETER DESCRIPTION</b>	<b>VALUE (s) Selected</b>
Source lifetime – For all radionuclides except H-3 (tritium), value taken from User Manual for Resrad-BUILD Version 3, Table 3.1. Tritium is assumed to have a lifetime of one year, and delivers all dose to the individual during that year.	10,000 days
Resuspension Rate – Numerous publications estimate resuspension rate. The conservative value chosen is taken from User Manual for Resrad-BUILD Version 3, Table J-8.	Alpha emitters: $3.7 \times 10^{-6} \text{ s}^{-1}$
Direct ingestion rate – Value taken from User Manual for Resrad-BUILD Version 3, Table 3.1.	$3.06 \times 10^{-6} \text{ s}^{-1}$
Removable Fraction – Value taken from User Manual for Resrad-BUILD Version 3, Table 3.1. Value is supported by scoping/Scoping survey results.	Ran 2 models – one using 1.0 and one using 0.1 for final model.
Airborne Fraction – Value taken from User Manual for Resrad-BUILD Version 3, Table 3.1.	0.357

Both runs used the maximum concentrations of each radionuclide in all post-remediation samples. Radionuclide concentrations were:

<b>Radionuclide</b>	<b>C0-60*</b>	<b>Th-232</b>	<b>Mn-54</b>	<b>H-3</b>
<b>Concentration, dpm/100 cm<sup>2</sup></b>	<b>3,391</b>	<b>24</b>	<b>14,740</b>	<b>9</b>

\*Average C-14 concentration was indistinguishable from background and was ignored.

The maximum dose (TEDE) is 1.01 mrem/year which occurs at 499 years.

	<b>Calculated dose (TEDE), mrem/year</b>									
<b>Years</b>	<b>0</b>	<b>1 yr</b>	<b>3 yr</b>	<b>10 yr</b>	<b>30 yr</b>	<b>100 yr</b>	<b>300 yr</b>	<b>1000</b>	<b>3000 yr</b>	<b>10,000</b>
<b>Total</b>	<b>7.34</b>	<b>5.91</b>	<b>4.40</b>	<b>2.39</b>	<b>.238</b>	<b>.163</b>	<b>.163</b>	<b>.163</b>	<b>.163</b>	<b>.163</b>



## **SECTION 20.0 – FINANCIAL ASSURANCE**

### **20 FINANCIAL ASSURANCE**

Decommissioning was completed within the CDC's operating budget.

#### **20.1 Cost Estimate**

Not applicable.

#### **20.2 Certification Statement**

Not applicable.

#### **20.3 Financial Mechanism**

Not applicable.

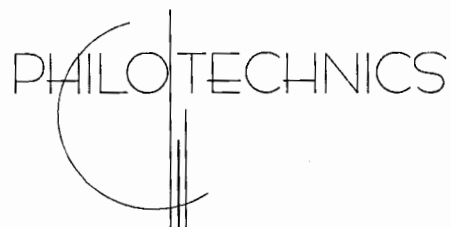
**21 RESTRICTED USE/ALTERNATE CRITERIA**

Not applicable.

## **22 REFERENCES**

- NUREG-1575, “Multi-Agency Radiation Survey and Site Investigation Manual” (MARSSIM) Revision 1, August 2000 – including June 2001 updates
- NUREG-1505, Revision 1, “A Nonparametric Statistical Methodology for the Design and Analysis of Final Decommissioning Surveys,” June 1998
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- NUREG-1757, Volume 1, Rev. 1 “Consolidated NMSS Decommissioning Guidance: Decommissioning Process for Materials Licensees,” 2006
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- ANL/EAD/03-1 “User’s Manual for RESRAD-BUILD Version 3,” June 2003
- “Decommissioning Health Physics, A Handbook for MARSSIM Users,” 2001
- “Handbook of Health Physics and Radiological Health”, 3<sup>rd</sup> Edition, 1998
- Federal Guidance Report No. 11 (EPA-5201/1-88-020), “Limiting Values of Radionuclide Intake and Air Concentration and Dose Conversion Factors for Inhalation, Submersion, and Ingestion,” 1988
- Federal Guidance Report No. 12 (EPA-402-R-93-081), “External Exposure to Radionuclides in Air, Water, and Soil,” September 1993
- Federal Guidance Report No. 13 (EPA-402-R-99-001), “Cancer Risk Coefficients for Environmental Exposure to Radionuclides,” September 1999
- Regulatory Guide 1.86, “Termination of Operating License for Nuclear Reactors”, U.S. Nuclear Regulatory Commission, Washington, DC, June, 1974
- CDC Radioactive Materials License Number #10-06772-01

**CDC**  
**RAW Room #1**  
**Final Status Survey Report Appendix**



Prepared by:  
Philotechnics, Ltd.  
201 Renovare Blvd.  
Oak Ridge, TN 37830

**Appendix A - Facilities Layout**



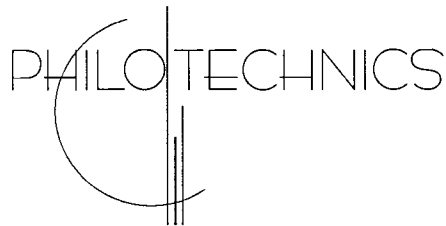
**Facility Layout**  
CDC – Chamblee Building 1  
4770 Buford Highway  
Final Status Survey - Survey Units Overview



# **CDC**

## **RAW Room #1**

### **Final Status Survey Report Appendix**

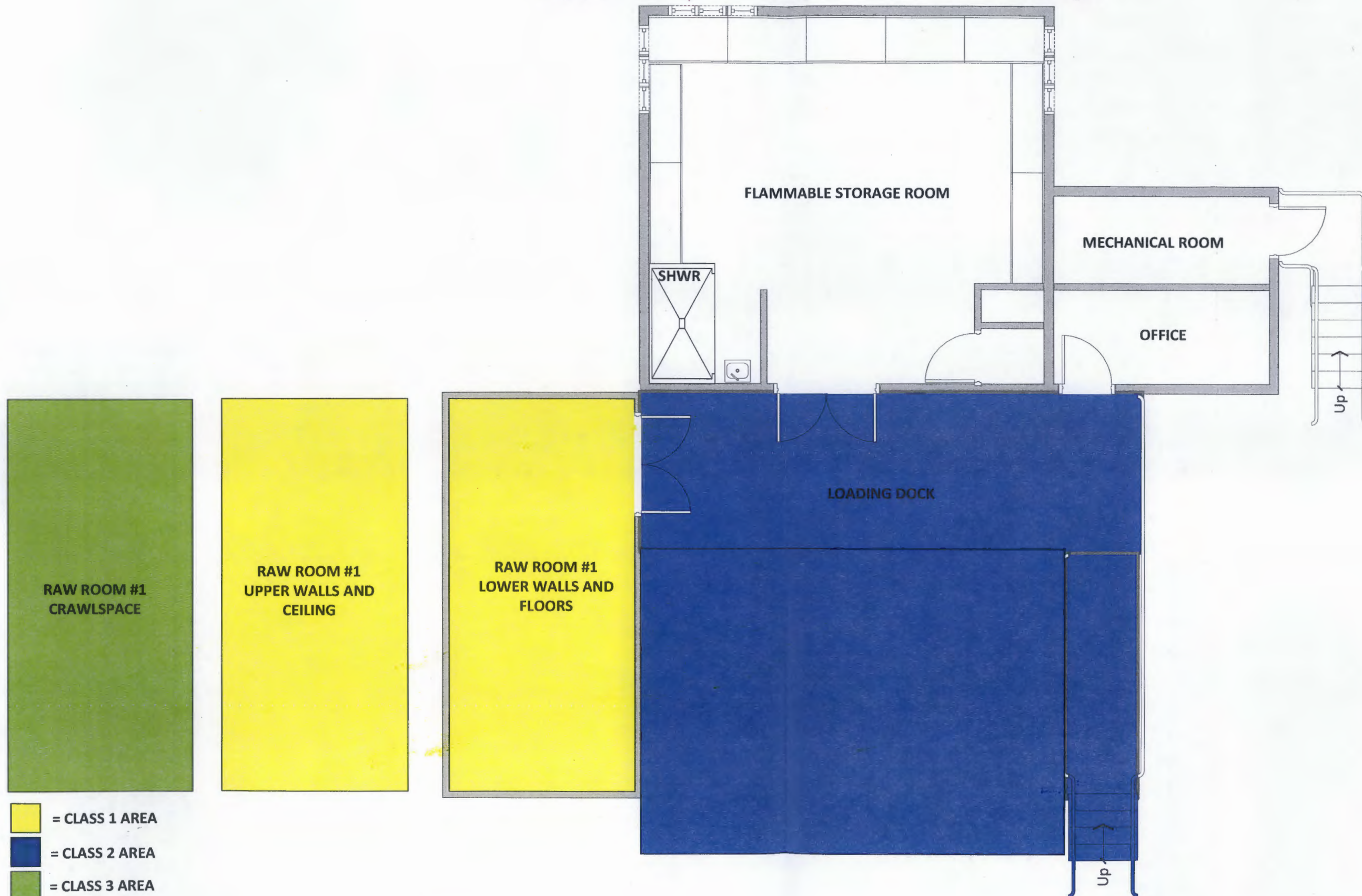


Prepared by:  
Philotechnics, Ltd.  
201 Renovare Blvd.  
Oak Ridge, TN 37830

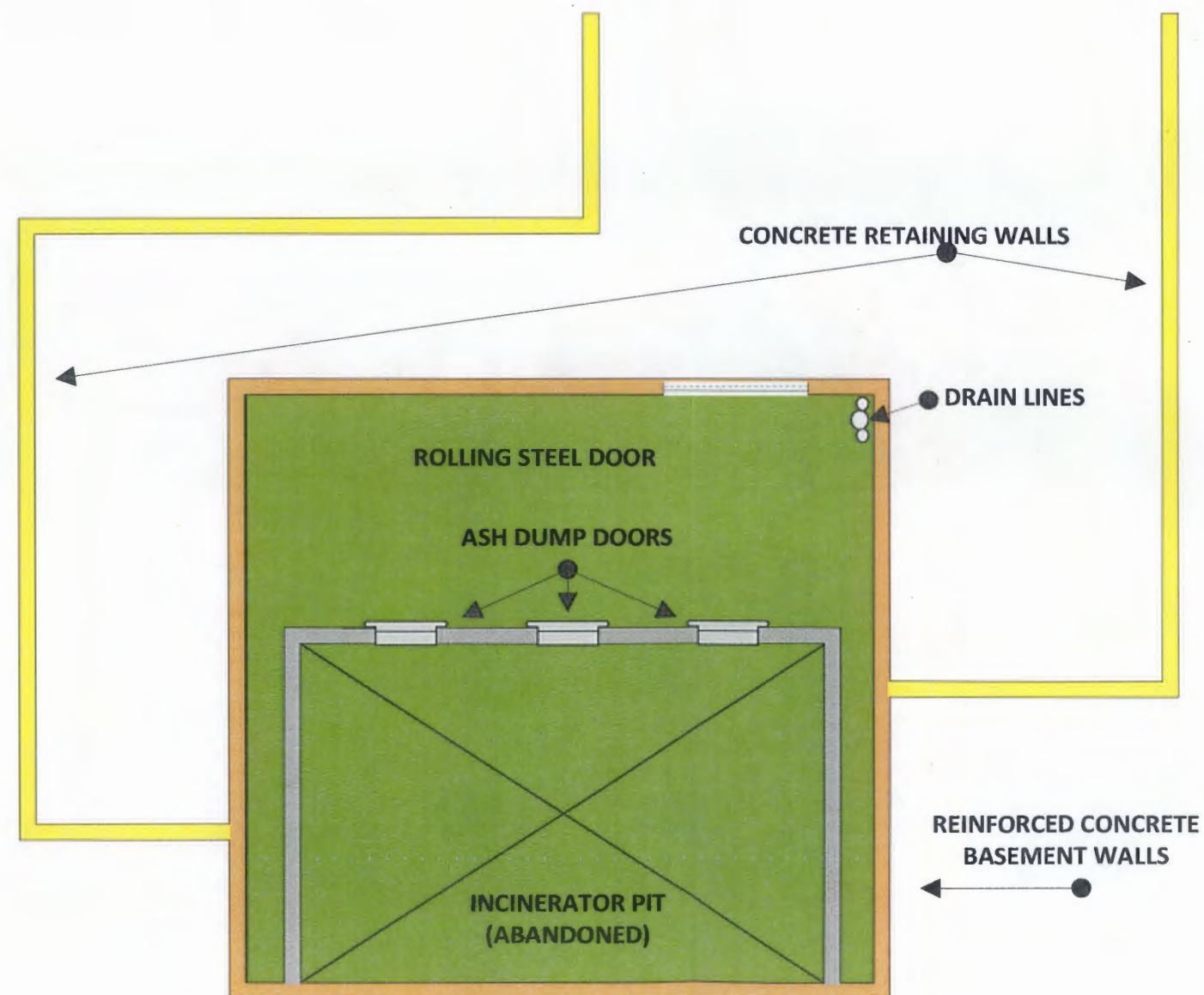
## **Appendix B – Survey Unit Overview Maps**



# Centers for Disease Control and Prevention RAW ROOM #1, Crawlspace, and Loading Dock Appendix B - Survey Unit Overview Maps



**Centers for Disease Control and Prevention  
RAW ROOM #1 - Basement  
Appendix B - Survey Unit Overview Maps**



 = CLASS 3 AREA

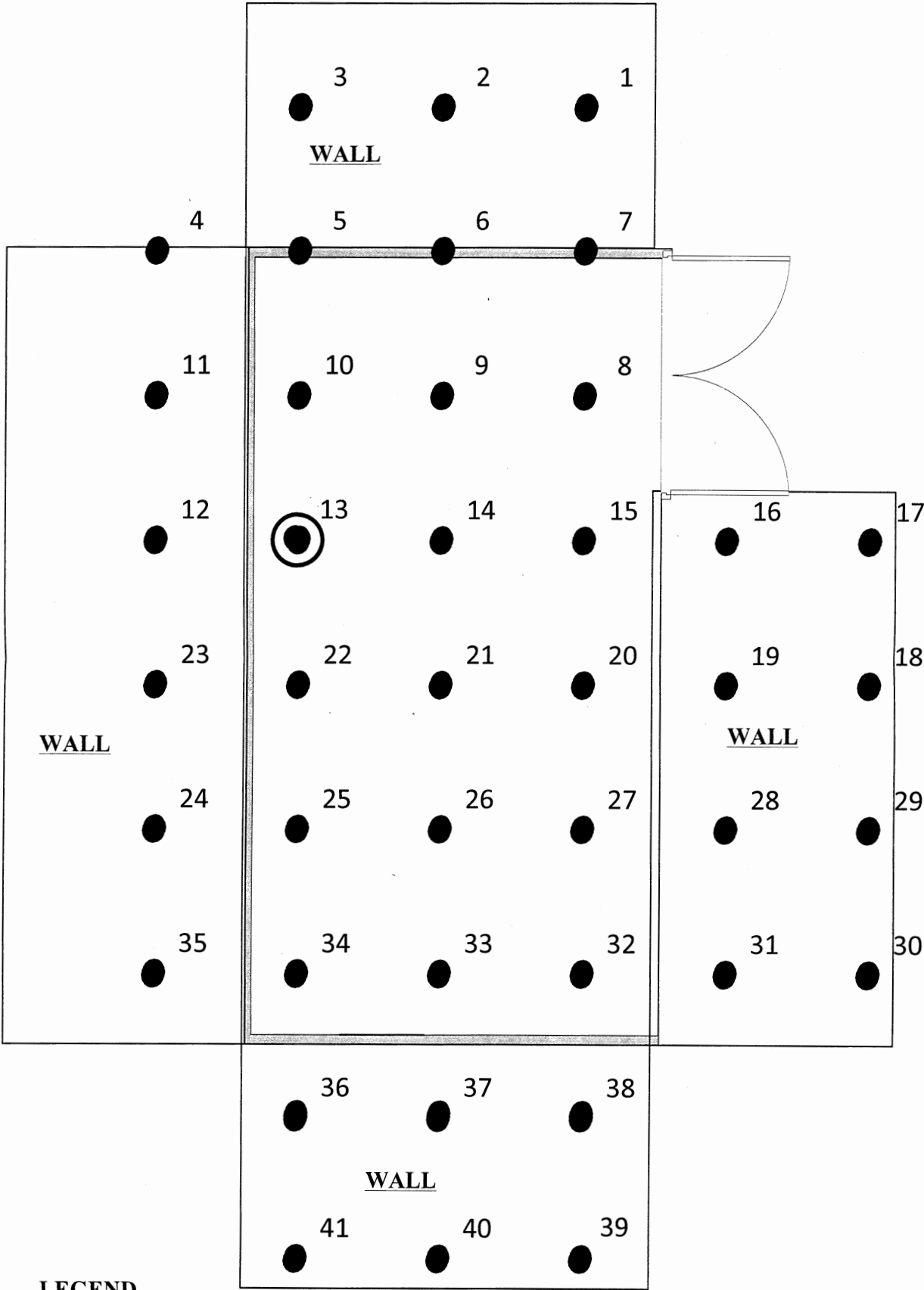


CDC  
Final Status Survey Report

Building: Chamblee Building 1      Area: RAW Room #1 Floors and Lower Walls      Survey Unit: 1      Date: 6-22-16      Class: 1

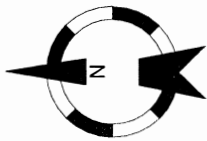
Instruments: Ludlum 2350-1 (Serial #203439), BP19DD Detector, Calibrated on 8-15-15  
Ludlum 2350-1 (Serial #203447), GP13A Detector, Calibrated on 7-10-15  
Beckman Scintillation Counter, Operational Test 6-2-16

Surveyor: Kevin Banks & Shaq Dews



**LEGEND**

⊙ - Random Starting Point from  
Random Number Generation  
X-Axis Start Location 1'  
Y-Axis Start Location 13'  
Typical Spacing = 1.18 m (3'7")  
Area ~ 18.02 m<sup>2</sup> (194 ft<sup>2</sup>)

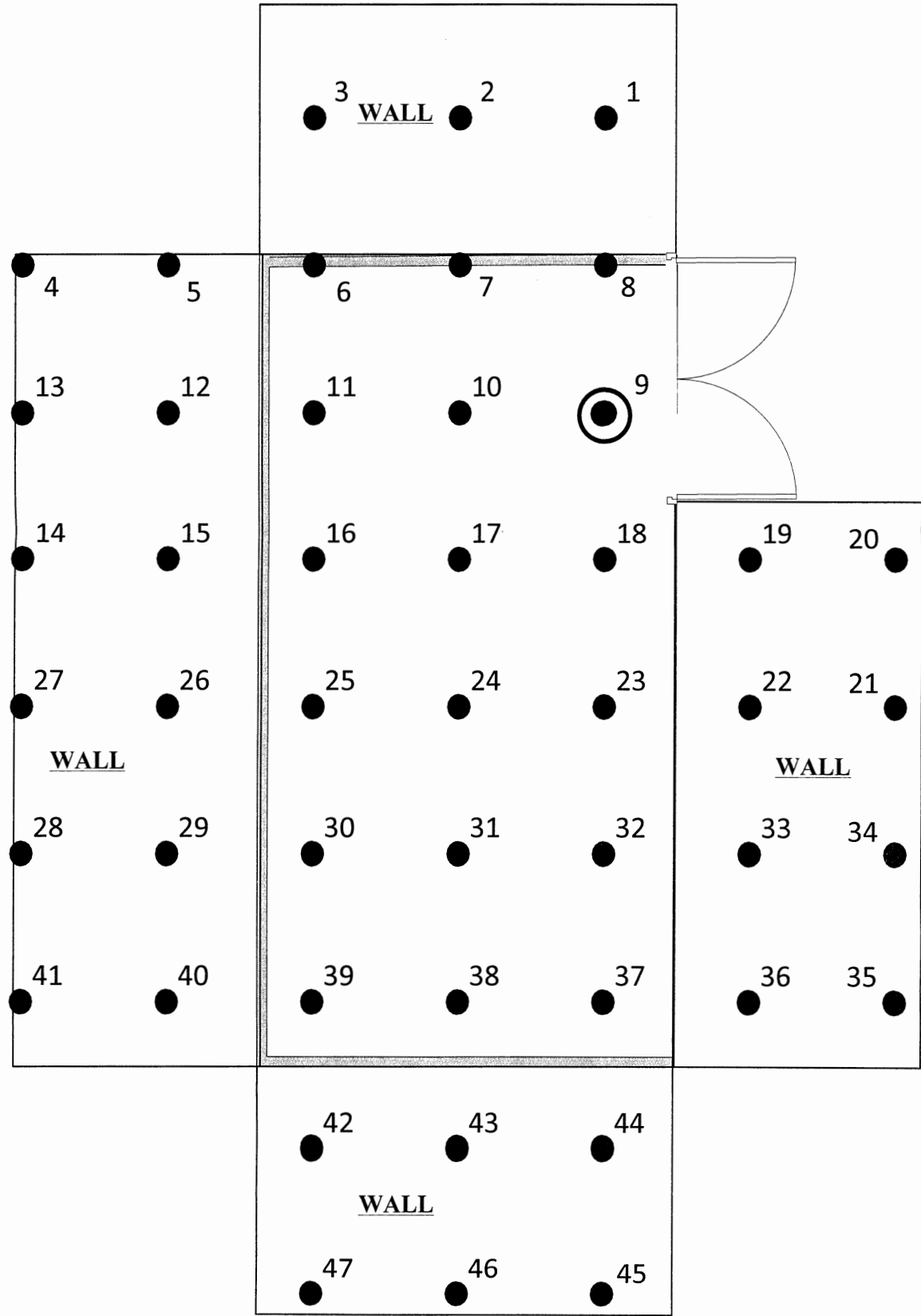


CDC  
Final Status Survey Report

Building: Chamblee Building 1      Area: RAW Room #1 Ceiling and Upper Walls      Survey Unit: 2      Date: 6-22-16      Class: 1

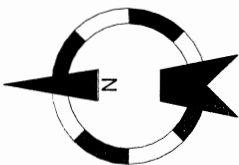
Instruments: Ludlum 2350-1 (Serial #203439), BP19DD Detector, Calibrated on 8-15-15  
Ludlum 2350-1 (Serial #203447), GP13A Detector, Calibrated on 7-10-15  
Beckman Scintillation Counter, Operational Test 6-2-16

Surveyor: Kevin Banks & Shaq Dews



**LEGEND**

- ⊙ - Random Starting Point from Random Number Generation
- X-Axis Start Location 7'
- Y-Axis Start Location 15'
- Typical Spacing = 1.18 m (3'7")
- Area ~ 18.02 m<sup>2</sup> (194 ft<sup>2</sup>)

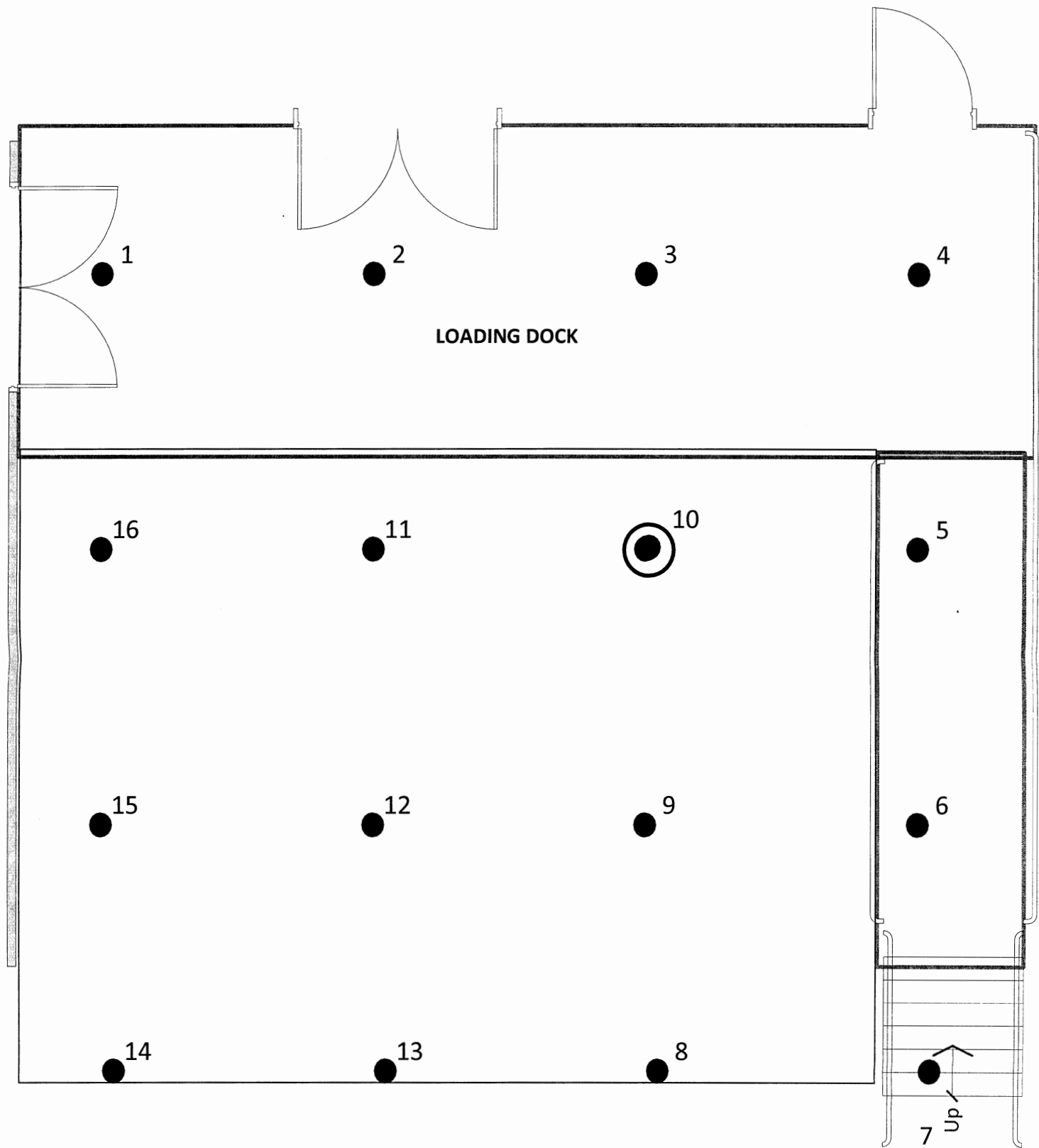


CDC  
Final Status Survey Report

Building: Chamblee Building 1      Area: Loading Dock and Ramp      Survey Unit: 3      Date: 6-22-16      Class: 2

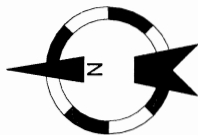
Instruments: Ludlum 2350-1 (Serial #203439), BP19DD Detector, Calibrated on 8-15-15  
Ludlum 2350-1 (Serial #203447), GP13A Detector, Calibrated on 7-10-15  
Beckman Scintillation Counter, Operational Test 6-2-16

Surveyor: Kevin Banks & Shaq Dews



**LEGEND**

- ⊙ - Random Starting Point from Random Number Generation  
X-Axis Start Location 17'  
Y-Axis Start Location 14'
- Typical Spacing = 2.07 m (6'10"), Plus Judgmental
- Area ~ 55.74 m<sup>2</sup> (600 ft<sup>2</sup>)

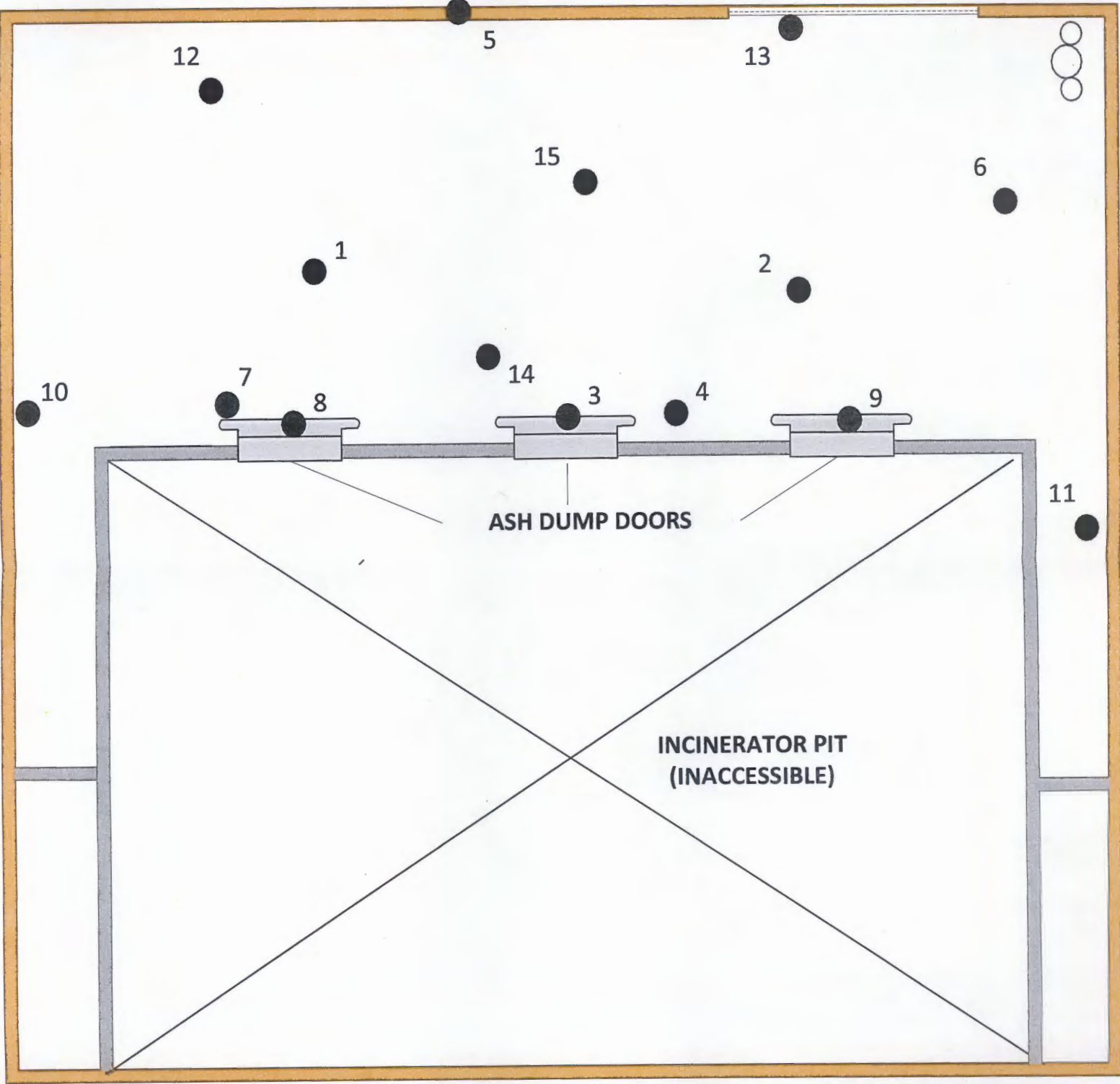


CDC  
Final Status Survey Report

Building: Chamblee Building 1      Area: Incinerator Room      Survey Unit: 4      Date: 6-22-16      Class: 3

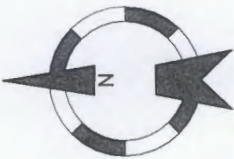
Instruments: Ludlum 2350-1 (Serial #203439), BP19DD Detector, Calibrated on 8-15-15  
Ludlum 2350-1 (Serial #203447), GP13A Detector, Calibrated on 7-10-15  
Beckman Scintillation Counter, Operational Test 6-2-16

Surveyor: Kevin Banks & Shaq Dews



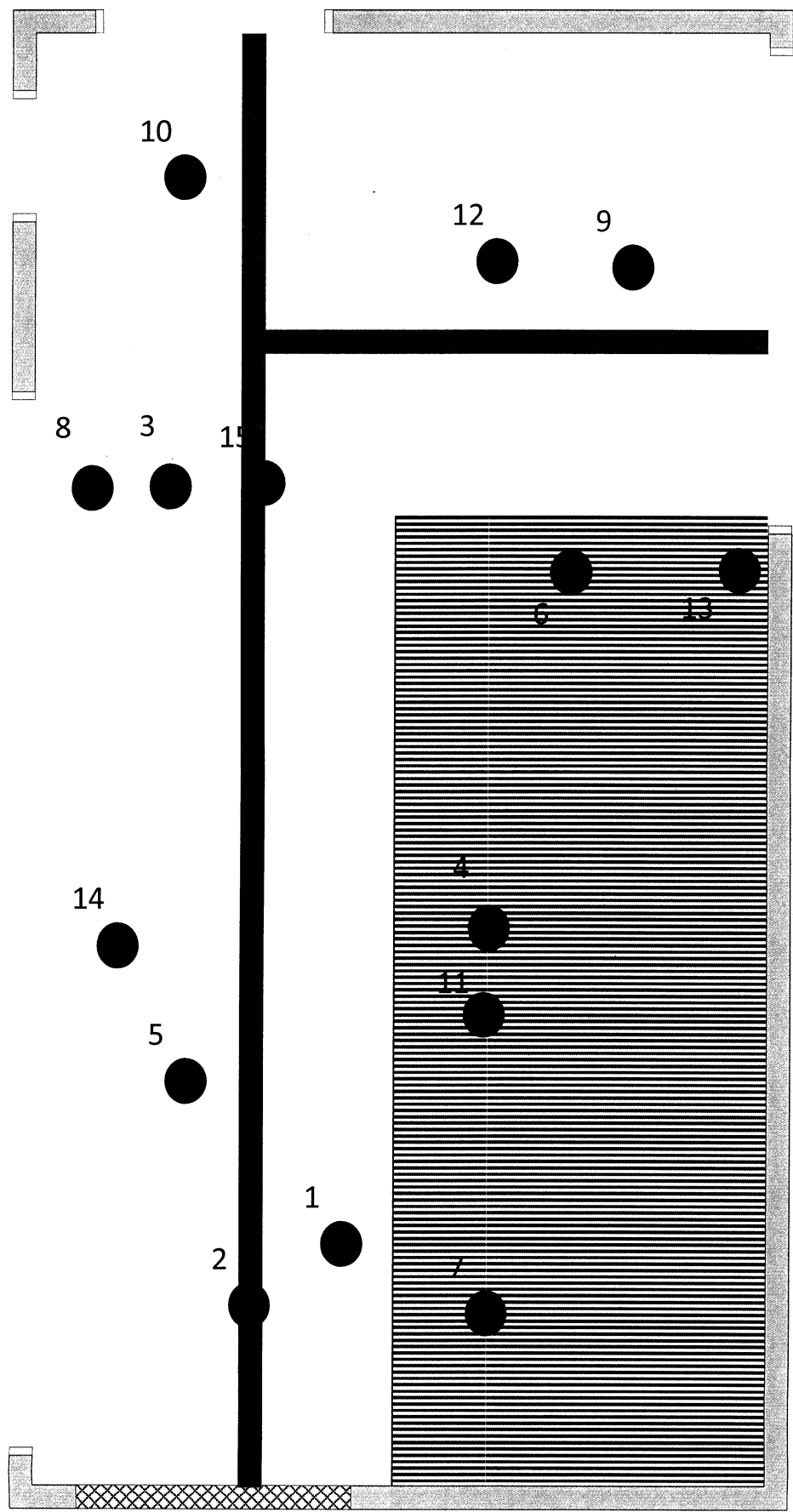
**LEGEND**


- Random Starting Point from  
Random Number Generation  
Typical Spacing = Random, Random, Plus Judgmental



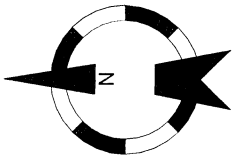
CDC  
Final Status Survey Report

Building: <u>Chamblee Building 1</u>	Area: <u>Crawlspace</u>	Survey Unit: <u>5</u>	Date: <u>6-22-16</u>	Class: <u>3</u>
Instruments: <u>Ludlum 2350-1 (Serial #203439), BP19DD Detector, Calibrated on 8-15-15</u> <u>Ludlum 2350-1 (Serial #203447), GP13A Detector, Calibrated on 7-10-15</u> <u>Beckman Scintillation Counter, Operational Test 6-2-16</u>				
Surveyor: <u>Kevin Banks</u>				



 - Aluminum crawlspace ceiling  
(Concrete ceiling elsewhere)

**LEGEND**  
- Random Starting Point from  
Random Number Generation  
Typical Spacing = Random, Random, Plus Judgmental





GRIFFIN INSTRUMENTS



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

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

Calibration Sticker Attached?: ☒ Yes ☐ No

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

INSTRUMENT MARRIED WITH 2350-1 #186177

Performed/Reviewed by: E.M. Glenn *ds* Date: 10/5/2015 Entered by: ds Initials

2 pi efficiencies denoted in italics.

Calibrations performed to ANSI N323A-1997 standards.





Griffin Instruments



Calibration Certificate for 2224-1 SERIAL# 187286

Owner: PHILOTECHNICS

DATE: 04/27/15 LOCATION: Griffin Inst  
TECH: D. Steimel DATE LAST CAL EXPIRES: 04/21/15  
Reason For Calibration: ☒ Due For Calibration ☐ Repair (See Remarks)  
☐ Other (See Remarks) ☐ Due and Repair (See Remarks)

NIST TRACEABLE EQUIPMENT USED DURING CALIBRATION

MODEL: M-500 SERIAL #: 134715 CAL. DUE: 12/08/15  
☒ Audio Response ☒ Geotropism CABLE LENGTH: 39"

CONDITION: Sat AF MECHANICAL ZERO: 0 AL MECHANICAL ZERO: 0  
NEW BATTERIES: ☐ Yes ☒ No BATTERY CHECK: Sat

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

RATE METER SCALER

SCALE	RATE CPM	AS FOUND	% ERROR	AS LEFT	% ERROR	AS FOUND	% ERROR	AS LEFT	% ERROR
x.1 or x1	200	200	0.0%	A.F.		499	0.2%	A.F.	
	500	500	0.0%	A.F.					
	800	800	0.0%	A.F.					
x1 or x10	2000	2000	0.0%	A.F.					
	5000	5000	0.0%	A.F.					
	8000	8000	0.0%	A.F.					
x10 or x100	20K	20	K	0.0%	A.F.				
	50K	50	K	0.0%	A.F.				
	80K	80	K	0.0%	A.F.				
x100 or x1000	200K	200	K	0.0%	A.F.				
	500K	500	K	0.0%	A.F.				
	800K	800	K	0.0%	A.F.				

Is the As Found Data Within 20% of the Set Point?: ☒ Yes ☐ No

Overload Light: ☒ Adjusted / Verified ☐ Not Adj.  
REMARKS:

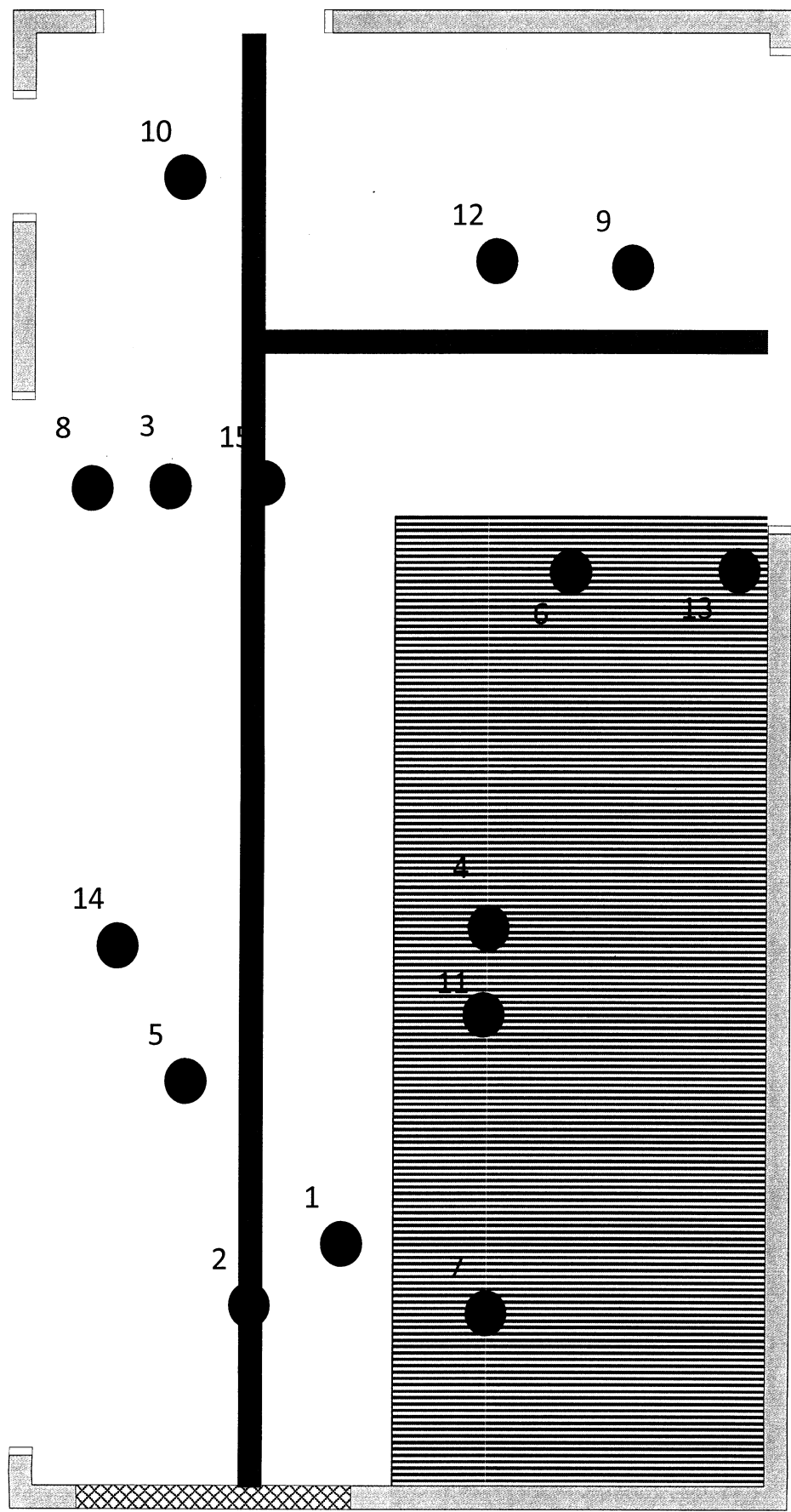
Does Instrument Meet Final Acceptance Criteria?: ☒ Yes ☐ No  
Calibration Sticker Attached?: ☒ Yes ☐ No  
Date Instrument is Due For Next Calibration: 04/27/16

INSTRUMENT MARRIED WITH 43-93 # PR294119  
Performed/Reviewed by: D. Steimel Date: 4/27/2015 Entered by: DS Initials  
1  
Calibrations performed to ANSI N323A-1997 standards.



CDC  
Final Status Survey Report

Building: <u>Chamblee Building 1</u>	Area: <u>Crawlspace</u>	Survey Unit: <u>5</u>	Date: <u>6-22-16</u>	Class: <u>3</u>
Instruments: <u>Ludlum 2350-1 (Serial #203439), BP19DD Detector, Calibrated on 8-15-15</u> <u>Ludlum 2350-1 (Serial #203447), GP13A Detector, Calibrated on 7-10-15</u> <u>Beckman Scintillation Counter, Operational Test 6-2-16</u>				
Surveyor: <u>Kevin Banks</u>				

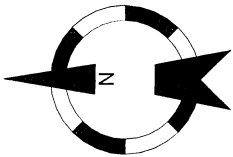


- Aluminum crawlspace ceiling  
(Concrete ceiling elsewhere)

**LEGEND**

- Random Starting Point from  
Random Number Generation

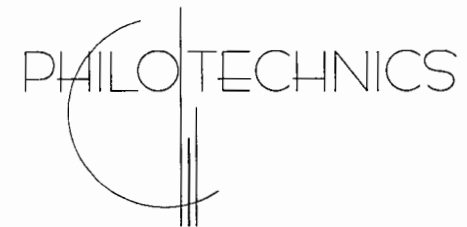
Typical Spacing = Random, Random, Plus Judgmental





[illegible]

**CDC**  
**RAW Room #1**  
**Final Status Survey Report Appendix**



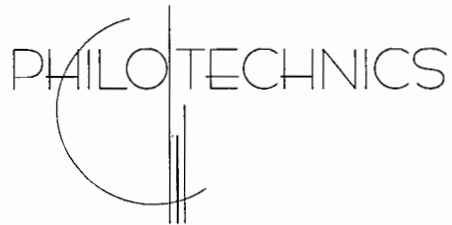
Prepared by:  
Philotechnics, Ltd.  
201 Renovare Blvd.  
Oak Ridge, TN 37830

**Appendix G – Wipe Survey Data**

**CDC**

**RAW Room #1**

**Final Status Survey Report Appendix**



Prepared by:  
Philotechnics, Ltd.  
201 Renovare Blvd.  
Oak Ridge, TN 37830

**Appendix C –  
Certificate of Calibration and Scintillation Check**



## GRIFFIN INSTRUMENTS



## CALIBRATION CERTIFICATE FOR 43-37-1 PROBE # PR352912

Owner: PHILOTECHNICS

DATE: 10/05/15

LOCATION: Griffin Inst

TECH: E.M. Glenn

DATE LAST CAL EXPIRES:

## REASON FOR CALIBRATION:

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

CABLE LENGTH: 6'

INPUT SENSITIVITY: 4mV

## NIST TRACEABLE EQUIPMENT AND STANDARDS USED DURING CALIBRATION

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

## NIST TRACEABLE SOURCES USED

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

## Efficiencies from last cal.:

Condition: ☒ Sat ☐ UnsatPu:  Th:  Sr: Tc ss:  C14:  Tc Ni: 

## As Found (AF) Efficiencies:

HV / Vernier:	Tc-99 Source Response Nickel (CPM):			Pu-239 Source Response (CPM):			Background (CPM):		Tc-99 Source Response Stainless Steel (CPM):		
	A ch.	B ch.	Net Eff.	A ch.	B ch.	Net Eff.	A ch.	B ch.	A ch.	B ch.	Net Eff.
N/A											

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

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

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

☐ Yes ☒ No (See Remarks)

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





# GRIFFIN INSTRUMENTS



PROBE #: **PR352912**

Date: 10/05/15

## PLATEAU AND SET POINT DATA

HV / Vernier:	Tc-99 Source Response SS (CPM):			Pu-239 Source Response (CPM):			Background (CPM):		Net A to B Xtalk: <10%	B to A Xtalk: <1%
	A ch.	B ch.	Net Eff.	A ch.	B ch.	Net Eff.	A ch.	B ch.		
1600		2235	12.1%					137		
1650		3307	17.4%					298		
1700		4603	23.5%					545		
1750		5602	26.8%					968		
1800		6134	27.0%					1463		
1850		6423	28.4%					1509		

Alpha / Beta Bkg (cpm)		1449					
HV / Vernier		Pu-239	Tc-99 Ni	Tc-99 SS	Th-230	C-14	Sr-90
1800 b	CPM:			6262		8736	4751
	4 pi AL Efficiencies:			27.82%		14.94%	39.39%
	2 pi AL Efficiencies:			44.56%		39.05%	56.34%

PROBE #: **PR352912**

Date: 10/05/15

## PLATEAU AND SET POINT DATA

HV / Vernier:	Tc-99 Source Response SS (CPM):			Pu-239 Source Response (CPM):			Background (CPM):		Net A to B Xtalk: <10%	B to A Xtalk: <1%
	A ch.	B ch.	Net Eff.	A ch.	B ch.	Net Eff.	A ch.	B ch.		
1100				2647		14.3%	1			
1150				4016		21.7%	5			
1200				4097		22.1%	3			
1250				4241		22.9%	7			
1300				4326		23.3%	7			
1350				4370		23.6%	9			

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





## GRIFFIN INSTRUMENTS



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

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

Calibration Sticker Attached?: ☒ Yes ☐ No

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

INSTRUMENT MARRIED WITH 2350-1 # 186177

Performed/Reviewed by:

E. M. Glenn *ds*

Date: 10/5/2015

Entered by: *ds* Initials

2 pi efficiencies denoted in italics.

Calibrations performed to ANSI N323A-1997 standards.





## GRIFFIN INSTRUMENTS



## CALIBRATION CERTIFICATE FOR

2224-1

SERIAL#

187286

Owner: PHILOTECHNICS

DATE: 04/27/15

LOCATION:

Griffin Inst

TECH: D. Steimel

DATE LAST CAL EXPIRES:

04/21/15

Reason For Calibration:

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

## NIST TRACEABLE EQUIPMENT USED DURING CALIBRATION

MODEL: M-500

SERIAL #: 134715

CAL. DUE: 12/08/15

☒ Audio Response☒ Geotropism

CABLE LENGTH: 39"

CONDITION: Sat

AF MECHANICAL ZERO: 0

AL MECHANICAL ZERO: 0

NEW BATTERIES:

☐ Yes ☒ No

BATTERY CHECK: Sat

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

## RATE METER

## SCALER

SCALE	RATE CPM	AS FOUND	% ERROR	AS LEFT	% ERROR	AS FOUND	% ERROR	AS LEFT	% ERROR
x.1 or x1	200	200	0.0%	A.F.		499	0.2%	A.F.	
	500	500	0.0%	A.F.					
	800	800	0.0%	A.F.					
x1 or x10	2000	2000	0.0%	A.F.					
	5000	5000	0.0%	A.F.					
	8000	8000	0.0%	A.F.					
x10 or x100	20K	20	K 0.0%	A.F.					
	50K	50	K 0.0%	A.F.					
	80K	80	K 0.0%	A.F.					
x100 or x1000	200K	200	K 0.0%	A.F.					
	500K	500	K 0.0%	A.F.					
	800K	800	K 0.0%	A.F.					

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

☒ Yes ☐ No

Overload Light:

☒ Adjusted / Verified ☐ Not Adj.

REMARKS:

Does Instrument Meet Final Acceptance Criteria?:

☒ Yes ☐ No

Calibration Sticker Attached?:

☒ Yes ☐ No

Date Instrument is Due For Next Calibration:

04/27/16

INSTRUMENT MARKED WITH

43-93

# PR294119

Performed/Reviewed by:

*D. Steimel*

Date: 4/27/2015

Entered by: *DS* Initials



# GRIFFIN INSTRUMENTS



## CALIBRATION CERTIFICATE FOR 43-93 PROBE # PR294119

Owner: PHILOTECHNICS

DATE: 04/27/15  
TECH: D. Steimel

LOCATION: Griffin Inst  
DATE LAST CAL EXPIRES: 04/21/15

### REASON FOR CALIBRATION:

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

CABLE LENGTH: 39"

INPUT SENSITIVITY: DUAL

### NIST TRACEABLE EQUIPMENT AND STANDARDS USED DURING CALIBRATION

MODEL: 2224-1 SERIAL #: 187286 CAL. DUE: 04/27/16

### NIST TRACEABLE SOURCES USED

Source Number	Isotope	4 pi Activity	Assay Date	2 pi Activity
99TC470-1814	Tc99 SS	31,330 dpm	05/27/14	19,600 cpm
2697-00	Sr90	12,200 dpm	03/01/00	8,530 cpm
99TH470-1815	Th230	24,052 dpm	09/05/14	10,930 cpm
L7-434	Pu239	18,084 dpm	09/01/14	9,131 cpm

### Efficiencies from last cal.:

Condition: ☒ Sat ☐ Unsat

Pu: 21.79% Th: 18.81% Sr: 33.39%

Tc ss: 16.67% C14: Tc Ni:

### As Found (AF) Efficiencies:

HV / Vernier:	Tc-99 Source Response Nickel (CPM):			Pu-239 Source Response (CPM):			Background (CPM):		Tc-99 Source Response Stainless Steel (CPM):		
	A ch.	B ch.	Net Eff.	A ch.	B ch.	Net Eff.	A ch.	B ch.	A ch.	B ch.	Net Eff.
650 V / N/A				3933	472	21.74%	1	218	1	5406	16.56%

Net A to B Xtalk: <10%	B to A Xtalk: <1%
6.1%	<1%

	Pu239	Tc99 Ni	Tc99 ss	Th-230	Sr90	C-14
AF CPM:	3933		5406	4179	2912	
AF 4 pi eff:	21.74%		16.56%	17.37%	31.75%	
AF 2 pi eff:	43.06%		26.47%	38.23%	45.41%	

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

☒ Yes ☐ No (See Remarks)

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







# CALIBRATION CERTIFICATE

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

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

CUSTOMER INFORMATION		INSTRUMENT INFORMATION		
Customer Name: Griffin Instruments		Manufacturer: Ludlum		
Address: 131 Gallaher Road, Kingston, TN 37763		Model: 2350-1	Serial Number: 212234	
Contact Name: Joanne Glenn		Probe: N/A	Serial Number: N/A	
Customer Purchase Order Number: N/A	Work Order Number: 2015-14329	Calibration Method: Electronic		
INSTRUMENT CALIBRATION INFORMATION				
Instrument Range (CPM)	Calibration Standard Value (CPM)	Instrument Response ( $\pm 10\%$ )		Comments
		Before Calibration	After Calibration	
400	400	399	399	DVM: 88020324 Cal Due: 03/27/16
4,000	4,000	3,989	3,989	Temp/Press: 3076 Cal Due: 01/06/16
40,000	40,000	39,890	39,890	Humidity: 958670 Cal Due: 01/30/16
400,000	400,000	398,896	398,896	Pulser: 246163 Cal Due: 02/04/16
HV Cal Values (M2350 HV Entry)	Desired HV Tolerance (Voltmeter) (VDC)	As Found (VDC)	As Left (VDC)	CP Firmware Version: 37122N28 I/O Firmware Version: 37123N05
500	(490 - 510)	494	498	
1,500	(1,498 - 1,502)	1,488	1,500	
2,000	(1,940 - 2,060)	1,982	1,998	Temp: 21.0 °C Pressure: 741 mmHg Humidity: 34.3 %
Parameter	Tolerance ( $\pm 10\%$ )	As Found	As Left	
Threshold T = 100	10 $\pm$ (9 to 11) mVDC	9.3	10.0	Geotropism: SAT ACK/Scroll: SAT
Threshold T = 500	50 $\pm$ (45 to 55) mVDC	46.5	50.0	BAT >4.5V: SAT Volume: SAT
Threshold T = 1000	100 $\pm$ (90 to 110) mVDC	95	102	Count: SAT Audio Divide: SAT
Window Width W = 100	10 $\pm$ (9 to 11) mVDC	9.1	9.9	Alarms: SAT Lamp: SAT
Display-to-mV ratio:	100 to 10 mV		Overload Test: SAT Physical Cond: SAT	
STATEMENT OF CERTIFICATION				
We Certify that the instrument listed above was calibrated and inspected prior to shipment and that it met all the Manufacturers published operating specifications. We further certify that our Calibration Measurements are traceable to the National Institute of Standards and Technology. (We are not responsible for damage incurred during shipment or use of this instrument).				
Instrument				
Calibrated By: <i>Mike Yone</i>		Reviewed By: <i>Jeff Dupinso</i>	Date: 7/31/15	
Calibration Date: 07/31/2015		Certification Due (12 mo.): 07/31/2016		

7/31/15



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

## CALIBRATION CERTIFICATE

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

CUSTOMER INFORMATION				DETECTOR INFORMATION		
Customer Name: Griffin Instruments				Manufacturer: NE Technology		
Address: 131 Gallaher Road, Kingston, TN 37763				Model: GP13A	Serial Number: 360	
Contact Name: Joanne Glenn				Calibration Method: Source		
Contract Purchase Order Number: Credit Card		Work Order Number: 2015-14329				
DETECTOR PARAMETER SETUPS						
Parameter	As Found	As Left	Parameter	As Found	As Left	Comments
Model	GP13A	GP13A	CC	1.0	1.0	DVM: 88020324 Cal Due: 02/04/16
S/N	360	360	DT	4.0 uSec	4.0 uSec	Temp/Press: 3076 Cal Due: 01/06/16
Units	7 = counts	7 = counts	Threshold	350 = 35 mV	350 = 35 mV	Humidity: 958670 Cal Due: 01/30/16
multiplier	0 = auto	0 = auto				
Time base	1 = minutes	1 = minutes				Temp: 21.0 °C Pressure: 741 mmHg
HV	780V	800V				Humidity: 34.3 %
Count time	30 sec	60 sec				** Detector specific parameters must be entered into instrument manually to be used with another 2350-1 **
Saved as Detector #1						
INSTRUMENT INFORMATION						
<u>Model</u>		<u>Serial Number</u>		<u>Calibration Due Date</u>		
2350-1		212234		07/31/16		
USED FOR EFFICIENCY DETERMINATION AND HV PLATEAUGING						
I <sup>129</sup> #040202 at 95,682 DPM Certification Date: 04/13/99						
Background (CPM)	Gross Source Counts (CPM)		Net Source Counts (CPM)		Efficiency in % (Determined on contact)	
3,519	17,284		13,765		14.4 % for I <sup>129</sup>	
** Gross source counts taken from an average of three one minute counts from the Heel, Middle, and Toe of Detector **						
COMMENTS						
** Detectors set up with a 2350-1 may be used with any 2350-1 provided that the setup parameters are scanned into the 2350-1 prior to use with that specific detector and the threshold ratio is 100 = 10 mV on the instrument **						
STATEMENT OF CERTIFICATION						
We Certify that the instrument listed above was calibrated and inspected prior to shipment and that it met all the Manufacturers published operating specifications. We further certify that our Calibration Measurements are traceable to the National Institute of Standards and Technology. (We are not responsible for damage incurred during shipment or use of this instrument).						
Instrument						
Calibrated By: <i>Mike Jones</i>			Reviewed By: <i>Jeff Dubinso</i>		Date: 7/31/15	
Calibration Date: 07/31/2015			Calibration Due: 07/31/2016			

8/4/15

# NE Technology GP13A HIGH VOLTAGE PLATEAU DATA SHEET

Serial Number: **360**

HIGH VOLTAGE	BACKGROUND (CPM)	SOURCE (CPM)
700	2,948	3,322
720	3,157	5,846
740	3,307	11,120
760	3,405	15,072
780	3,512	16,763
<b>800 (SET)</b>	<b>3,620</b>	<b>17,323</b>
820	3,798	17,697
840	4,190	18,224
860	5,031	19,171
N/A	N/A	N/A
N/A	N/A	N/A
N/A	N/A	N/A
N/A	N/A	N/A
N/A	N/A	N/A
N/A	N/A	N/A
N/A	N/A	N/A
N/A	N/A	N/A
N/A	N/A	N/A
N/A	N/A	N/A
N/A	N/A	N/A
N/A	N/A	N/A
N/A	N/A	N/A
N/A	N/A	N/A
N/A	N/A	N/A
N/A	N/A	N/A
N/A	N/A	N/A
N/A	N/A	N/A

Plateau performed with I<sup>129</sup> Source # 040202 at 95,682 dpm at center of detector

Performed By: Mike Jones

Date: 7-31-15

# Philotechnics Analytical Worksheet

Appendix C

## Centers For Disease Control Instrument Operational Check

6/23/2016

### Counting Data:

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

### Nuclide Information:

Analytical Sampling Date: 6/22/2016

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

### Efficiency Calculations Unquenched:

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

### Efficiency Used Based on Quench Curve:

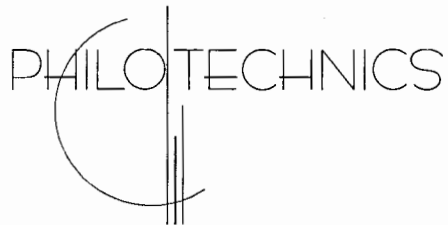
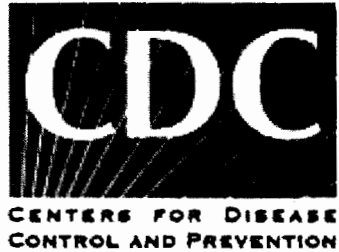
H-3 Quench	
H#	Eff.
0.1	61.20%
39.8	55.95%
94.1	42.34%
132.4	33.29%
165.7	25.65%
202.8	18.25%
231.6	13.55%
253.5	10.52%
280.6	7.49%

C-14 Quench	
H#	Eff.
0.1	95.64%
46.9	94.75%
95.2	92.78%
124.4	91.27%
159.7	88.63%
204.2	84.76%
224.2	82.04%
263.1	76.05%
284.5	72.26%

**CDC**

**RAW Room #1**

**Final Status Survey Report Appendix**



Prepared by:  
Philotechnics, Ltd.  
201 Renovare Blvd.  
Oak Ridge, TN 37830

**Appendix D – Analytical Worksheets**

# **Philotechnics** **Analytical Worksheet**

Appendix D

## **Minimum Detectable Concentration (MDC) Static Count**

### **Calculations for Liquid Scintillation Counter**

(95% confidence level via NUREG 1507 method)

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

Where:

Eff. = LSC total efficiency, Counter cpm/NIST Standard dpm

R<sub>b</sub> = LSC background rate (cpm)

T<sub>s+b</sub> = Sample count time (minutes)

T<sub>b</sub> = Background count time (minutes)

Static Count MDC Calculations					
Nuclide	Eff.	R <sub>b</sub>	T <sub>s+b</sub>	T <sub>b</sub>	MDC (Static)
H-3	69.9%	11.5	1	1	26.9 dpm/100 cm <sup>2</sup>
C-14	62.5%	11.5	1	1	30.0 dpm/100 cm <sup>2</sup>
I-125	50.0%	11.5	1	1	37.6 dpm/100 cm <sup>2</sup>

## **Minimum Detectable Concentration (MDC) Static Count**

### **Calculations for Planchet Counter**

(95% confidence level via NUREG 1507 method)

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

Where:

Eff. = Planchet total efficiency {4π efficiency}

R<sub>b</sub> = Planchet background rate (cpm)

T<sub>s+b</sub> = Sample count time (minutes)

T<sub>b</sub> = Background count time (minutes)

Static Count MDC Calculations						
PIC ASC #0713821						
Meter	Nuclide	Total Eff.	R <sub>b</sub>	T <sub>s+b</sub>	T <sub>b</sub>	MDC (Static)
Protean	Th-230	7.90%	0.1	15	60	6.6 dpm/100 cm <sup>2</sup>
Protean	Tc-99	6.14%	61.5	15	60	124.5 dpm/100 cm <sup>2</sup>

# Philotechnics Analytical Worksheet

Appendix D

## Minimum Detectable Concentration (MDC) Static Count

### Calculations for Hand-Held Monitors

(95% confidence level via NUREG 1507 method)

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

Where:

Total Eff. = Total Efficiency (2pi efficiency \* 0.25 per ISO 7503-1)  
 $R_b$  = Average background rate (cpm)  
 $T_{s+b}$  = Sample count time (minutes)  
 $T_b$  = Background count time (minutes)  
 $P$  = Probe area (cm<sup>2</sup>)

Static Count MDC Calculations						
<i>Meter: 187286 (Hand Held)</i>						
Nuclide	Total Eff.	$R_b$	$T_{s+b}$	$T_b$	P	MDC (Static)
Tc-99	10.32%	468.4	1	1	100	1005 dpm/100 cm <sup>2</sup>

<i>Meter: 187286 (Hand Held)</i>						
Nuclide	Total Eff.	$R_b$	$T_{s+b}$	$T_b$	P	MDC (Static)
Th-230	7.51%	3.0	3	3	100	75 dpm/100 cm <sup>2</sup>

<i>Meter: 212234 (Hand Held)</i>						
Nuclide	Total Eff.	$R_b$	$T_{s+b}$	$T_b$	P	MDC (Static)
I-129	7.07%	9008.7	1	1	100	6289 dpm/100 cm <sup>2</sup>

# Philotechnics Analytical Worksheet

Appendix D

## Scan Minimum Detectable Concentration (MDC)

### Calculations for Hand-Held Monitors

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

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

Where:

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

And,

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

Where:

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

And,

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

Where:

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

And,

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

Where:

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



# Philotechnics Analytical Worksheet

Appendix D

## Scan Minimum Detectable Concentration (MDC)

### Calculations for Hand-Held Monitors

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

### Specific Scan MDC calculation results:

#352912	Ambient	
P <sub>b</sub> =	1534.0	cpm
i =	1.25	sec
B <sub>i</sub> =	31.96	counts
d' =	1.38	
S <sub>i</sub> =	7.80	counts
MDCR =	374.5	cpm

#212234	Ambient	
P <sub>b</sub> =	9008.7	cpm
i =	1.25	sec
B <sub>i</sub> =	187.68	counts
d' =	1.38	
S <sub>i</sub> =	18.91	counts
MDCR =	907.5	cpm

#352912	Ambient	
P <sub>b</sub> =	23.2	cpm
i =	3.975	sec
B <sub>i</sub> =	1.54	counts
d' =	1.38	
S <sub>i</sub> =	1.71	counts
MDCR =	25.8	cpm

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

Ambient

Meter: 352912 Large Area Probe (Hand Held)			
Nuclide	Total Efficiency	Area	MDC (Scan)
Th-230	11.26%	821	39.5 dpm/100 cm <sup>2</sup>

Ambient

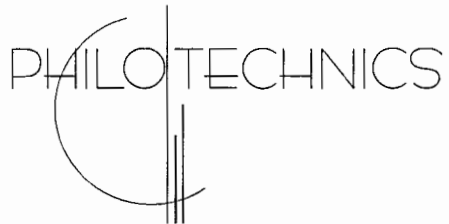
Meter: 212234 (Hand Held)			
Nuclide	Total Efficiency	Area	MDC (Scan)
I-129	7.07%	100	18152.1 dpm/100 cm <sup>2</sup>

Ambient

**CDC**

**RAW Room #1**

# **Final Status Survey Report Appendix**



Prepared by:  
**Philotechnics, Ltd.**  
**201 Renovare Blvd.**  
**Oak Ridge, TN 37830**

## **Appendix E – Background Documentation**

## Background Documentation

### Fail Levels

Ld, system detection limit is the net count having 95% probability of being detected when a survey sample point contains activity at Ld, which translates to a 5% probability of falsely interpreting sample activity as activity due to background (NUREG-1507 Table 3-8)

$$L_d(\text{cpm}) = 3 + 4.65\sqrt{B}$$

(Eq. 7)

Fail Level CPM = Bkg cpm + Ld cpm

Fail Level Calculations (Static) #187286				
Probe	Surface	Bkg	Ld (cpm)	Fail Level (cpm)
43-93	Beta	468	103.6	572.0
43-93	Alpha	3	10.8	13.6

Fail Level Calculations (Static) #212234				
Probe	Surface	Bkg	Ld (cpm)	Fail Level (cpm)
GP-13A	Gamma	9009	444.4	9453.1

### Background Data

Ludlum 2224 with 43-93 probe #187286 (Hand Held)					
Surface	Counts (cpm)				
Ambient	448	465	436	504	449
Beta	481	482	475	480	484
Average: 468 cpm					

Surface	Counts (cpm)				
Ambient	3	1	2	4	3
Alpha	2	5	3	3	2
Average: 3 cpm					

Ludlum 2360 with 43-93 probe #236964 (Hand Held)					
Surface	Counts (cpm)				
Ambient	460	444	461	483	457
Beta	471	459	461	474	488
Average: 466 cpm					

Surface	Counts (cpm)				
Ambient	1	2	4	3	3
Alpha	5	2	3	3	3
Average: 3 cpm					

Ludlum 2360 with GP-13A probe #212234 (Hand Held)					
Surface	Counts (cpm)				
Ambient	8913	9219	9124	9027	8651
Gamma	9180	9248	8913	8992	8820
Average: 9009 cpm					

Ludlum 2360 with GP-13A probe #192611 (Hand Held)					
Surface	Counts (cpm)				
Ambient	9292	9028	9234	9181	9033
Gamma	9007	9140	8976	9211	8857
Average: 9096 cpm					

Ludlum 2350-1 with 43-37-1 probe #352912 (Hand Held)					
Surface	Counts (cpm)				
Ambient	27	28	21	20	21
Alpha	21	27	24	20	23
Average: 23 cpm					

Ludlum 2350-1 with 43-37-1 probe #352912 (Hand Held)					
Surface	Counts (cpm)				
Ambient	1551	1430	1441	1602	1655
Beta	1569	1422	1569	1489	1612
Average: 1534 cpm					

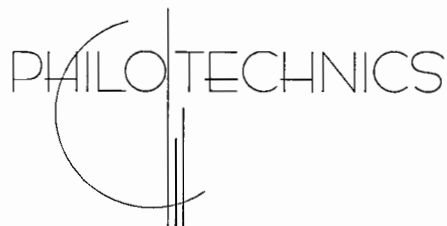
Planchet Counter - Serial #0713821		
Surface	Counts (cpm)	
Ambient (Alpha)	One 60 minute count	7
Ambient (Beta)	One 60 minute count	3689
Average: Alpha 0.1 cpm Beta 61 cpm		

Scintillation Counter				
Counts (cpm)				
Sample	Time	Chan A (cpm)	Chan B (cpm)	Chan C (cpm)
1	1 min.	5	11	11
2	1 min.	13	13	15
3	1 min.	14	12	9
4	1 min.	16	10	4
5	1 min.	11	12	8
6	1 min.	14	10	11
7	1 min.	8	12	14
8	1 min.	8	11	13
9	1 min.	12	9	11
10	1 min.	14	15	13
Average: 11.5 11.5 10.9				

**CDC**

**RAW Room #1**

# **Final Status Survey Report Appendix**



Prepared by:

**Philotechnics, Ltd.**

**201 Renovare Blvd.**

**Oak Ridge, TN 37830**

## **Appendix F – Static Measurements Documentation**

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

Appendix F

Static Measurements																			
Survey Unit 1		Alpha	Beta	Gamma		Survey Unit 1		Alpha dpm/100cm <sup>2</sup>	Beta dpm/100cm <sup>2</sup>	Gamma dpm/100cm <sup>2</sup>									
RAW Room #1		187286	187286	212234		Gross DCGL		150	10,000	40,000									
Surface		Background (CPM)																	
Ambient (B01)		3	468	9009															
Meter Efficiency		10.32%	7.51%	7.20%															
Survey Unit 1 - Floor and Lower Walls																			
Sample	Type	Alpha (CPM)	Beta (CPM)	Gamma (CPM)	Alpha CPM	Net Beta CPM	Net Gamma CPM	Net Alpha (DPM/100cm <sup>2</sup> )	Net Beta (DPM/100cm <sup>2</sup> )	Net Gama (DPM/100cm <sup>2</sup> )	Unity	Comment							
1	B01	3	460	8546	0.2	-8	-463	1.5	-112	-6,426	-0.16	<DCGL							
2	B01	3	449	8910	0.2	-19	-99	1.5	-258	-1,371	-0.05	<DCGL							
3	B01	5	524	8812	2.2	56	-197	16.9	741	-2,732	0.12	<DCGL							
4	B01	5	505	8653	2.2	37	-356	16.9	488	-4,940	0.04	<DCGL							
5	B01	2	443	9092	-0.8	-25	83	-6.2	-338	1,157	-0.05	<DCGL							
6	B01	4	442	9130	1.2	-26	121	9.2	-352	1,685	0.07	<DCGL							
7	B01	3	467	9126	0.2	-1	117	1.5	-19	1,629	0.05	<DCGL							
8	B01	6	509	9060	3.2	41	51	24.6	541	712	0.24	<DCGL							
9	B01	3	556	9164	0.2	88	155	1.5	1,167	2,157	0.18	<DCGL							
10	B01	3	481	9072	0.2	13	63	1.5	168	879	0.05	<DCGL							
11	B01	4	441	8639	1.2	-27	-370	9.2	-365	-5,135	-0.10	<DCGL							
12	B01	2	538	8717	-0.8	70	-292	-6.2	927	-4,051	-0.05	<DCGL							
13	B01	5	490	9016	2.2	22	7	16.9	288	101	0.14	<DCGL							
14	B01	2	454	9200	-0.8	-14	191	-6.2	-192	2,657	0.01	<DCGL							
15	B01	4	443	9091	1.2	-25	82	9.2	-338	1,143	0.06	<DCGL							
16	B01	4	462	8722	1.2	-6	-287	9.2	-85	-3,982	-0.05	<DCGL							
17	B01	3	481	8971	0.2	13	-38	1.5	168	-524	0.01	<DCGL							
18	B01	6	519	8947	3.2	51	-62	24.6	674	-857	0.21	<DCGL							
19	B01	3	480	9003	0.2	12	-6	1.5	155	-79	0.02	<DCGL							
20	B01	1	723	9930	-1.8	255	921	-13.8	3,391	12,796	0.57	<DCGL							
21	B01	3	462	9449	0.2	-6	440	1.5	-85	6,115	0.15	<DCGL							
22	B01	2	536	9160	-0.8	68	151	-6.2	900	2,101	0.10	<DCGL							
23	B01	2	516	8971	-0.8	48	-38	-6.2	634	-524	0.01	<DCGL							
24	B01	5	522	8982	2.2	54	-27	16.9	714	-371	0.17	<DCGL							
25	B01	3	450	9074	0.2	-18	65	1.5	-245	907	0.01	<DCGL							
26	B01	5	461	8859	2.2	-7	-150	16.9	-99	-2,079	0.05	<DCGL							
27	B01	1	642	9181	-1.8	174	172	-13.8	2,312	2,393	0.20	<DCGL							
28	B01	5	554	8842	2.2	86	-167	16.9	1,140	-2,315	0.17	<DCGL							
29	B01	3	528	8997	0.2	60	-12	1.5	794	-163	0.09	<DCGL							
30	B01	2	559	8878	-0.8	91	-131	-6.2	1,207	-1,815	0.03	<DCGL							
31	B01	1	497	8688	-1.8	29	-321	-13.8	381	-4,454	-0.17	<DCGL							
32	B01	4	513	9191	1.2	45	182	9.2	594	2,532	0.18	<DCGL							
33	B01	3	519	9014	0.2	51	5	1.5	674	74	0.08	<DCGL							
34	B01	4	527	8861	1.2	59	-148	9.2	781	-2,051	0.09	<DCGL							
35	B01	5	511	8583	2.2	43	-426	16.9	567	-5,913	0.02	<DCGL							
36	B01	3	450	9042	0.2	-18	33	1.5	-245	462	0.00	<DCGL							
37	B01	4	445	8984	1.2	-23	-25	9.2	-312	-343	0.02	<DCGL							
38	B01	2	424	8843	-0.8	-44	-166	-6.2	-591	-2,301	-0.16	<DCGL							
39	B01	1	450	8843	-1.8	-18	-166	-13.8	-245	-2,301	-0.17	<DCGL							
40	B01	3	442	9087	0.2	-26	78	1.5	-352	1,087	0.00	<DCGL							
41	B01	2	436	9002	-0.8	-32	-7	-6.2	-432	-93	-0.09	<DCGL							

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Appendix F

Survey Unit 2			Alpha	Beta	Gamma		Survey Unit 2	Alpha dpm/100cm <sup>2</sup>	Beta dpm/100cm <sup>2</sup>	Gamma dpm/100cm <sup>2</sup>						
RAW Room #1			187286	187286	212234		Gross DCGL	150	10,000	40,000						
Surface			Background (CPM)													
Ambient (B01)			3	468	9009											
Meter Efficiency			10.32%	7.51%	7.07%											
Survey Unit 2 - Upper Walls and Ceiling																
Sample	Type	Gross Alpha (CPM)	Gross Beta (CPM)	Gross Gamma (CPM)	Net Alpha CPM	Net Beta CPM	Net Gamma CPM	Net Alpha (DPM/100cm <sup>2</sup> )	Net Beta (DPM/100cm <sup>2</sup> )	Net Gamma (DPM/100cm <sup>2</sup> )	Unity	Comment				
1	B01	1	471	8687	-1.8	3	-322	-13.8	35	-4,468	-0.20	<DCGL				
2	B01	2	428	9015	-0.8	-40	6	-6.2	-538	87	-0.09	<DCGL				
3	B01	2	460	8506	-0.8	-8	-503	-6.2	-112	-6,982	-0.23	<DCGL				
4	B01	4	485	8531	1.2	17	-478	9.2	221	-6,635	-0.08	<DCGL				
5	B01	3	441	8960	0.2	-27	-49	1.5	-365	-676	-0.04	<DCGL				
6	B01	2	490	8731	-0.8	22	-278	-6.2	288	-3,857	-0.11	<DCGL				
7	B01	2	492	8459	-0.8	24	-550	-6.2	314	-7,635	-0.20	<DCGL				
8	B01	2	478	8919	-0.8	10	-90	-6.2	128	-1,246	-0.06	<DCGL				
9	B01	1	432	8739	-1.8	-36	-270	-13.8	-485	-3,746	-0.23	<DCGL				
10	B01	5	434	9032	2.2	-34	23	16.9	-458	324	0.08	<DCGL				
11	B01	3	466	8923	0.2	-2	-86	1.5	-32	-1,190	-0.02	<DCGL				
12	B01	3	455	8976	0.2	-13	-33	1.5	-178	-454	-0.02	<DCGL				
13	B01	3	481	8708	0.2	13	-301	1.5	168	-4,176	-0.08	<DCGL				
14	B01	3	461	8540	0.2	-7	-469	1.5	-99	-6,510	-0.16	<DCGL				
15	B01	3	450	8658	0.2	-18	-351	1.5	-245	-4,871	-0.14	<DCGL				
16	B01	4	490	8608	1.2	22	-401	9.2	288	-5,565	-0.05	<DCGL				
17	B01	2	424	8898	-0.8	-44	-111	-6.2	-591	-1,538	-0.14	<DCGL				
18	B01	3	498	8973	0.2	30	-36	1.5	394	-496	0.04	<DCGL				
19	B01	3	456	8810	0.2	-12	-199	1.5	-165	-2,760	-0.08	<DCGL				
20	B01	2	469	8619	-0.8	1	-390	-6.2	8	-5,413	-0.18	<DCGL				
21	B01	2	443	8719	-0.8	-25	-290	-6.2	-338	-4,024	-0.18	<DCGL				
22	B01	3	465	9039	0.2	-3	30	1.5	-45	421	0.02	<DCGL				
23	B01	5	469	8978	2.2	1	-31	16.9	8	-426	0.10	<DCGL				
24	B01	4	448	9032	1.2	-20	23	9.2	-272	324	0.04	<DCGL				
25	B01	3	452	8847	0.2	-16	-162	1.5	-218	-2,246	-0.07	<DCGL				
26	B01	1	476	8731	-1.8	8	-278	-13.8	101	-3,857	-0.18	<DCGL				
27	B01	2	436	8697	-0.8	-32	-312	-6.2	-432	-4,329	-0.19	<DCGL				
28	B01	2	489	8486	-0.8	21	-523	-6.2	274	-7,260	-0.20	<DCGL				
29	B01	6	464	8541	3.2	-4	-468	24.6	-59	-6,496	0.00	<DCGL				
30	B01	4	459	8657	1.2	-9	-352	9.2	-125	-4,885	-0.07	<DCGL				
31	B01	3	465	8926	0.2	-3	-83	1.5	-45	-1,149	-0.02	<DCGL				
32	B01	2	424	8704	-0.8	-44	-305	-6.2	-591	-4,232	-0.21	<DCGL				
33	B01	3	488	8504	0.2	20	-505	1.5	261	-7,010	-0.14	<DCGL				
34	B01	4	424	8582	1.2	-44	-427	9.2	-591	-5,926	-0.15	<DCGL				
35	B01	2	420	8798	-0.8	-48	-211	-6.2	-645	-2,926	-0.18	<DCGL				
36	B01	2	497	8475	-0.8	29	-534	-6.2	381	-7,413	-0.19	<DCGL				
37	B01	3	435	8874	0.2	-33	-135	1.5	-445	-1,871	-0.08	<DCGL				
38	B01	3	494	8522	0.2	26	-487	1.5	341	-6,760	-0.12	<DCGL				
39	B01	5	483	8877	2.2	15	-132	16.9	194	-1,829	0.09	<DCGL				
40	B01	3	436	8808	0.2	-32	-201	1.5	-432	-2,788	-0.10	<DCGL				
41	B01	2	457	9034	-0.8	-11	25	-6.2	-152	351	-0.05	<DCGL				

## Appendix F

Ref. NUREG-1507

## Appendix F

Ref. NUREG-1507



## Appendix F

Ref. NUREG-1507

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Centers for Disease Control and Prevention

Appendix F

Survey Unit 5		Alpha	Beta	Gamma	Survey Unit 5		Alpha dpm/100cm <sup>2</sup>	Beta dpm/100cm <sup>2</sup>	Gamma dpm/100cm <sup>2</sup>			
Crawlspace		187286	187286	212234	Gross DCGL		150	10,000	40,000			
Surface		Background (CPM)										
Ambient (B01)		3	468	9009								
Meter Efficiency		10.32%	7.51%	7.07%								
Survey Unit 5 - Crawlspace												
Sample	Type	Gross Alpha (CPM)	Gross Beta (CPM)	Gross Gamma (CPM)	Net Alpha CPM	Net Beta CPM	Net Gamma CPM	Net Alpha (DPM/100cm <sup>2</sup> )	Net Beta (DPM/100cm <sup>2</sup> )	Net Gama (DPM/100cm <sup>2</sup> )	Unity	Comment
1	B01	1	526	9276	-1.8	58	267	-13.8	767	3,712	0.08	<DCGL
2	B01	2	565	8225	-0.8	97	-784	-6.2	1,287	-10,885	-0.18	<DCGL
3	B01	2	561	9871	-0.8	93	862	-6.2	1,233	11,976	0.38	<DCGL
4	B01	2	540	8441	-0.8	72	-568	-6.2	954	-7,885	-0.14	<DCGL
5	B01	1	540	9419	-1.8	72	410	-13.8	954	5,699	0.15	<DCGL
6	B01	0	569	8667	-2.8	101	-342	-21.5	1,340	-4,746	-0.13	<DCGL
7	B01	4	515	9146	1.2	47	137	9.2	621	1,907	0.17	<DCGL
8	B01	3	503	9167	0.2	35	158	1.5	461	2,199	0.11	<DCGL
9	B01	3	565	9056	0.2	97	47	1.5	1,287	657	0.16	<DCGL
10	B01	2	524	9306	-0.8	56	297	-6.2	741	4,129	0.14	<DCGL
11	B01	2	555	9273	-0.8	87	264	-6.2	1,154	3,671	0.17	<DCGL
12	B01	3	548	8922	0.2	80	-87	1.5	1,060	-1,204	0.09	<DCGL
13	B01	0	574	8928	-2.8	106	-81	-21.5	1,407	-1,121	-0.03	<DCGL
14	B01	0	560	9545	-2.8	92	536	-21.5	1,220	7,449	0.16	<DCGL
15	B01	1	582	9366	-1.8	114	357	-13.8	1,513	4,962	0.18	<DCGL
Survey Unit QA		Alpha	Beta	Gamma	Survey Unit 5		Alpha dpm/100cm <sup>2</sup>	Beta dpm/100cm <sup>2</sup>	Gamma dpm/100cm <sup>2</sup>			
Crawlspace		236964	236964	192611	Gross DCGL		150	10,000	40,000			
Surface		Background (CPM)										
Ambient (B01)		3	466	9096								
Meter Efficiency		10.46%	5.42%	7.46%								
Survey Unit 5 - Crawlspace												
Sample	Type	Gross Alpha (CPM)	Gross Beta (CPM)	Gross Gamma (CPM)	Net Alpha CPM	Net Beta CPM	Net Gamma CPM	Net Alpha (DPM/100cm <sup>2</sup> )	Net Beta (DPM/100cm <sup>2</sup> )	Net Gama (DPM/100cm <sup>2</sup> )	Unity	Comment
1	B01	2	493	9117	-0.8	25	108	-6.1	454	1,452	0.04	<DCGL
2	B01	1	527	8528	-1.8	59	-481	-13.7	1,081	-6,444	-0.14	<DCGL
3	B01	3	456	9001	0.2	-12	-8	1.5	-229	-103	-0.02	<DCGL
4	B01	1	581	8743	-1.8	113	-266	-13.7	2,077	-3,562	0.03	<DCGL
5	B01	0	517	9896	-2.8	49	887	-21.2	897	11,894	0.25	<DCGL
6	B01	1	581	9915	-1.8	113	906	-13.7	2,077	12,149	0.42	<DCGL
7	B01	3	448	8857	0.2	-20	-152	1.5	-376	-2,034	-0.08	<DCGL

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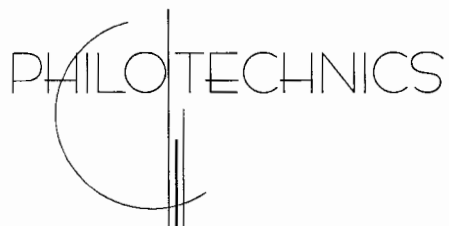
## Appendix F

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**CDC**

**RAW Room #1**

## **Final Status Survey Report Appendix**



Prepared by:  
Philotechnics, Ltd.  
201 Renovare Blvd.  
Oak Ridge, TN 37830

## **Appendix G – Wipe Survey Data**

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

Appendix G

Survey Unit 1	Instrument				
	Protean- 0713821		LSC - 7065636		
	Alpha	Beta	Chan A	Chan B	I-125
Background (CPM)	0.1	61.5	11.5	11.5	10.9
MDC Value	6.6	124.5	26.9	30.0	37.6
Meter Efficiency	7.9%	6.1%	61.1%	96.2%	50.0%

Survey Unit 1 - Floor and Lower Walls

Sample	Gross CPM / 100 cm <sup>2</sup>					Quench & Efficiency		Net DPM / 100 cm <sup>2</sup>					Comment
	Alpha Planchet	Beta Planchet	Chan A Scint	Chan B Scint	Chan C Scint	H-3 Eff.	C-14 Eff.	Alpha Planchet	Beta Planchet	H-3	C-14/S-35	I-125	
1	0	55	15	13	12	61.1%	96.2%	-1.5	-105.6	5.7	1.6	8.2	<DCGL
2	0	72	5	16	15	61.1%	96.2%	-1.5	171.3	-10.6	4.7	-11.8	<DCGL
3	1	70	8	12	8	61.1%	96.2%	11.2	138.7	-5.7	0.5	-5.8	<DCGL
4	0	56	11	11	14	61.1%	96.2%	-1.5	-89.3	-0.8	-0.5	0.2	<DCGL
5	1	70	12	16	5	61.1%	96.2%	11.2	138.7	0.8	4.7	2.2	<DCGL
6	0	77	9	9	9	61.1%	96.2%	-1.5	252.7	-4.1	-2.6	-3.8	<DCGL
7	1	76	5	15	14	61.1%	96.2%	11.2	236.4	-10.6	3.6	-11.8	<DCGL
8	0	57	5	14	8	61.1%	96.2%	-1.5	-73.0	-10.6	2.6	-11.8	<DCGL
9	1	75	11	9	4	61.1%	96.2%	11.2	220.1	-0.8	-2.6	0.2	<DCGL
10	1	63	10	16	5	61.1%	96.2%	11.2	24.7	-2.5	4.7	-1.8	<DCGL
11	0	59	9	16	10	61.1%	96.2%	-1.5	-40.4	-4.1	4.7	-3.8	<DCGL
12	1	60	11	8	9	61.1%	96.2%	11.2	-24.2	-0.8	-3.6	0.2	<DCGL
13	1	62	11	8	11	61.1%	96.2%	11.2	8.4	-0.8	-3.6	0.2	<DCGL
14	1	56	11	10	14	61.1%	96.2%	11.2	-89.3	-0.8	-1.6	0.2	<DCGL
15	0	56	12	9	14	61.1%	96.2%	-1.5	-89.3	0.8	-2.6	2.2	<DCGL
16	0	69	4	16	8	61.1%	96.2%	-1.5	122.4	-12.3	4.7	-13.8	<DCGL
17	0	73	10	10	5	61.1%	96.2%	-1.5	187.6	-2.5	-1.6	-1.8	<DCGL
18	1	76	12	15	10	61.1%	96.2%	11.2	236.4	0.8	3.6	2.2	<DCGL
19	0	67	8	13	4	61.1%	96.2%	-1.5	89.8	-5.7	1.6	-5.8	<DCGL
20	1	57	8	10	8	61.1%	96.2%	11.2	-73.0	-5.7	-1.6	-5.8	<DCGL
21	1	78	6	15	13	61.1%	96.2%	11.2	269.0	-9.0	3.6	-9.8	<DCGL
22	1	57	7	15	15	61.1%	96.2%	11.2	-73.0	-7.4	3.6	-7.8	<DCGL
23	0	63	15	14	8	61.1%	96.2%	-1.5	24.7	5.7	2.6	8.2	<DCGL
24	0	79	7	10	11	61.1%	96.2%	-1.5	285.3	-7.4	-1.6	-7.8	<DCGL
25	0	70	10	14	9	61.1%	96.2%	-1.5	138.7	-2.5	2.6	-1.8	<DCGL
26	1	64	4	15	12	61.1%	96.2%	11.2	41.0	-12.3	3.6	-13.8	<DCGL
27	0	67	15	9	14	61.1%	96.2%	-1.5	89.8	5.7	-2.6	8.2	<DCGL
28	1	72	8	14	5	61.1%	96.2%	11.2	171.3	-5.7	2.6	-5.8	<DCGL
29	1	71	8	13	6	61.1%	96.2%	11.2	155.0	-5.7	1.6	-5.8	<DCGL
30	0	68	14	14	14	61.1%	96.2%	-1.5	106.1	4.1	2.6	6.2	<DCGL
31	1	77	7	9	15	61.1%	96.2%	11.2	252.7	-7.4	-2.6	-7.8	<DCGL
32	1	74	11	11	11	61.1%	96.2%	11.2	203.9	-0.8	-0.5	0.2	<DCGL
33	1	56	9	12	8	61.1%	96.2%	11.2	-89.3	-4.1	0.5	-3.8	<DCGL
34	0	60	9	15	14	61.1%	96.2%	-1.5	-24.2	-4.1	3.6	-3.8	<DCGL
35	1	79	7	13	5	61.1%	96.2%	11.2	285.3	-7.4	1.6	-7.8	<DCGL
36	0	57	13	8	8	61.1%	96.2%	-1.5	-73.0	2.5	-3.6	4.2	<DCGL
37	1	70	15	11	10	61.1%	96.2%	11.2	138.7	5.7	-0.5	8.2	<DCGL
38	0	55	13	13	14	61.1%	96.2%	-1.5	-105.6	2.5	1.6	4.2	<DCGL
39	1	58	8	12	7	61.1%	96.2%	11.2	-56.7	-5.7	0.5	-5.8	<DCGL
40	0	79	9	15	5	61.1%	96.2%	-1.5	285.3	-4.1	3.6	-3.8	<DCGL
41	0	62	4	16	9	61.1%	96.2%	-1.5	8.4	-12.3	4.7	-13.8	<DCGL

**Philotechnics Analytical Worksheet**  
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**Centers for Disease Control and Prevention**

Appendix G

Survey Unit 2	Instrument				
	Protean		LSC - 7065636		
	Alpha	Beta	Chan A	Chan B	I-125
Background (CPM)	0.1	61.5	11.5	11.5	10.9
MDC Value	6.6	124.5	26.9	30.0	37.6
Meter Efficiency	7.9%	6.1%	61.1%	96.2%	50.0%

Survey Unit 2 - Ceiling and Upper Walls

Sample	Gross CPM / 100 cm <sup>2</sup>					Quench & Efficiency		Net DPM / 100 cm <sup>2</sup>					Comment
	Alpha Planchet	Beta Planchet	Chan A Scint	Chan B Scint	Chan C Scint	H-3 Eff.	C-14 Eff.	Alpha Planchet	Beta Planchet	H-3	C-14/S-35	I-125	
1	1	69	14	16	14	61.1%	96.2%	11.2	122.4	4.1	4.7	6.2	<DCGL
2	0	59	5	8	9	61.1%	96.2%	-1.5	-40.4	-10.6	-3.6	-11.8	<DCGL
3	0	64	7	14	11	61.1%	96.2%	-1.5	41.0	-7.4	2.6	-7.8	<DCGL
4	0	70	12	13	10	61.1%	96.2%	-1.5	138.7	0.8	1.6	2.2	<DCGL
5	1	61	6	15	5	61.1%	96.2%	11.2	-7.9	-9.0	3.6	-9.8	<DCGL
6	0	60	11	16	6	61.1%	96.2%	-1.5	-24.2	-0.8	4.7	0.2	<DCGL
7	1	75	15	10	8	61.1%	96.2%	11.2	220.1	5.7	-1.6	8.2	<DCGL
8	0	71	15	14	7	61.1%	96.2%	-1.5	155.0	5.7	2.6	8.2	<DCGL
9	1	78	8	10	4	61.1%	96.2%	11.2	269.0	-5.7	-1.6	-5.8	<DCGL
10	1	70	15	11	14	61.1%	96.2%	11.2	138.7	5.7	-0.5	8.2	<DCGL
11	0	69	4	12	7	61.1%	96.2%	-1.5	122.4	-12.3	0.5	-13.8	<DCGL
12	1	63	13	12	5	61.1%	96.2%	11.2	24.7	2.5	0.5	4.2	<DCGL
13	1	66	5	8	11	61.1%	96.2%	11.2	73.6	-10.6	-3.6	-11.8	<DCGL
14	0	60	10	16	13	61.1%	96.2%	-1.5	-24.2	-2.5	4.7	-1.8	<DCGL
15	1	56	11	9	5	61.1%	96.2%	11.2	-89.3	-0.8	-2.6	0.2	<DCGL
16	0	70	13	12	7	61.1%	96.2%	-1.5	138.7	2.5	0.5	4.2	<DCGL
17	1	71	8	8	13	61.1%	96.2%	11.2	155.0	-5.7	-3.6	-5.8	<DCGL
18	0	76	7	14	13	61.1%	96.2%	-1.5	236.4	-7.4	2.6	-7.8	<DCGL
19	0	71	9	16	9	61.1%	96.2%	-1.5	155.0	-4.1	4.7	-3.8	<DCGL
20	1	75	5	15	6	61.1%	96.2%	11.2	220.1	-10.6	3.6	-11.8	<DCGL
21	0	67	9	16	13	61.1%	96.2%	-1.5	89.8	-4.1	4.7	-3.8	<DCGL
22	1	64	11	13	10	61.1%	96.2%	11.2	41.0	-0.8	1.6	0.2	<DCGL
23	1	67	12	11	6	61.1%	96.2%	11.2	89.8	0.8	-0.5	2.2	<DCGL
24	1	75	11	13	14	61.1%	96.2%	11.2	220.1	-0.8	1.6	0.2	<DCGL
25	0	78	6	15	14	61.1%	96.2%	-1.5	269.0	-9.0	3.6	-9.8	<DCGL
26	0	64	7	13	4	61.1%	96.2%	-1.5	41.0	-7.4	1.6	-7.8	<DCGL
27	1	77	12	9	13	61.1%	96.2%	11.2	252.7	0.8	-2.6	2.2	<DCGL
28	1	74	10	11	11	61.1%	96.2%	11.2	203.9	-2.5	-0.5	-1.8	<DCGL
29	1	69	11	11	4	61.1%	96.2%	11.2	122.4	-0.8	-0.5	0.2	<DCGL
30	0	72	9	13	15	61.1%	96.2%	-1.5	171.3	-4.1	1.6	-3.8	<DCGL
31	0	69	14	10	15	61.1%	96.2%	-1.5	122.4	4.1	-1.6	6.2	<DCGL
32	1	68	11	9	12	61.1%	96.2%	11.2	106.1	-0.8	-2.6	0.2	<DCGL
33	1	70	13	16	11	61.1%	96.2%	11.2	138.7	2.5	4.7	4.2	<DCGL
34	1	75	14	10	13	61.1%	96.2%	11.2	220.1	4.1	-1.6	6.2	<DCGL
35	1	77	15	13	5	61.1%	96.2%	11.2	252.7	5.7	1.6	8.2	<DCGL
36	1	55	8	12	13	61.1%	96.2%	11.2	-105.6	-5.7	0.5	-5.8	<DCGL
37	0	73	5	10	7	61.1%	96.2%	-1.5	187.6	-10.6	-1.6	-11.8	<DCGL
38	0	75	8	8	9	61.1%	96.2%	-1.5	220.1	-5.7	-3.6	-5.8	<DCGL
39	1	77	8	14	7	61.1%	96.2%	11.2	252.7	-5.7	2.6	-5.8	<DCGL
40	1	71	15	12	14	61.1%	96.2%	11.2	155.0	5.7	0.5	8.2	<DCGL
41	0	63	14	15	5	61.1%	96.2%	-1.5	24.7	4.1	3.6	6.2	<DCGL
42	1	65	6	8	4	61.1%	96.2%	11.2	57.3	-9.0	-3.6	-9.8	<DCGL
43	1	60	5	8	14	61.1%	96.2%	11.2	-24.2	-10.6	-3.6	-11.8	<DCGL
44	1	61	13	14	5	61.1%	96.2%	11.2	-7.9	2.5	2.6	4.2	<DCGL
45	1	61	4	11	5	61.1%	96.2%	11.2	-7.9	-12.3	-0.5	-13.8	<DCGL
46	0	70	4	8	12	61.1%	96.2%	-1.5	138.7	-12.3	-3.6	-13.8	<DCGL
47	1	66	10	10	8	61.1%	96.2%	11.2	73.6	-2.5	-1.6	-1.8	<DCGL

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

Appendix G

Survey Unit 3	Instrument				
	Protean		LSC - 7065836		
	Alpha	Beta	Chan A	Chan B	I-125
Background (CPM)	0.1	61.5	11.5	11.5	10.9
MDC Value	6.6	124.5	26.9	30.0	37.6
Meter Efficiency	7.9%	6.1%	61.1%	96.2%	50.0%

Survey Unit 3 - Loading Dock

Sample	Gross CPM / 100 cm <sup>2</sup>					Quench & Efficiency		Net DPM / 100 cm <sup>2</sup>					Comment
	Alpha Planchet	Beta Planchet	Chan A Scint	Chan B Scint	Chan C Scint	H-3 Eff.	C-14 Eff.	Alpha Planchet	Beta Planchet	H-3	C-14/S-35	I-125	
1	0	58	8	16	6	61.1%	96.2%	-1.5	-56.7	-5.7	4.7	-5.8	<DCGL
2	1	56	6	15	10	61.1%	96.2%	11.2	-89.3	-9.0	3.6	-9.8	<DCGL
3	0	78	10	11	9	61.1%	96.2%	-1.5	269.0	-2.5	-0.5	-1.8	<DCGL
4	1	78	10	9	12	61.1%	96.2%	11.2	269.0	-2.5	-2.6	-1.8	<DCGL
5	1	72	13	11	4	61.1%	96.2%	11.2	171.3	2.5	-0.5	4.2	<DCGL
6	0	67	15	16	15	61.1%	96.2%	-1.5	89.8	5.7	4.7	8.2	<DCGL
7	0	57	7	8	9	61.1%	96.2%	-1.5	-73.0	-7.4	-3.6	-7.8	<DCGL
8	1	60	17	13	6	61.1%	96.2%	11.2	-24.2	9.0	1.6	12.2	<DCGL
9	0	58	6	11	4	61.1%	96.2%	-1.5	-56.7	-9.0	-0.5	-9.8	<DCGL
10	1	56	9	12	4	61.1%	96.2%	11.2	-89.3	-4.1	0.5	-3.8	<DCGL
11	0	64	12	8	11	61.1%	96.2%	-1.5	41.0	0.8	-3.6	2.2	<DCGL
12	1	66	6	11	6	61.1%	96.2%	11.2	73.6	-9.0	-0.5	-9.8	<DCGL
13	0	67	13	14	4	61.1%	96.2%	-1.5	89.8	2.5	2.6	4.2	<DCGL
14	0	61	7	13	11	61.1%	96.2%	-1.5	-7.9	-7.4	1.6	-7.8	<DCGL
15	0	65	13	9	9	61.1%	96.2%	-1.5	57.3	2.5	-2.6	4.2	<DCGL

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

Appendix G

Survey Unit 4	Instrument				
	Protean		LSC - 7065636		
	Alpha	Beta	Chan A	Chan B	I-125
Background (CPM)	0.1	61.5	11.5	11.5	10.9
MDC Value	6.6	124.5	26.9	30.0	37.6
Meter Efficiency	7.9%	6.1%	61.1%	96.2%	50.0%

**Survey Unit 4 - Incinerator Room**

Sample	Gross CPM / 100 cm <sup>2</sup>					Quench & Efficiency		Net DPM / 100 cm <sup>2</sup>					Comment
	Alpha Planchet	Beta Planchet	Chan A Scint	Chan B Scint	Chan C Scint	H-3 Eff.	C-14 Eff.	Alpha Planchet	Beta Planchet	H-3	C-14/S-35	I-125	
1	2	69	6	14	8	61.1%	96.2%	23.8	122.4	-9.0	2.6	-9.8	<DCGL
2	1	77	10	10	5	61.1%	96.2%	11.2	252.7	-2.5	-1.6	-1.8	<DCGL
3	1	71	11	8	4	61.1%	96.2%	11.2	155.0	-0.8	-3.6	0.2	<DCGL
4	0	73	9	16	4	61.1%	96.2%	-1.5	187.6	-4.1	4.7	-3.8	<DCGL
5	0	61	12	13	6	61.1%	96.2%	-1.5	-7.9	0.8	1.6	2.2	<DCGL
6	1	77	9	15	10	61.1%	96.2%	11.2	252.7	-4.1	3.6	-3.8	<DCGL
7	0	59	17	12	15	61.1%	96.2%	-1.5	-40.4	9.0	0.5	12.2	<DCGL
8	1	71	7	14	11	61.1%	96.2%	11.2	155.0	-7.4	2.6	-7.8	<DCGL
9	0	75	10	10	4	61.1%	96.2%	-1.5	220.1	-2.5	-1.6	-1.8	<DCGL
10	0	73	9	13	8	61.1%	96.2%	-1.5	187.6	-4.1	1.6	-3.8	<DCGL
11	0	59	13	14	7	61.1%	96.2%	-1.5	-40.4	2.5	2.6	4.2	<DCGL
12	0	57	8	12	6	61.1%	96.2%	-1.5	-73.0	-5.7	0.5	-5.8	<DCGL
13	1	61	11	15	4	61.1%	96.2%	11.2	-7.9	-0.8	3.6	0.2	<DCGL
14	0	68	6	8	12	61.1%	96.2%	-1.5	106.1	-9.0	-3.6	-9.8	<DCGL
15	1	60	16	11	7	61.1%	96.2%	11.2	-24.2	7.4	-0.5	10.2	<DCGL



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

Appendix G

Survey Unit 5	Instrument				
	Protean		LSC - 7065636		
	Alpha	Beta	Chan A	Chan B	I-125
Background (CPM)	0.1	61.5	11.5	11.5	10.9
MDC Value	6.6	124.5	26.9	30.0	37.6
Meter Efficiency	7.9%	6.1%	61.1%	96.2%	50.0%

Survey Unit 5 - Crawlspace

Sample	Gross CPM / 100 cm <sup>2</sup>					Quench & Efficiency		Net DPM / 100 cm <sup>2</sup>					Comment
	Alpha Planchet	Beta Planchet	Chan A Scint	Chan B Scint	Chan C Scint	H-3 Eff.	C-14 Eff.	Alpha Planchet	Beta Planchet	H-3	C-14/S-35	I-125	
1	1	69	17	15	7	61.1%	96.2%	11.2	122.4	9.0	3.6	12.2	<DCGL
2	1	67	9	17	13	61.1%	96.2%	11.2	89.8	-4.1	5.7	-3.8	<DCGL
3	2	77	16	14	9	61.1%	96.2%	23.8	252.7	7.4	2.6	10.2	<DCGL
4	2	75	11	17	14	61.1%	96.2%	23.8	220.1	-0.8	5.7	0.2	<DCGL
5	0	72	13	8	6	61.1%	96.2%	-1.5	171.3	2.5	-3.6	4.2	<DCGL
6	0	68	16	9	13	61.1%	96.2%	-1.5	106.1	7.4	-2.6	10.2	<DCGL
7	0	70	8	15	9	61.1%	96.2%	-1.5	138.7	-5.7	3.6	-5.8	<DCGL
8	2	64	14	13	15	61.1%	96.2%	23.8	41.0	4.1	1.6	6.2	<DCGL
9	2	65	10	14	9	61.1%	96.2%	23.8	57.3	-2.5	2.6	-1.8	<DCGL
10	1	62	12	16	8	61.1%	96.2%	11.2	8.4	0.8	4.7	2.2	<DCGL
11	0	74	10	14	8	61.1%	96.2%	-1.5	203.9	-2.5	2.6	-1.8	<DCGL
12	2	61	15	17	14	61.1%	96.2%	23.8	-7.9	5.7	5.7	8.2	<DCGL
13	1	76	17	16	5	61.1%	96.2%	11.2	236.4	9.0	4.7	12.2	<DCGL
14	0	78	7	15	16	61.1%	96.2%	-1.5	269.0	-7.4	3.6	-7.8	<DCGL
15	2	74	13	11	9	61.1%	96.2%	23.8	203.9	2.5	-0.5	4.2	<DCGL

Survey Unit QA	Instrument				
	Protean		LSC - 7065636		
	Alpha	Beta	Chan A	Chan B	I-125
Background (CPM)	0.1	61.5	11.5	11.5	10.9
MDC Value	6.6	124.5	26.9	30.0	37.6
Meter Efficiency	7.9%	6.1%	61.1%	96.2%	50.0%

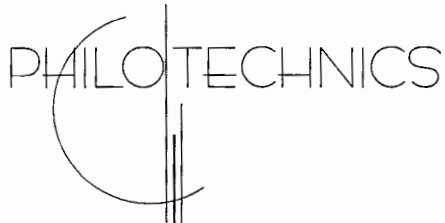
Survey Unit 5 - Crawlspace

Sample	Gross CPM / 100 cm <sup>2</sup>					Quench & Efficiency		Net DPM / 100 cm <sup>2</sup>					Comment
	Alpha Planchet	Beta Planchet	Chan A Scint	Chan B Scint	Chan C Scint	H-3 Eff.	C-14 Eff.	Alpha Planchet	Beta Planchet	H-3	C-14/S-35	I-125	
1	1	69	17	15	7	61.1%	96.2%	11.2	122.4	9.0	3.6	12.2	<DCGL
2	1	67	9	17	13	61.1%	96.2%	11.2	89.8	-4.1	5.7	-3.8	<DCGL
3	1	77	16	14	9	61.1%	96.2%	11.2	252.7	7.4	2.6	10.2	<DCGL
4	1	75	11	17	14	61.1%	96.2%	11.2	220.1	-0.8	5.7	0.2	<DCGL
5	0	72	13	8	6	61.1%	96.2%	-1.5	171.3	2.5	-3.6	4.2	<DCGL
6	0	68	16	9	13	61.1%	96.2%	-1.5	106.1	7.4	-2.6	10.2	<DCGL
7	0	70	8	15	9	61.1%	96.2%	-1.5	138.7	-5.7	3.6	-5.8	<DCGL
8	1	64	14	13	15	61.1%	96.2%	11.2	41.0	4.1	1.6	6.2	<DCGL
9	1	65	10	14	9	61.1%	96.2%	11.2	57.3	-2.5	2.6	-1.8	<DCGL
10	1	62	12	16	8	61.1%	96.2%	11.2	8.4	0.8	4.7	2.2	<DCGL
11	0	74	10	14	8	61.1%	96.2%	-1.5	203.9	-2.5	2.6	-1.8	<DCGL
12	1	61	15	17	14	61.1%	96.2%	11.2	-7.9	5.7	5.7	8.2	<DCGL
13	1	76	17	16	5	61.1%	96.2%	11.2	236.4	9.0	4.7	12.2	<DCGL
14	0	78	7	15	16	61.1%	96.2%	-1.5	269.0	-7.4	3.6	-7.8	<DCGL
15	1	74	13	11	9	61.1%	96.2%	11.2	203.9	2.5	-0.5	4.2	<DCGL

**CDC**

**RAW Room #1**

**Final Status Survey Report Appendix**



Prepared by:  
Philotechnics, Ltd.  
201 Renovare Blvd.  
Oak Ridge, TN 37830

**Appendix H.1 –  
RESRAD Build Results with 100% Removable Fraction**

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL Redo Mn54 100 percent removable.bld

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Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL Redo Mn54 100 percent removable.bld

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Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL Redo Mn54 100 percent removable.bld

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RESRAD-BUILD Input Parameters

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Number of Sources : 6  
 Number of Receptors: 1  
 Total Time : 3.650000E+02 days  
 Fraction Inside : 2.300000E-01

---

Receptor Information

---

Receptor	Room	x [m]	y [m]	z [m]	FracTime	Inhalation [m3/day]	Ingestion(Dust) [m2/hr]
1	1	1.600	2.800	1.000	1.000	1.80E+01	1.12E-04

---

Receptor-Source Shielding Relationship

---

Receptor	Source	Density [g/cm3]	Thickness [cm]	Material
1	1	2.40E+00	0.00E+00	Concrete
1	2	2.40E+00	0.00E+00	Concrete
1	3	2.40E+00	0.00E+00	Concrete
1	4	2.40E+00	0.00E+00	Concrete
1	5	2.40E+00	0.00E+00	Concrete
1	6	2.40E+00	0.00E+00	Concrete

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL Redo Mn54 100 percent removable.bld

===== Building Information =====

Building Air Exchange Rate: 8.00E-01 1/hr

Height[m]	Air Exchanges [m3/hr]	
Area [m2]		
	*****	
	*	*
	*	*
	*	<=Q01: 5.76E+01
H1: 4.000	* Room 1	* Q10 : 5.76E+01
	* LAMBDA: 8.00E-01	*
Area 18.000	*	*
	*	*
	*****	

Deposition velocity: 1.00E-02 [m/s] Resuspension Rate: 3.70E-06 [1/s]

===== Source Information =====

Source: 1  
 Location:: Room : 1 x: 1.60 y: 2.80 z: 0.00[m]  
 Geometry:: Type: Area Length[m]:3.20E+00 Width[m]:5.60E+00 Direction: z  
 Pathway ::  
     Direct Ingestion Rate: 3.060E-06 [1/hr]  
     Fraction released to air: 3.570E-01  
     Removable fraction: 1.000E+00  
     Time to Remove: 1.000E+04 [day]  
  
     Radon Release Fraction: 1.000E-01

Contamination::				
Nuclide Concentration		Dose Conversion Factor (Library: FGR 11)		
		Ingestion	Inhalation	Submersion
	[dpm/m2]	[mrem/dpm]	[mrem/dpm]	[mrem/yr/ (dpm/m3)]
TH-232	2.460E+03	1.230E-03	7.387E-01	4.588E-07
TH-228	0.000E+00	3.642E-04	1.556E-01	4.224E-03
RA-228	0.000E+00	6.496E-04	2.287E-03	2.515E-03
CO-60	3.390E+05	1.212E-05	9.865E-05	6.629E-03
MN-54	1.470E+06	1.248E-06	3.018E-06	2.152E-03
H-3	9.000E+02	2.883E-08	2.883E-08	1.741E-08

Source: 2  
 Location:: Room : 1 x: 1.60 y: 2.80 z: 4.00[m]  
 Geometry:: Type: Area Length[m]:3.20E+00 Width[m]:5.60E+00 Direction: z  
 Pathway ::  
     Direct Ingestion Rate: 3.060E-06 [1/hr]  
     Fraction released to air: 3.570E-01  
     Removable fraction: 1.000E+00  
     Time to Remove: 1.000E+04 [day]  
  
     Radon Release Fraction: 1.000E-01

Contamination::				
Nuclide Concentration		Dose Conversion Factor (Library: FGR 11)		
		Ingestion	Inhalation	Submersion
	[dpm/m2]	[mrem/dpm]	[mrem/dpm]	[mrem/yr/ (dpm/m3)]

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL Redo Mn54 100 percent removable.bld

TH-232	2.460E+03	1.230E-03	7.387E-01	4.588E-07
TH-228	0.000E+00	3.642E-04	1.556E-01	4.224E-03
AC-227	1.000E+00	6.665E-03	3.029E+00	9.734E-04
RA-228	0.000E+00	6.496E-04	2.287E-03	2.515E-03
CO-60	3.390E+05	1.212E-05	9.865E-05	6.629E-03
MN-54	1.470E+06	1.248E-06	3.018E-06	2.152E-03
H-3	9.000E+02	2.883E-08	2.883E-08	1.741E-08

Source: 3

Location:: Room : 1 x: 0.00 y: 2.80 z: 2.00[m]

Geometry:: Type: Area Length[m]:5.60E+00 Width[m]:4.00E+00 Direction: x

Pathway ::

Direct Ingestion Rate: 3.060E-06 [l/hr]  
 Fraction released to air: 3.570E-01  
 Removable fraction: 1.000E+00  
 Time to Remove: 1.000E+04 [day]

Radon Release Fraction: 1.000E-01

Contamination::

Nuclide Concentration Dose Conversion Factor (Library: EGR 11)

		Ingestion	Inhalation	Submersion
	[dpm/m2]	[mrem/dpm]	[mrem/dpm]	[mrem/yr/ (dpm/m3)]
TH-232	2.460E+03	1.230E-03	7.387E-01	4.588E-07
TH-228	0.000E+00	3.642E-04	1.556E-01	4.224E-03
RA-228	0.000E+00	6.496E-04	2.287E-03	2.515E-03
CO-60	3.390E+05	1.212E-05	9.865E-05	6.629E-03
MN-54	1.470E+06	1.248E-06	3.018E-06	2.152E-03
H-3	9.000E+02	2.883E-08	2.883E-08	1.741E-08



Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL Redo Mn54 100 percent removable.bld

Source: 4

Location:: Room : 1 x: 3.20 y: 2.80 z: 2.00[m]  
 Geometry:: Type: Area Length[m]:5.60E+00 Width[m]:4.00E+00 Direction: x  
 Pathway ::  
 Direct Ingestion Rate: 3.060E-06 [1/hr]  
 Fraction released to air: 3.570E-01  
 Removable fraction: 1.000E+00  
 Time to Remove: 1.000E+04 [day]  
 Radon Release Fraction: 1.000E-01

Contamination::

Nuclide Concentration Dose Conversion Factor (Library: FGR 11)

		Ingestion	Inhalation	Submersion
	[dpm/m2]	[mrem/dpm]	[mrem/dpm]	[mrem/yr/ (dpm/m3)]
TH-232	2.460E+03	1.230E-03	7.387E-01	4.588E-07
TH-228	0.000E+00	3.642E-04	1.556E-01	4.224E-03
RA-228	0.000E+00	6.496E-04	2.287E-03	2.515E-03
CO-60	3.390E+05	1.212E-05	9.865E-05	6.629E-03
MN-54	1.470E+06	1.248E-06	3.018E-06	2.152E-03
H-3	9.000E+02	2.883E-08	2.883E-08	1.741E-08

Source: 5

Location:: Room : 1 x: 1.60 y: 0.00 z: 2.00[m]  
 Geometry:: Type: Area Length[m]:3.20E+00 Width[m]:4.00E+00 Direction: y  
 Pathway ::  
 Direct Ingestion Rate: 3.060E-06 [1/hr]  
 Fraction released to air: 3.570E-01  
 Removable fraction: 1.000E+00  
 Time to Remove: 1.000E+04 [day]  
 Radon Release Fraction: 1.000E-01

Contamination::

Nuclide Concentration Dose Conversion Factor (Library: FGR 11)

		Ingestion	Inhalation	Submersion
	[dpm/m2]	[mrem/dpm]	[mrem/dpm]	[mrem/yr/ (dpm/m3)]
TH-232	2.460E+03	1.230E-03	7.387E-01	4.588E-07
TH-228	0.000E+00	3.642E-04	1.556E-01	4.224E-03
RA-228	0.000E+00	6.496E-04	2.287E-03	2.515E-03

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL Redo Mn54 100 percent removable.bld

CO-60	3.390E+05	1.212E-05	9.865E-05	6.629E-03
MN-54	1.470E+06	1.248E-06	3.018E-06	2.152E-03
H-3	9.000E+02	2.883E-08	2.883E-08	1.741E-08

Source: 6

Location:: Room : 1 x: 1.60 y: 5.60 z: 2.00[m]

Geometry:: Type: Area Length[m]:3.20E+00 Width[m]:4.00E+00 Direction: y

Pathway ::

Direct Ingestion Rate: 3.060E-06 [1/hr]

Fraction released to air: 3.570E-01

Removable fraction: 1.000E+00

Time to Remove: 1.000E+04 [day]

Radon Release Fraction: 1.000E-01

Contamination::

Nuclide Concentration Dose Conversion Factor (Library: FGR 11)

		Ingestion	Inhalation	Submersion
	[dpm/m2]	[mrem/dpm]	[mrem/dpm]	[mrem/yr/ (dpm/m3)]
TH-232	2.460E+03	1.230E-03	7.387E-01	4.588E-07
TH-228	0.000E+00	3.642E-04	1.556E-01	4.224E-03
RA-228	0.000E+00	6.496E-04	2.287E-03	2.515E-03
CO-60	3.390E+05	1.212E-05	9.865E-05	6.629E-03
MN-54	1.470E+05	1.248E-06	3.018E-06	2.152E-03
H-3	9.000E+02	2.883E-08	2.883E-08	1.741E-08

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL Redo Mn54 100 percent removable.bld

Evaluation Time: 0.00000000E+00 years

```

=====
Assessment for Time: 1
Time =0.00E+00 yr
=====

```

===== Source Information =====

Source: 1

Location:: Room : 1 x: 1.60 y: 2.80 z: 0.00 [m]

Geometry:: Type: Area Length[m]:3.20E+00 Width[m]:5.60E+00 Direction: z

Pathway ::

Direct Ingestion Rate: 3.060E-06 [1/hr]

Fraction released to air: 3.570E-01

Removable fraction: 1.000E+00

Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	2.460E+03
	TH-228	0.000E+00
	RA-228	0.000E+00
	CO-60	3.390E+05
	MN-54	1.470E+06
	H-3	9.000E+02

Source: 2

Location:: Room : 1 x: 1.60 y: 2.80 z: 4.00 [m]

Geometry:: Type: Area Length[m]:3.20E+00 Width[m]:5.60E+00 Direction: z

Pathway ::

Direct Ingestion Rate: 3.060E-06 [1/hr]

Fraction released to air: 3.570E-01

Removable fraction: 1.000E+00

Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	2.460E+03
	TH-228	0.000E+00
	AC-227	1.000E+00
	RA-228	0.000E+00
	CO-60	3.390E+05

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL Redo Mn54 100 percent removable.bld

Evaluation Time: 0.0000000E+00 years

MN-54	1.470E+06
H-3	9.000E+02

Source: 3

Location:: Room : 1 x: 0.00 y: 2.80 z: 2.00 [m]

Geometry:: Type: Area Length[m]:5.60E+00 Width[m]:4.00E+00 Direction: x

Pathway ::

Direct Ingestion Rate:	3.060E-06 [1/hr]
Fraction released to air:	3.570E-01
Removable fraction:	1.000E+00
Time to Remove:	1.000E+04 [day]

Contamination::	Nuclide	Concentration
		[dpm/m2]
	TH-232	2.460E+03
	TH-228	0.000E+00
	RA-228	0.000E+00
	CO-60	3.390E+05
	MN-54	1.470E+06
	H-3	9.000E+02

Source: 4

Location:: Room : 1 x: 3.20 y: 2.80 z: 2.00 [m]

Geometry:: Type: Area Length[m]:5.60E+00 Width[m]:4.00E+00 Direction: x

Pathway ::

Direct Ingestion Rate:	3.060E-06 [1/hr]
Fraction released to air:	3.570E-01
Removable fraction:	1.000E+00
Time to Remove:	1.000E+04 [day]

Contamination::	Nuclide	Concentration
		[dpm/m2]
	TH-232	2.460E+03
	TH-228	0.000E+00
	RA-228	0.000E+00
	CO-60	3.390E+05
	MN-54	1.470E+06
	H-3	9.000E+02

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL Redo Mn54 100 percent removable.bld

Evaluation Time: 0.0000000E+00 years

Source: 5

Location:: Room : 1 x: 1.60 y: 0.00 z: 2.00 [m]

Geometry:: Type: Area Length[m]:3.20E+00 Width[m]:4.00E+00 Direction: y

Pathway ::

Direct Ingestion Rate: 3.060E-06 [1/hr]

Fraction released to air: 3.570E-01

Removable fraction: 1.000E+00

Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	2.460E+03
	TH-228	0.000E+00
	RA-228	0.000E+00
	CO-60	3.390E+05
	MN-54	1.470E+06
	H-3	9.000E+02

Source: 6

Location:: Room : 1 x: 1.60 y: 5.60 z: 2.00 [m]

Geometry:: Type: Area Length[m]:3.20E+00 Width[m]:4.00E+00 Direction: y

Pathway ::

Direct Ingestion Rate: 3.060E-06 [1/hr]

Fraction released to air: 3.570E-01

Removable fraction: 1.000E+00

Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	2.460E+03
	TH-228	0.000E+00
	RA-228	0.000E+00
	CO-60	3.390E+05
	MN-54	1.470E+05
	H-3	9.000E+02

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL Redo Mn54 100 percent removable.bld

Evaluation Time: 0.00000000E+00 years

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RESRAD-BUILD Dose Tables

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Source Contributions to Receptor Doses

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[mrem]

	Source 1	Source 2	Source 3	Source 4	Source 5	Source 6	Total
Receptor 1	5.41E+00	3.03E+00	4.86E+00	4.86E+00	2.25E+00	1.84E+00	2.22E+01
Total	5.41E+00	3.03E+00	4.86E+00	4.86E+00	2.25E+00	1.84E+00	2.22E+01

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL Redo Mn54 100 percent removable.bld

Evaluation Time: 0.00000000E+00 years

Pathway Detail of Doses

[mrem]

Source: 1

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	3.21E+00	3.90E-03	4.36E-04	1.30E+00	1.54E-04	8.95E-01
Total	3.21E+00	3.90E-03	4.36E-04	1.30E+00	1.54E-04	8.95E-01

Source: 2

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	8.35E-01	3.90E-03	4.36E-04	1.30E+00	1.54E-04	8.96E-01
Total	8.35E-01	3.90E-03	4.36E-04	1.30E+00	1.54E-04	8.96E-01

Source: 3

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	2.11E+00	4.88E-03	5.45E-04	1.62E+00	1.92E-04	1.12E+00
Total	2.11E+00	4.88E-03	5.45E-04	1.62E+00	1.92E-04	1.12E+00

Source: 4

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	2.11E+00	4.88E-03	5.45E-04	1.62E+00	1.92E-04	1.12E+00
Total	2.11E+00	4.88E-03	5.45E-04	1.62E+00	1.92E-04	1.12E+00

Source: 5

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	6.86E-01	2.79E-03	3.11E-04	9.26E-01	1.10E-04	6.40E-01
Total	6.86E-01	2.79E-03	3.11E-04	9.26E-01	1.10E-04	6.40E-01

Source: 6

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	3.60E-01	1.51E-03	1.74E-04	9.25E-01	1.10E-04	5.51E-01
Total	3.60E-01	1.51E-03	1.74E-04	9.25E-01	1.10E-04	5.51E-01

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL Redo Mn54 100 percent removable.bld

Evaluation Time: 0.00000000E+00 years

# Nuclide Detail of Doses

[mrem]

Source: 1

Nuclide	Receptor	Total
	1	
TH-232	1.60E+00	1.60E+00
TH-228	2.50E-03	2.50E-03
RA-228	1.05E-02	1.05E-02
CO-60	1.96E+00	1.96E+00
MN-54	1.83E+00	1.83E+00
H-3	2.77E-06	2.77E-06

Source: 2

Nuclide	Receptor	Total
	1	
TH-232	1.60E+00	1.60E+00
TH-228	2.46E-03	2.46E-03
RA-228	1.03E-02	1.03E-02
AC-227	2.79E-03	2.79E-03
CO-60	8.37E-01	8.37E-01
MN-54	5.81E-01	5.81E-01
H-3	2.77E-06	2.77E-06

Source: 3

Nuclide	Receptor	Total
	1	
TH-232	2.00E+00	2.00E+00
TH-228	3.09E-03	3.09E-03
RA-228	1.30E-02	1.30E-02
CO-60	1.55E+00	1.55E+00
MN-54	1.29E+00	1.29E+00
H-3	3.46E-06	3.46E-06



Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL Redo Mn54 100 percent removable.bld

Evaluation Time: 0.00000000E+00 years

Source: 4

Nuclide	Receptor	Total
	1	
TH-232	2.00E+00	2.00E+00
TH-228	3.09E-03	3.09E-03
RA-228	1.30E-02	1.30E-02
CO-60	1.55E+00	1.55E+00
MN-54	1.29E+00	1.29E+00
H-3	3.46E-06	3.46E-06

Source: 5

Nuclide	Receptor	Total
	1	
TH-232	1.14E+00	1.14E+00
TH-228	1.76E-03	1.76E-03
RA-228	7.36E-03	7.36E-03
CO-60	6.40E-01	6.40E-01
MN-54	4.62E-01	4.62E-01
H-3	1.98E-06	1.98E-06

Source: 6

Nuclide	Receptor	Total
	1	
TH-232	1.14E+00	1.14E+00
TH-228	1.76E-03	1.76E-03
RA-228	7.36E-03	7.36E-03
CO-60	6.40E-01	6.40E-01
MN-54	4.62E-02	4.62E-02
H-3	1.98E-06	1.98E-06

```

===== Assessment for Time: 2 =====
===== Time =1.00E+00 yr =====

```

### Source Information

```

Location:: Room : 1 x: 1.60 y: 2.80 z: 0.00 [m]
Geometry:: Type: Area Length[m]:3.20E+00 Width[m]:5.60E+00 Direction: z
Pathway ::
    Direct Ingestion Rate: 3.060E-06 [1/hr]
    Fraction released to air: 3.570E-01
    Removable fraction: 1.000E+00
    Time to Remove: 1.000E+04 [day]

```

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	2.370E+03
	TH-228	4.425E+01
	RA-228	2.692E+02
	CO-60	2.864E+05
	MN-54	6.302E+05
	H-3	8.200E+02

```

Location:: Room : 1 x: 1.60 y: 2.80 z: 4.00 [m]
Geometry:: Type: Area Length[m]:3.20E+00 Width[m]:5.60E+00 Direction: z
Pathway ::
    Direct Ingestion Rate: 3.060E-06 [1/hr]
    Fraction released to air: 3.570E-01
    Removable fraction: 1.000E+00
    Time to Remove: 1.000E+04 [day]

```

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	2.370E+03
	TH-228	4.425E+01
	AC-227	9.333E-01
	RA-228	2.692E+02
	CO-60	2.864E+05

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL Redo Mn54 100 percent removable.bld

Evaluation Time: 1.00000000 years

MN-54	6.302E+05
H-3	8.200E+02

Source: 3

Location:: Room : 1 x: 0.00 y: 2.80 z: 2.00 [m]

Geometry:: Type: Area Length[m]:5.60E+00 Width[m]:4.00E+00 Direction: x

Pathway ::

Direct Ingestion Rate:	3.060E-06 [1/hr]
Fraction released to air:	3.570E-01
Removable fraction:	1.000E+00
Time to Remove:	1.000E+04 [day]

Contamination::	Nuclide	Concentration
		[dpm/m2]
	TH-232	2.370E+03
	TH-228	4.425E+01
	RA-228	2.692E+02
	CO-60	2.864E+05
	MN-54	6.302E+05
	H-3	8.200E+02

Source: 4

Location:: Room : 1 x: 3.20 y: 2.80 z: 2.00 [m]

Geometry:: Type: Area Length[m]:5.60E+00 Width[m]:4.00E+00 Direction: x

Pathway ::

Direct Ingestion Rate:	3.060E-06 [1/hr]
Fraction released to air:	3.570E-01
Removable fraction:	1.000E+00
Time to Remove:	1.000E+04 [day]

Contamination::	Nuclide	Concentration
		[dpm/m2]
	TH-232	2.370E+03
	TH-228	4.425E+01
	RA-228	2.692E+02
	CO-60	2.864E+05
	MN-54	6.302E+05
	H-3	8.200E+02

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL Redo Mn54 100 percent removable.bld

Evaluation Time: 1.00000000 years

Source: 5

Location:: Room : 1 x: 1.60 y: 0.00 z: 2.00 [m]

Geometry:: Type: Area Length[m]:3.20E+00 Width[m]:4.00E+00 Direction: y

Pathway ::

Direct Ingestion Rate: 3.060E-06 [1/hr]

Fraction released to air: 3.570E-01

Removable fraction: 1.000E+00

Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	2.370E+03
	TH-228	4.425E+01
	RA-228	2.692E+02
	CO-60	2.864E+05
	MN-54	6.302E+05
	H-3	8.200E+02

Source: 6

Location:: Room : 1 x: 1.60 y: 5.60 z: 2.00 [m]

Geometry:: Type: Area Length[m]:3.20E+00 Width[m]:4.00E+00 Direction: y

Pathway ::

Direct Ingestion Rate: 3.060E-06 [1/hr]

Fraction released to air: 3.570E-01

Removable fraction: 1.000E+00

Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	2.370E+03
	TH-228	4.425E+01
	RA-228	2.692E+02
	CO-60	2.864E+05
	MN-54	6.302E+04
	H-3	8.200E+02

=====

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RESRAD-BUILD Dose Tables

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Source Contributions to Receptor Doses

[mrem]							
=====							
	Source	Source	Source	Source	Source	Source	Total
	1	2	3	4	5	6	
Receptor 1	4.07E+00	2.59E+00	3.90E+00	3.90E+00	1.90E+00	1.73E+00	1.81E+01
Total	4.07E+00	2.59E+00	3.90E+00	3.90E+00	1.90E+00	1.73E+00	1.81E+01

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL Redo Mn54 100 percent removable.bld

Evaluation Time: 1.00000000 years

Pathway Detail of Doses

[mrem]

Source: 1

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	2.01E+00	2.56E-03	2.90E-04	1.30E+00	9.15E-04	7.60E-01
Total	2.01E+00	2.56E-03	2.90E-04	1.30E+00	9.15E-04	7.60E-01

Source: 2

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	5.22E-01	2.56E-03	2.90E-04	1.30E+00	9.15E-04	7.61E-01
Total	5.22E-01	2.56E-03	2.90E-04	1.30E+00	9.15E-04	7.61E-01

Source: 3

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	1.32E+00	3.21E-03	3.62E-04	1.63E+00	1.14E-03	9.50E-01
Total	1.32E+00	3.21E-03	3.62E-04	1.63E+00	1.14E-03	9.50E-01

Source: 4

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	1.32E+00	3.21E-03	3.62E-04	1.63E+00	1.14E-03	9.50E-01
Total	1.32E+00	3.21E-03	3.62E-04	1.63E+00	1.14E-03	9.50E-01

Source: 5

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	4.29E-01	1.83E-03	2.07E-04	9.30E-01	6.54E-04	5.43E-01
Total	4.29E-01	1.83E-03	2.07E-04	9.30E-01	6.54E-04	5.43E-01

Source: 6

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	2.89E-01	1.26E-03	1.46E-04	9.29E-01	6.54E-04	5.05E-01
Total	2.89E-01	1.26E-03	1.46E-04	9.29E-01	6.54E-04	5.05E-01

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL Redo Mn54 100 percent removable.bld

Evaluation Time: 1.00000000 years

# Nuclide Detail of Doses

[mrem]

Source: 1

Nuclide	Receptor	Total
	1	
TH-232	1.59E+00	1.59E+00
TH-228	1.52E-02	1.52E-02
RA-228	2.89E-02	2.89E-02
CO-60	1.65E+00	1.65E+00
MN-54	7.85E-01	7.85E-01
H-3	2.52E-06	2.52E-06

Source: 2

Nuclide	Receptor	Total
	1	
TH-232	1.59E+00	1.59E+00
TH-228	1.50E-02	1.50E-02
RA-228	2.84E-02	2.84E-02
AC-227	2.68E-03	2.68E-03
CO-60	7.07E-01	7.07E-01
MN-54	2.49E-01	2.49E-01
H-3	2.52E-06	2.52E-06

Source: 3

Nuclide	Receptor	Total
	1	
TH-232	1.98E+00	1.98E+00
TH-228	1.88E-02	1.88E-02
RA-228	3.57E-02	3.57E-02
CO-60	1.31E+00	1.31E+00
MN-54	5.53E-01	5.53E-01
H-3	3.16E-06	3.16E-06

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL Redo Mn54 100 percent removable.bld

Evaluation Time: 1.00000000 years

Source: 4

Nuclide	Receptor	Total
	1	
TH-232	1.98E+00	1.98E+00
TH-228	1.88E-02	1.88E-02
RA-228	3.57E-02	3.57E-02
CO-60	1.31E+00	1.31E+00
MN-54	5.53E-01	5.53E-01
H-3	3.16E-06	3.16E-06

Source: 5

Nuclide	Receptor	Total
	1	
TH-232	1.13E+00	1.13E+00
TH-228	1.07E-02	1.07E-02
RA-228	2.03E-02	2.03E-02
CO-60	5.41E-01	5.41E-01
MN-54	1.98E-01	1.98E-01
H-3	1.80E-06	1.80E-06

Source: 6

Nuclide	Receptor	Total
	1	
TH-232	1.13E+00	1.13E+00
TH-228	1.07E-02	1.07E-02
RA-228	2.03E-02	2.03E-02
CO-60	5.41E-01	5.41E-01
MN-54	1.98E-02	1.98E-02
H-3	1.80E-06	1.80E-06



Evaluation Time: 3.00000000 years

Time =3.00E+00 vr

## Source Information

Pathway ::

Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	2.190E+03
	TH-228	2.726E+02
	RA-228	6.647E+02
	CO-60	2.034E+05
	MN-54	1.153E+05
	H-3	6.777E+02

Pathway ::

Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	2.190E+03
	TH-228	2.726E+02
	AC-227	8.094E-01
	RA-228	6.647E+02
	CO-60	2.034E+05

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL Redo Mn54 100 percent removable.bld

Evaluation Time: 3.00000000 years

MN-54	1.153E+05
H-3	6.777E+02

Source: 3

Location:: Room : 1 x: 0.00 y: 2.80 z: 2.00 [m]

Geometry:: Type: Area Length[m]:5.60E+00 Width[m]:4.00E+00 Direction: x

Pathway ::

Direct Ingestion Rate: 3.060E-06 [1/hr]

Fraction released to air: 3.570E-01

Removable fraction: 1.000E+00

Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	2.190E+03
	TH-228	2.726E+02
	RA-228	6.647E+02
	CO-60	2.034E+05
	MN-54	1.153E+05
	H-3	6.777E+02

Source: 4

Location:: Room : 1 x: 3.20 y: 2.80 z: 2.00 [m]

Geometry:: Type: Area Length[m]:5.60E+00 Width[m]:4.00E+00 Direction: x

Pathway ::

Direct Ingestion Rate: 3.060E-06 [1/hr]

Fraction released to air: 3.570E-01

Removable fraction: 1.000E+00

Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	2.190E+03
	TH-228	2.726E+02
	RA-228	6.647E+02
	CO-60	2.034E+05
	MN-54	1.153E+05
	H-3	6.777E+02

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL Redo Mn54 100 percent removable.bld

Evaluation Time: 3.00000000 years

Source: 5

Location:: Room : 1 x: 1.60 y: 0.00 z: 2.00 [m]

Geometry:: Type: Area Length[m]:3.20E+00 Width[m]:4.00E+00 Direction: y

Pathway ::

Direct Ingestion Rate: 3.060E-06 [1/hr]

Fraction released to air: 3.570E-01

Removable fraction: 1.000E+00

Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	2.190E+03
	TH-228	2.726E+02
	RA-228	6.647E+02
	CO-60	2.034E+05
	MN-54	1.153E+05
	H-3	6.777E+02

Source: 6

Location:: Room : 1 x: 1.60 y: 5.60 z: 2.00 [m]

Geometry:: Type: Area Length[m]:3.20E+00 Width[m]:4.00E+00 Direction: y

Pathway ::

Direct Ingestion Rate: 3.060E-06 [1/hr]

Fraction released to air: 3.570E-01

Removable fraction: 1.000E+00

Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	2.190E+03
	TH-228	2.726E+02
	RA-228	6.647E+02
	CO-60	2.034E+05
	MN-54	1.153E+04
	H-3	6.777E+02

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL Redo Mn54 100 percent removable.bld

Evaluation Time: 3.00000000 years

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RESRAD-BUILD Dose Tables

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Source Contributions to Receptor Doses

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[mrem]

	Source	Source	Source	Source	Source	Source	Total
	1	2	3	4	5	6	
Receptor 1	3.00E+00	2.23E+00	3.13E+00	3.13E+00	1.62E+00	1.59E+00	1.47E+01
Total	3.00E+00	2.23E+00	3.13E+00	3.13E+00	1.62E+00	1.59E+00	1.47E+01

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL Redo Mn54 100 percent removable.bld

Evaluation Time: 3.00000000 years

Pathway Detail of Doses

[mrem]

Source: 1

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	1.04E+00	1.47E-03	1.69E-04	1.33E+00	3.36E-03	6.21E-01
Total	1.04E+00	1.47E-03	1.69E-04	1.33E+00	3.36E-03	6.21E-01

Source: 2

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	2.71E-01	1.47E-03	1.69E-04	1.33E+00	3.36E-03	6.21E-01
Total	2.71E-01	1.47E-03	1.69E-04	1.33E+00	3.36E-03	6.21E-01

Source: 3

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	6.87E-01	1.84E-03	2.11E-04	1.66E+00	4.21E-03	7.76E-01
Total	6.87E-01	1.84E-03	2.11E-04	1.66E+00	4.21E-03	7.76E-01

Source: 4

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	6.87E-01	1.84E-03	2.11E-04	1.66E+00	4.21E-03	7.76E-01
Total	6.87E-01	1.84E-03	2.11E-04	1.66E+00	4.21E-03	7.76E-01

Source: 5

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	2.23E-01	1.05E-03	1.20E-04	9.48E-01	2.40E-03	4.43E-01
Total	2.23E-01	1.05E-03	1.20E-04	9.48E-01	2.40E-03	4.43E-01

Source: 6

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	1.97E-01	9.36E-04	1.08E-04	9.48E-01	2.40E-03	4.36E-01
Total	1.97E-01	9.36E-04	1.08E-04	9.48E-01	2.40E-03	4.36E-01

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL Redo Mn54 100 percent removable.bld

Evaluation Time: 3.00000000 years

# Nuclide Detail of Doses

[mrem]

Source: 1

Nuclide	Receptor	Total
	1	
TH-232	1.56E+00	1.56E+00
TH-228	5.88E-02	5.88E-02
RA-228	5.58E-02	5.58E-02
CO-60	1.18E+00	1.18E+00
MN-54	1.44E-01	1.44E-01
H-3	2.08E-06	2.08E-06

Source: 2

Nuclide	Receptor	Total
	1	
TH-232	1.56E+00	1.56E+00
TH-228	5.81E-02	5.81E-02
RA-228	5.48E-02	5.48E-02
AC-227	2.47E-03	2.47E-03
CO-60	5.03E-01	5.03E-01
MN-54	4.56E-02	4.56E-02
H-3	2.08E-06	2.08E-06

Source: 3

Nuclide	Receptor	Total
	1	
TH-232	1.95E+00	1.95E+00
TH-228	7.29E-02	7.29E-02
RA-228	6.89E-02	6.89E-02
CO-60	9.31E-01	9.31E-01
MN-54	1.01E-01	1.01E-01
H-3	2.61E-06	2.61E-06

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL Redo Mn54 100 percent removable.bld

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Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL Redo Mn54 100 percent removable.bld

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RESRAD-BUILD Table of Contents

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Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL Redo Mn54 100 percent removable.bld

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RESRAD-BUILD Input Parameters

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Number of Sources : 6  
 Number of Receptors: 1  
 Total Time : 3.650000E+02 days  
 Fraction Inside : 2.300000E-01

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Receptor Information

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Receptor	Room	x [m]	y [m]	z [m]	FracTime	Inhalation [m3/day]	Ingestion(Dust) [m2/hr]
1	1	1.600	2.800	1.000	1.000	1.80E+01	1.12E-04

---

Receptor-Source Shielding Relationship

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Receptor	Source	Density [g/cm3]	Thickness [cm]	Material
1	1	2.40E+00	0.00E+00	Concrete
1	2	2.40E+00	0.00E+00	Concrete
1	3	2.40E+00	0.00E+00	Concrete
1	4	2.40E+00	0.00E+00	Concrete
1	5	2.40E+00	0.00E+00	Concrete
1	6	2.40E+00	0.00E+00	Concrete

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL Redo Mn54 100 percent removable.bld

===== Building Information =====

Building Air Exchange Rate: 8.00E-01 1/hr

Height[m]	Air Exchanges [m3/hr]	
Area [m2]		
	*****	
	*	*
	*	*
	*	<=Q01: 5.76E+01
H1: 4.000	* Room 1	* Q10 : 5.76E+01
	* LAMBDA: 8.00E-01	*
Area 18.000	*	*
	*	*
	*****	

Deposition velocity: 1.00E-02 [m/s] Resuspension Rate: 3.70E-06 [1/s]

===== Source Information =====

Source: 1

Location:: Room : 1 x: 1.60 y: 2.80 z: 0.00[m]  
Geometry:: Type: Area Length[m]:3.20E+00 Width[m]:5.60E+00 Direction: z  
Pathway ::  
Direct Ingestion Rate: 3.060E-06 [1/hr]  
Fraction released to air: 3.570E-01  
Removable fraction: 1.000E+00  
Time to Remove: 1.000E+04 [day]  
  
Radon Release Fraction: 1.000E-01

Contamination::

Nuclide Concentration Dose Conversion Factor (Library: FGR 11)

	[dpm/m2]	Ingestion	Inhalation	Submersion
		[mrem/dpm]	[mrem/dpm]	[mrem/yr/ (dpm/m3)]
TH-232	2.460E+03	1.230E-03	7.387E-01	4.588E-07
TH-228	0.000E+00	3.642E-04	1.556E-01	4.224E-03
RA-228	0.000E+00	6.496E-04	2.287E-03	2.515E-03
CO-60	3.390E+05	1.212E-05	9.865E-05	6.629E-03
MN-54	1.470E+06	1.248E-06	3.018E-06	2.152E-03
H-3	9.000E+02	2.883E-08	2.883E-08	1.741E-08

Source: 2

Location:: Room : 1 x: 1.60 y: 2.80 z: 4.00[m]  
Geometry:: Type: Area Length[m]:3.20E+00 Width[m]:5.60E+00 Direction: z  
Pathway ::  
Direct Ingestion Rate: 3.060E-06 [1/hr]  
Fraction released to air: 3.570E-01  
Removable fraction: 1.000E+00  
Time to Remove: 1.000E+04 [day]  
  
Radon Release Fraction: 1.000E-01

Contamination::

Nuclide Concentration Dose Conversion Factor (Library: FGR 11)

	[dpm/m2]	Ingestion	Inhalation	Submersion
		[mrem/dpm]	[mrem/dpm]	[mrem/yr/ (dpm/m3)]

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL Redo Mn54 100 percent removable.bld

TH-232	2.460E+03	1.230E-03	7.387E-01	4.588E-07
TH-228	0.000E+00	3.642E-04	1.556E-01	4.224E-03
AC-227	1.000E+00	6.665E-03	3.029E+00	9.734E-04
RA-228	0.000E+00	6.496E-04	2.287E-03	2.515E-03
CO-60	3.390E+05	1.212E-05	9.865E-05	6.629E-03
MN-54	1.470E+06	1.248E-06	3.018E-06	2.152E-03
H-3	9.000E+02	2.883E-08	2.883E-08	1.741E-08

Source: 3

Location:: Room : 1 x: 0.00 y: 2.80 z: 2.00[m]

Geometry:: Type: Area Length[m]:5.60E+00 Width[m]:4.00E+00 Direction: x

Pathway ::

Direct Ingestion Rate: 3.060E-06 [l/hr]  
 Fraction released to air: 3.570E-01  
 Removable fraction: 1.000E+00  
 Time to Remove: 1.000E+04 [day]

Radon Release Fraction: 1.000E-01

Contamination::

Nuclide Concentration Dose Conversion Factor (Library: EGR 11)

		Ingestion	Inhalation	Submersion
	[dpm/m2]	[mrem/dpm]	[mrem/dpm]	[mrem/yr/ (dpm/m3)]
TH-232	2.460E+03	1.230E-03	7.387E-01	4.588E-07
TH-228	0.000E+00	3.642E-04	1.556E-01	4.224E-03
RA-228	0.000E+00	6.496E-04	2.287E-03	2.515E-03
CO-60	3.390E+05	1.212E-05	9.865E-05	6.629E-03
MN-54	1.470E+06	1.248E-06	3.018E-06	2.152E-03
H-3	9.000E+02	2.883E-08	2.883E-08	1.741E-08

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL Redo Mn54 100 percent removable.bld

Source: 4

Location:: Room : 1 x: 3.20 y: 2.80 z: 2.00[m]  
 Geometry:: Type: Area Length[m]:5.60E+00 Width[m]:4.00E+00 Direction: x  
 Pathway ::  
 Direct Ingestion Rate: 3.060E-06 [1/hr]  
 Fraction released to air: 3.570E-01  
 Removable fraction: 1.000E+00  
 Time to Remove: 1.000E+04 [day]  
 Radon Release Fraction: 1.000E-01

Contamination::

Nuclide Concentration Dose Conversion Factor (Library: FGR 11)

		Ingestion	Inhalation	Submersion
	[dpm/m2]	[mrem/dpm]	[mrem/dpm]	[mrem/yr/ (dpm/m3)]
TH-232	2.460E+03	1.230E-03	7.387E-01	4.588E-07
TH-228	0.000E+00	3.642E-04	1.556E-01	4.224E-03
RA-228	0.000E+00	6.496E-04	2.287E-03	2.515E-03
CO-60	3.390E+05	1.212E-05	9.865E-05	6.629E-03
MN-54	1.470E+06	1.248E-06	3.018E-06	2.152E-03
H-3	9.000E+02	2.883E-08	2.883E-08	1.741E-08

Source: 5

Location:: Room : 1 x: 1.60 y: 0.00 z: 2.00[m]  
 Geometry:: Type: Area Length[m]:3.20E+00 Width[m]:4.00E+00 Direction: y  
 Pathway ::  
 Direct Ingestion Rate: 3.060E-06 [1/hr]  
 Fraction released to air: 3.570E-01  
 Removable fraction: 1.000E+00  
 Time to Remove: 1.000E+04 [day]  
 Radon Release Fraction: 1.000E-01

Contamination::

Nuclide Concentration Dose Conversion Factor (Library: FGR 11)

		Ingestion	Inhalation	Submersion
	[dpm/m2]	[mrem/dpm]	[mrem/dpm]	[mrem/yr/ (dpm/m3)]
TH-232	2.460E+03	1.230E-03	7.387E-01	4.588E-07
TH-228	0.000E+00	3.642E-04	1.556E-01	4.224E-03
RA-228	0.000E+00	6.496E-04	2.287E-03	2.515E-03

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL Redo Mn54 100 percent removable.bld

CO-60	3.390E+05	1.212E-05	9.865E-05	6.629E-03
MN-54	1.470E+06	1.248E-06	3.018E-06	2.152E-03
H-3	9.000E+02	2.883E-08	2.883E-08	1.741E-08

Source: 6

Location:: Room : 1 x: 1.60 y: 5.60 z: 2.00[m]

Geometry:: Type: Area Length[m]:3.20E+00 Width[m]:4.00E+00 Direction: y

Pathway ::

Direct Ingestion Rate: 3.060E-06 [1/hr]

Fraction released to air: 3.570E-01

Removable fraction: 1.000E+00

Time to Remove: 1.000E+04 [day]

Radon Release Fraction: 1.000E-01

Contamination::

Nuclide Concentration Dose Conversion Factor (Library: FGR 11)

		Ingestion	Inhalation	Submersion
	[dpm/m2]	[mrem/dpm]	[mrem/dpm]	[mrem/yr/ (dpm/m3)]
TH-232	2.460E+03	1.230E-03	7.387E-01	4.588E-07
TH-228	0.000E+00	3.642E-04	1.556E-01	4.224E-03
RA-228	0.000E+00	6.496E-04	2.287E-03	2.515E-03
CO-60	3.390E+05	1.212E-05	9.865E-05	6.629E-03
MN-54	1.470E+05	1.248E-06	3.018E-06	2.152E-03
H-3	9.000E+02	2.883E-08	2.883E-08	1.741E-08

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL Redo Mn54 100 percent removable.bld

Evaluation Time: 0.00000000E+00 years

```

=====
Assessment for Time: 1
Time =0.00E+00 yr
=====

```

===== Source Information =====

Source: 1

Location:: Room : 1 x: 1.60 y: 2.80 z: 0.00 [m]

Geometry:: Type: Area Length[m]:3.20E+00 Width[m]:5.60E+00 Direction: z

Pathway ::

Direct Ingestion Rate: 3.060E-06 [1/hr]

Fraction released to air: 3.570E-01

Removable fraction: 1.000E+00

Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	2.460E+03
	TH-228	0.000E+00
	RA-228	0.000E+00
	CO-60	3.390E+05
	MN-54	1.470E+06
	H-3	9.000E+02

Source: 2

Location:: Room : 1 x: 1.60 y: 2.80 z: 4.00 [m]

Geometry:: Type: Area Length[m]:3.20E+00 Width[m]:5.60E+00 Direction: z

Pathway ::

Direct Ingestion Rate: 3.060E-06 [1/hr]

Fraction released to air: 3.570E-01

Removable fraction: 1.000E+00

Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	2.460E+03
	TH-228	0.000E+00
	AC-227	1.000E+00
	RA-228	0.000E+00
	CO-60	3.390E+05

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL Redo Mn54 100 percent removable.bld

Evaluation Time: 0.0000000E+00 years

MN-54	1.470E+06
H-3	9.000E+02

Source: 3

Location:: Room : 1 x: 0.00 y: 2.80 z: 2.00 [m]

Geometry:: Type: Area Length[m]:5.60E+00 Width[m]:4.00E+00 Direction: x

Pathway ::

Direct Ingestion Rate:	3.060E-06 [1/hr]
Fraction released to air:	3.570E-01
Removable fraction:	1.000E+00
Time to Remove:	1.000E+04 [day]

Contamination::	Nuclide	Concentration
		[dpm/m2]
	TH-232	2.460E+03
	TH-228	0.000E+00
	RA-228	0.000E+00
	CO-60	3.390E+05
	MN-54	1.470E+06
	H-3	9.000E+02

Source: 4

Location:: Room : 1 x: 3.20 y: 2.80 z: 2.00 [m]

Geometry:: Type: Area Length[m]:5.60E+00 Width[m]:4.00E+00 Direction: x

Pathway ::

Direct Ingestion Rate:	3.060E-06 [1/hr]
Fraction released to air:	3.570E-01
Removable fraction:	1.000E+00
Time to Remove:	1.000E+04 [day]

Contamination::	Nuclide	Concentration
		[dpm/m2]
	TH-232	2.460E+03
	TH-228	0.000E+00
	RA-228	0.000E+00
	CO-60	3.390E+05
	MN-54	1.470E+06
	H-3	9.000E+02



Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL Redo Mn54 100 percent removable.bld

Evaluation Time: 0.0000000E+00 years

Source: 5

Location:: Room : 1 x: 1.60 y: 0.00 z: 2.00 [m]

Geometry:: Type: Area Length[m]:3.20E+00 Width[m]:4.00E+00 Direction: y

Pathway ::

Direct Ingestion Rate: 3.060E-06 [1/hr]

Fraction released to air: 3.570E-01

Removable fraction: 1.000E+00

Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	2.460E+03
	TH-228	0.000E+00
	RA-228	0.000E+00
	CO-60	3.390E+05
	MN-54	1.470E+06
	H-3	9.000E+02

Source: 6

Location:: Room : 1 x: 1.60 y: 5.60 z: 2.00 [m]

Geometry:: Type: Area Length[m]:3.20E+00 Width[m]:4.00E+00 Direction: y

Pathway ::

Direct Ingestion Rate: 3.060E-06 [1/hr]

Fraction released to air: 3.570E-01

Removable fraction: 1.000E+00

Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	2.460E+03
	TH-228	0.000E+00
	RA-228	0.000E+00
	CO-60	3.390E+05
	MN-54	1.470E+05
	H-3	9.000E+02

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL Redo Mn54 100 percent removable.bld

Evaluation Time: 0.00000000E+00 years

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RESRAD-BUILD Dose Tables

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Source Contributions to Receptor Doses

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[mrem]

	Source 1	Source 2	Source 3	Source 4	Source 5	Source 6	Total
Receptor 1	5.41E+00	3.03E+00	4.86E+00	4.86E+00	2.25E+00	1.84E+00	2.22E+01
Total	5.41E+00	3.03E+00	4.86E+00	4.86E+00	2.25E+00	1.84E+00	2.22E+01

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL Redo Mn54 100 percent removable.bld

Evaluation Time: 0.00000000E+00 years

Pathway Detail of Doses

[mrem]

Source: 1

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	3.21E+00	3.90E-03	4.36E-04	1.30E+00	1.54E-04	8.95E-01
Total	3.21E+00	3.90E-03	4.36E-04	1.30E+00	1.54E-04	8.95E-01

Source: 2

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	8.35E-01	3.90E-03	4.36E-04	1.30E+00	1.54E-04	8.96E-01
Total	8.35E-01	3.90E-03	4.36E-04	1.30E+00	1.54E-04	8.96E-01

Source: 3

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	2.11E+00	4.88E-03	5.45E-04	1.62E+00	1.92E-04	1.12E+00
Total	2.11E+00	4.88E-03	5.45E-04	1.62E+00	1.92E-04	1.12E+00

Source: 4

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	2.11E+00	4.88E-03	5.45E-04	1.62E+00	1.92E-04	1.12E+00
Total	2.11E+00	4.88E-03	5.45E-04	1.62E+00	1.92E-04	1.12E+00

Source: 5

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	6.86E-01	2.79E-03	3.11E-04	9.26E-01	1.10E-04	6.40E-01
Total	6.86E-01	2.79E-03	3.11E-04	9.26E-01	1.10E-04	6.40E-01

Source: 6

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	3.60E-01	1.51E-03	1.74E-04	9.25E-01	1.10E-04	5.51E-01
Total	3.60E-01	1.51E-03	1.74E-04	9.25E-01	1.10E-04	5.51E-01

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL Redo Mn54 100 percent removable.bld

Evaluation Time: 0.00000000E+00 years

Nuclide Detail of Doses

[mrem]

Source: 1

Nuclide	Receptor	Total
	1	
TH-232	1.60E+00	1.60E+00
TH-228	2.50E-03	2.50E-03
RA-228	1.05E-02	1.05E-02
CO-60	1.96E+00	1.96E+00
MN-54	1.83E+00	1.83E+00
H-3	2.77E-06	2.77E-06

Source: 2

Nuclide	Receptor	Total
	1	
TH-232	1.60E+00	1.60E+00
TH-228	2.46E-03	2.46E-03
RA-228	1.03E-02	1.03E-02
AC-227	2.79E-03	2.79E-03
CO-60	8.37E-01	8.37E-01
MN-54	5.81E-01	5.81E-01
H-3	2.77E-06	2.77E-06

Source: 3

Nuclide	Receptor	Total
	1	
TH-232	2.00E+00	2.00E+00
TH-228	3.09E-03	3.09E-03
RA-228	1.30E-02	1.30E-02
CO-60	1.55E+00	1.55E+00
MN-54	1.29E+00	1.29E+00
H-3	3.46E-06	3.46E-06

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL Redo Mn54 100 percent removable.bld

Evaluation Time: 0.00000000E+00 years

Source: 4

Nuclide	Receptor	Total
	1	
TH-232	2.00E+00	2.00E+00
TH-228	3.09E-03	3.09E-03
RA-228	1.30E-02	1.30E-02
CO-60	1.55E+00	1.55E+00
MN-54	1.29E+00	1.29E+00
H-3	3.46E-06	3.46E-06

Source: 5

Nuclide	Receptor	Total
	1	
TH-232	1.14E+00	1.14E+00
TH-228	1.76E-03	1.76E-03
RA-228	7.36E-03	7.36E-03
CO-60	6.40E-01	6.40E-01
MN-54	4.62E-01	4.62E-01
H-3	1.98E-06	1.98E-06

Source: 6

Nuclide	Receptor	Total
	1	
TH-232	1.14E+00	1.14E+00
TH-228	1.76E-03	1.76E-03
RA-228	7.36E-03	7.36E-03
CO-60	6.40E-01	6.40E-01
MN-54	4.62E-02	4.62E-02
H-3	1.98E-06	1.98E-06

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Assessment for Time: 2
Time =1.00E+00 yr

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===== Source Information =====

Source: 1

Location:: Room : 1 x: 1.60 y: 2.80 z: 0.00 [m]  
Geometry:: Type: Area Length[m]:3.20E+00 Width[m]:5.60E+00 Direction: z  
Pathway ::  
Direct Ingestion Rate: 3.060E-06 [1/hr]  
Fraction released to air: 3.570E-01  
Removable fraction: 1.000E+00  
Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration
		[dpm/m2]
	TH-232	2.370E+03
	TH-228	4.425E+01
	RA-228	2.692E+02
	CO-60	2.864E+05
	MN-54	6.302E+05
	H-3	8.200E+02

Source: 2

Location:: Room : 1 x: 1.60 y: 2.80 z: 4.00 [m]  
Geometry:: Type: Area Length[m]:3.20E+00 Width[m]:5.60E+00 Direction: z  
Pathway ::  
Direct Ingestion Rate: 3.060E-06 [1/hr]  
Fraction released to air: 3.570E-01  
Removable fraction: 1.000E+00  
Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration
		[dpm/m2]
	TH-232	2.370E+03
	TH-228	4.425E+01
	AC-227	9.333E-01
	RA-228	2.692E+02
	CO-60	2.864E+05

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL Redo Mn54 100 percent removable.bld

Evaluation Time: 1.00000000 years

MN-54	6.302E+05
H-3	8.200E+02

Source: 3

Location:: Room : 1 x: 0.00 y: 2.80 z: 2.00 [m]

Geometry:: Type: Area Length[m]:5.60E+00 Width[m]:4.00E+00 Direction: x

Pathway ::

Direct Ingestion Rate:	3.060E-06 [1/hr]
Fraction released to air:	3.570E-01
Removable fraction:	1.000E+00
Time to Remove:	1.000E+04 [day]

Contamination::	Nuclide	Concentration
		[dpm/m2]
	TH-232	2.370E+03
	TH-228	4.425E+01
	RA-228	2.692E+02
	CO-60	2.864E+05
	MN-54	6.302E+05
	H-3	8.200E+02

Source: 4

Location:: Room : 1 x: 3.20 y: 2.80 z: 2.00 [m]

Geometry:: Type: Area Length[m]:5.60E+00 Width[m]:4.00E+00 Direction: x

Pathway ::

Direct Ingestion Rate:	3.060E-06 [1/hr]
Fraction released to air:	3.570E-01
Removable fraction:	1.000E+00
Time to Remove:	1.000E+04 [day]

Contamination::	Nuclide	Concentration
		[dpm/m2]
	TH-232	2.370E+03
	TH-228	4.425E+01
	RA-228	2.692E+02
	CO-60	2.864E+05
	MN-54	6.302E+05
	H-3	8.200E+02

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL Redo Mn54 100 percent removable.bld

Evaluation Time: 1.00000000 years

Source: 5

Location:: Room : 1 x: 1.60 y: 0.00 z: 2.00 [m]

Geometry:: Type: Area Length[m]:3.20E+00 Width[m]:4.00E+00 Direction: y

Pathway ::

Direct Ingestion Rate: 3.060E-06 [1/hr]

Fraction released to air: 3.570E-01

Removable fraction: 1.000E+00

Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	2.370E+03
	TH-228	4.425E+01
	RA-228	2.692E+02
	CO-60	2.864E+05
	MN-54	6.302E+05
	H-3	8.200E+02

Source: 6

Location:: Room : 1 x: 1.60 y: 5.60 z: 2.00 [m]

Geometry:: Type: Area Length[m]:3.20E+00 Width[m]:4.00E+00 Direction: y

Pathway ::

Direct Ingestion Rate: 3.060E-06 [1/hr]

Fraction released to air: 3.570E-01

Removable fraction: 1.000E+00

Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	2.370E+03
	TH-228	4.425E+01
	RA-228	2.692E+02
	CO-60	2.864E+05
	MN-54	6.302E+04
	H-3	8.200E+02



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RESRAD-BUILD Dose Tables

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Source Contributions to Receptor Doses

[mrem]							
=====							
	Source	Source	Source	Source	Source	Source	Total
	1	2	3	4	5	6	
Receptor 1	4.07E+00	2.59E+00	3.90E+00	3.90E+00	1.90E+00	1.73E+00	1.81E+01
Total	4.07E+00	2.59E+00	3.90E+00	3.90E+00	1.90E+00	1.73E+00	1.81E+01

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL Redo Mn54 100 percent removable.bld

Evaluation Time: 1.00000000 years

Pathway Detail of Doses

[mrem]

Source: 1

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	2.01E+00	2.56E-03	2.90E-04	1.30E+00	9.15E-04	7.60E-01
Total	2.01E+00	2.56E-03	2.90E-04	1.30E+00	9.15E-04	7.60E-01

Source: 2

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	5.22E-01	2.56E-03	2.90E-04	1.30E+00	9.15E-04	7.61E-01
Total	5.22E-01	2.56E-03	2.90E-04	1.30E+00	9.15E-04	7.61E-01

Source: 3

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	1.32E+00	3.21E-03	3.62E-04	1.63E+00	1.14E-03	9.50E-01
Total	1.32E+00	3.21E-03	3.62E-04	1.63E+00	1.14E-03	9.50E-01

Source: 4

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	1.32E+00	3.21E-03	3.62E-04	1.63E+00	1.14E-03	9.50E-01
Total	1.32E+00	3.21E-03	3.62E-04	1.63E+00	1.14E-03	9.50E-01

Source: 5

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	4.29E-01	1.83E-03	2.07E-04	9.30E-01	6.54E-04	5.43E-01
Total	4.29E-01	1.83E-03	2.07E-04	9.30E-01	6.54E-04	5.43E-01

Source: 6

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	2.89E-01	1.26E-03	1.46E-04	9.29E-01	6.54E-04	5.05E-01
Total	2.89E-01	1.26E-03	1.46E-04	9.29E-01	6.54E-04	5.05E-01

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL Redo Mn54 100 percent removable.bld

Evaluation Time: 1.00000000 years

# Nuclide Detail of Doses

[mrem]

Source: 1

Nuclide	Receptor	Total
	1	
TH-232	1.59E+00	1.59E+00
TH-228	1.52E-02	1.52E-02
RA-228	2.89E-02	2.89E-02
CO-60	1.65E+00	1.65E+00
MN-54	7.85E-01	7.85E-01
H-3	2.52E-06	2.52E-06

Source: 2

Nuclide	Receptor	Total
	1	
TH-232	1.59E+00	1.59E+00
TH-228	1.50E-02	1.50E-02
RA-228	2.84E-02	2.84E-02
AC-227	2.68E-03	2.68E-03
CO-60	7.07E-01	7.07E-01
MN-54	2.49E-01	2.49E-01
H-3	2.52E-06	2.52E-06

Source: 3

Nuclide	Receptor	Total
	1	
TH-232	1.98E+00	1.98E+00
TH-228	1.88E-02	1.88E-02
RA-228	3.57E-02	3.57E-02
CO-60	1.31E+00	1.31E+00
MN-54	5.53E-01	5.53E-01
H-3	3.16E-06	3.16E-06

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL Redo Mn54 100 percent removable.bld

Evaluation Time: 1.00000000 years

Source: 4

Nuclide	Receptor	Total
	1	
TH-232	1.98E+00	1.98E+00
TH-228	1.88E-02	1.88E-02
RA-228	3.57E-02	3.57E-02
CO-60	1.31E+00	1.31E+00
MN-54	5.53E-01	5.53E-01
H-3	3.16E-06	3.16E-06

Source: 5

Nuclide	Receptor	Total
	1	
TH-232	1.13E+00	1.13E+00
TH-228	1.07E-02	1.07E-02
RA-228	2.03E-02	2.03E-02
CO-60	5.41E-01	5.41E-01
MN-54	1.98E-01	1.98E-01
H-3	1.80E-06	1.80E-06

Source: 6

Nuclide	Receptor	Total
	1	
TH-232	1.13E+00	1.13E+00
TH-228	1.07E-02	1.07E-02
RA-228	2.03E-02	2.03E-02
CO-60	5.41E-01	5.41E-01
MN-54	1.98E-02	1.98E-02
H-3	1.80E-06	1.80E-06

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL Redo Mn54 100 percent removable.bld

Evaluation Time: 3.00000000 years

Assessment for Time: 3

Time =3.00E+00 yr

Source Information

Source: 1

Location:: Room : 1 x: 1.60 y: 2.80 z: 0.00 [m]

Geometry:: Type: Area Length[m]:3.20E+00 Width[m]:5.60E+00 Direction: z

Pathway ::

Direct Ingestion Rate: 3.060E-06 [1/hr]

Fraction released to air: 3.570E-01

Removable fraction: 1.000E+00

Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	2.190E+03
	TH-228	2.726E+02
	RA-228	6.647E+02
	CO-60	2.034E+05
	MN-54	1.153E+05
	H-3	6.777E+02

Source: 2

Location:: Room : 1 x: 1.60 y: 2.80 z: 4.00 [m]

Geometry:: Type: Area Length[m]:3.20E+00 Width[m]:5.60E+00 Direction: z

Pathway ::

Direct Ingestion Rate: 3.060E-06 [1/hr]

Fraction released to air: 3.570E-01

Removable fraction: 1.000E+00

Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	2.190E+03
	TH-228	2.726E+02
	AC-227	8.094E-01
	RA-228	6.647E+02
	CO-60	2.034E+05

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL Redo Mn54 100 percent removable.bld

Evaluation Time: 3.00000000 years

MN-54	1.153E+05
H-3	6.777E+02

Source: 3

Location:: Room : 1 x: 0.00 y: 2.80 z: 2.00 [m]

Geometry:: Type: Area Length[m]:5.60E+00 Width[m]:4.00E+00 Direction: x

Pathway ::

Direct Ingestion Rate:	3.060E-06 [1/hr]
Fraction released to air:	3.570E-01
Removable fraction:	1.000E+00
Time to Remove:	1.000E+04 [day]

Contamination::	Nuclide	Concentration
		[dpm/m2]
	TH-232	2.190E+03
	TH-228	2.726E+02
	RA-228	6.647E+02
	CO-60	2.034E+05
	MN-54	1.153E+05
	H-3	6.777E+02

Source: 4

Location:: Room : 1 x: 3.20 y: 2.80 z: 2.00 [m]

Geometry:: Type: Area Length[m]:5.60E+00 Width[m]:4.00E+00 Direction: x

Pathway ::

Direct Ingestion Rate:	3.060E-06 [1/hr]
Fraction released to air:	3.570E-01
Removable fraction:	1.000E+00
Time to Remove:	1.000E+04 [day]

Contamination::	Nuclide	Concentration
		[dpm/m2]
	TH-232	2.190E+03
	TH-228	2.726E+02
	RA-228	6.647E+02
	CO-60	2.034E+05
	MN-54	1.153E+05
	H-3	6.777E+02

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL Redo Mn54 100 percent removable.bld

Evaluation Time: 3.00000000 years

Source: 5

Location:: Room : 1 x: 1.60 y: 0.00 z: 2.00 [m]

Geometry:: Type: Area Length[m]:3.20E+00 Width[m]:4.00E+00 Direction: y

Pathway ::

Direct Ingestion Rate: 3.060E-06 [1/hr]

Fraction released to air: 3.570E-01

Removable fraction: 1.000E+00

Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	2.190E+03
	TH-228	2.726E+02
	RA-228	6.647E+02
	CO-60	2.034E+05
	MN-54	1.153E+05
	H-3	6.777E+02

Source: 6

Location:: Room : 1 x: 1.60 y: 5.60 z: 2.00 [m]

Geometry:: Type: Area Length[m]:3.20E+00 Width[m]:4.00E+00 Direction: y

Pathway ::

Direct Ingestion Rate: 3.060E-06 [1/hr]

Fraction released to air: 3.570E-01

Removable fraction: 1.000E+00

Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	2.190E+03
	TH-228	2.726E+02
	RA-228	6.647E+02
	CO-60	2.034E+05
	MN-54	1.153E+04
	H-3	6.777E+02

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL Redo Mn54 100 percent removable.bld

Evaluation Time: 3.00000000 years

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RESRAD-BUILD Dose Tables

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Source Contributions to Receptor Doses

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[mrem]

	Source	Source	Source	Source	Source	Source	Total
	1	2	3	4	5	6	
Receptor 1	3.00E+00	2.23E+00	3.13E+00	3.13E+00	1.62E+00	1.59E+00	1.47E+01
Total	3.00E+00	2.23E+00	3.13E+00	3.13E+00	1.62E+00	1.59E+00	1.47E+01



Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL Redo Mn54 100 percent removable.bld

Evaluation Time: 3.00000000 years

Pathway Detail of Doses

[mrem]

Source: 1

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	1.04E+00	1.47E-03	1.69E-04	1.33E+00	3.36E-03	6.21E-01
Total	1.04E+00	1.47E-03	1.69E-04	1.33E+00	3.36E-03	6.21E-01

Source: 2

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	2.71E-01	1.47E-03	1.69E-04	1.33E+00	3.36E-03	6.21E-01
Total	2.71E-01	1.47E-03	1.69E-04	1.33E+00	3.36E-03	6.21E-01

Source: 3

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	6.87E-01	1.84E-03	2.11E-04	1.66E+00	4.21E-03	7.76E-01
Total	6.87E-01	1.84E-03	2.11E-04	1.66E+00	4.21E-03	7.76E-01

Source: 4

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	6.87E-01	1.84E-03	2.11E-04	1.66E+00	4.21E-03	7.76E-01
Total	6.87E-01	1.84E-03	2.11E-04	1.66E+00	4.21E-03	7.76E-01

Source: 5

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	2.23E-01	1.05E-03	1.20E-04	9.48E-01	2.40E-03	4.43E-01
Total	2.23E-01	1.05E-03	1.20E-04	9.48E-01	2.40E-03	4.43E-01

Source: 6

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	1.97E-01	9.36E-04	1.08E-04	9.48E-01	2.40E-03	4.36E-01
Total	1.97E-01	9.36E-04	1.08E-04	9.48E-01	2.40E-03	4.36E-01

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL Redo Mn54 100 percent removable.bld

Evaluation Time: 3.00000000 years

# Nuclide Detail of Doses

[mrem]

Source: 1

Nuclide	Receptor	Total
	1	
TH-232	1.56E+00	1.56E+00
TH-228	5.88E-02	5.88E-02
RA-228	5.58E-02	5.58E-02
CO-60	1.18E+00	1.18E+00
MN-54	1.44E-01	1.44E-01
H-3	2.08E-06	2.08E-06

Source: 2

Nuclide	Receptor	Total
	1	
TH-232	1.56E+00	1.56E+00
TH-228	5.81E-02	5.81E-02
RA-228	5.48E-02	5.48E-02
AC-227	2.47E-03	2.47E-03
CO-60	5.03E-01	5.03E-01
MN-54	4.56E-02	4.56E-02
H-3	2.08E-06	2.08E-06

Source: 3

Nuclide	Receptor	Total
	1	
TH-232	1.95E+00	1.95E+00
TH-228	7.29E-02	7.29E-02
RA-228	6.89E-02	6.89E-02
CO-60	9.31E-01	9.31E-01
MN-54	1.01E-01	1.01E-01
H-3	2.61E-06	2.61E-06

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL Redo Mn54 100 percent removable.bld

Evaluation Time: 3.00000000 years

Source: 4

Nuclide	Receptor	Total
	1	
TH-232	1.95E+00	1.95E+00
TH-228	7.29E-02	7.29E-02
RA-228	6.89E-02	6.89E-02
CO-60	9.31E-01	9.31E-01
MN-54	1.01E-01	1.01E-01
H-3	2.61E-06	2.61E-06

Source: 5

Nuclide	Receptor	Total
	1	
TH-232	1.12E+00	1.12E+00
TH-228	4.15E-02	4.15E-02
RA-228	3.92E-02	3.92E-02
CO-60	3.85E-01	3.85E-01
MN-54	3.62E-02	3.62E-02
H-3	1.49E-06	1.49E-06

Source: 6

Nuclide	Receptor	Total
	1	
TH-232	1.12E+00	1.12E+00
TH-228	4.15E-02	4.15E-02
RA-228	3.92E-02	3.92E-02
CO-60	3.85E-01	3.85E-01
MN-54	3.62E-03	3.62E-03
H-3	1.49E-06	1.49E-06

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL Redo Mn54 100 percent removable.bld

Evaluation Time: 3.00000000 years

Source: 4

Nuclide	Receptor	Total
	1	
TH-232	1.95E+00	1.95E+00
TH-228	7.29E-02	7.29E-02
RA-228	6.89E-02	6.89E-02
CO-60	9.31E-01	9.31E-01
MN-54	1.01E-01	1.01E-01
H-3	2.61E-06	2.61E-06

Source: 5

Nuclide	Receptor	Total
	1	
TH-232	1.12E+00	1.12E+00
TH-228	4.15E-02	4.15E-02
RA-228	3.92E-02	3.92E-02
CO-60	3.85E-01	3.85E-01
MN-54	3.62E-02	3.62E-02
H-3	1.49E-06	1.49E-06

Source: 6

Nuclide	Receptor	Total
	1	
TH-232	1.12E+00	1.12E+00
TH-228	4.15E-02	4.15E-02
RA-228	3.92E-02	3.92E-02
CO-60	3.85E-01	3.85E-01
MN-54	3.62E-03	3.62E-03
H-3	1.49E-06	1.49E-06

## Time =1.00E+01 yr

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	1.561E+03
	TH-228	8.817E+02
	AC-227	4.619E-01
	RA-228	1.094E+03
	CO-60	5.775E+04

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL Redo Mn54 100 percent removable.bld

Evaluation Time: 10.0000000 years

MN-54	2.839E+02
H-3	3.266E+02

Source: 3

Location:: Room : 1 x: 0.00 y: 2.80 z: 2.00 [m]

Geometry:: Type: Area Length[m]:5.60E+00 Width[m]:4.00E+00 Direction: x

Pathway ::

Direct Ingestion Rate:	3.060E-06 [1/hr]
Fraction released to air:	3.570E-01
Removable fraction:	1.000E+00
Time to Remove:	1.000E+04 [day]

Contamination::	Nuclide	Concentration
		[dpm/m2]
	TH-232	1.561E+03
	TH-228	8.817E+02
	RA-228	1.094E+03
	CO-60	5.775E+04
	MN-54	2.839E+02
	H-3	3.266E+02

Source: 4

Location:: Room : 1 x: 3.20 y: 2.80 z: 2.00 [m]

Geometry:: Type: Area Length[m]:5.60E+00 Width[m]:4.00E+00 Direction: x

Pathway ::

Direct Ingestion Rate:	3.060E-06 [1/hr]
Fraction released to air:	3.570E-01
Removable fraction:	1.000E+00
Time to Remove:	1.000E+04 [day]

Contamination::	Nuclide	Concentration
		[dpm/m2]
	TH-232	1.561E+03
	TH-228	8.817E+02
	RA-228	1.094E+03
	CO-60	5.775E+04
	MN-54	2.839E+02
	H-3	3.266E+02

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL Redo Mn54 100 percent removable.bld

Evaluation Time: 10.0000000 years

Source: 5

Location:: Room : 1 x: 1.60 y: 0.00 z: 2.00 [m]

Geometry:: Type: Area Length[m]:3.20E+00 Width[m]:4.00E+00 Direction: y

Pathway ::

Direct Ingestion Rate: 3.060E-06 [1/hr]

Fraction released to air: 3.570E-01

Removable fraction: 1.000E+00

Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	1.561E+03
	TH-228	8.817E+02
	RA-228	1.094E+03
	CO-60	5.775E+04
	MN-54	2.839E+02
	H-3	3.266E+02

Source: 6

Location:: Room : 1 x: 1.60 y: 5.60 z: 2.00 [m]

Geometry:: Type: Area Length[m]:3.20E+00 Width[m]:4.00E+00 Direction: y

Pathway ::

Direct Ingestion Rate: 3.060E-06 [1/hr]

Fraction released to air: 3.570E-01

Removable fraction: 1.000E+00

Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	1.561E+03
	TH-228	8.817E+02
	RA-228	1.094E+03
	CO-60	5.775E+04
	MN-54	2.839E+01
	H-3	3.266E+02

## RESRAD-BUILD Dose Tables

## Source Contributions to Receptor Doses

```
[mrem]
```

	Source	Source	Source	Source	Source	Source	Total
	1	2	3	4	5	6	
Receptor 1	2.09E+00	1.90E+00	2.46E+00	2.46E+00	1.37E+00	1.37E+00	1.17E+01
Total	2.09E+00	1.90E+00	2.46E+00	2.46E+00	1.37E+00	1.37E+00	1.17E+01



Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL Redo Mn54 100 percent removable.bld

Evaluation Time: 10.0000000 years

Pathway Detail of Doses

[mrem]

Source: 1

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	2.61E-01	5.24E-04	6.06E-05	1.43E+00	8.88E-03	3.92E-01
Total	2.61E-01	5.24E-04	6.06E-05	1.43E+00	8.88E-03	3.92E-01

Source: 2

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	6.78E-02	5.24E-04	6.06E-05	1.43E+00	8.88E-03	3.92E-01
Total	6.78E-02	5.24E-04	6.06E-05	1.43E+00	8.88E-03	3.92E-01

Source: 3

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	1.72E-01	6.55E-04	7.58E-05	1.79E+00	1.11E-02	4.90E-01
Total	1.72E-01	6.55E-04	7.58E-05	1.79E+00	1.11E-02	4.90E-01

Source: 4

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	1.72E-01	6.55E-04	7.58E-05	1.79E+00	1.11E-02	4.90E-01
Total	1.72E-01	6.55E-04	7.58E-05	1.79E+00	1.11E-02	4.90E-01

Source: 5

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	5.57E-02	3.74E-04	4.33E-05	1.02E+00	6.34E-03	2.80E-01
Total	5.57E-02	3.74E-04	4.33E-05	1.02E+00	6.34E-03	2.80E-01

Source: 6

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	5.56E-02	3.74E-04	4.33E-05	1.02E+00	6.34E-03	2.80E-01
Total	5.56E-02	3.74E-04	4.33E-05	1.02E+00	6.34E-03	2.80E-01

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL Redo Mn54 100 percent removable.bld

Evaluation Time: 10.0000000 years

# Nuclide Detail of Doses

[mrem]

Source: 1

Nuclide	Receptor	Total
	1	
TH-232	1.48E+00	1.48E+00
TH-228	2.00E-01	2.00E-01
RA-228	8.34E-02	8.34E-02
CO-60	3.33E-01	3.33E-01
MN-54	3.51E-04	3.51E-04
H-3	1.00E-06	1.00E-06

Source: 2

Nuclide	Receptor	Total
	1	
TH-232	1.48E+00	1.48E+00
TH-228	1.98E-01	1.98E-01
RA-228	8.18E-02	8.18E-02
AC-227	1.84E-03	1.84E-03
CO-60	1.44E-01	1.44E-01
MN-54	1.12E-04	1.12E-04
H-3	1.00E-06	1.00E-06

Source: 3

Nuclide	Receptor	Total
	1	
TH-232	1.85E+00	1.85E+00
TH-228	2.48E-01	2.48E-01
RA-228	1.03E-01	1.03E-01
CO-60	2.65E-01	2.65E-01
MN-54	2.48E-04	2.48E-04
H-3	1.25E-06	1.25E-06

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL Redo Mn54 100 percent removable.bld

Evaluation Time: 10.0000000 years

Source: 4

Nuclide	Receptor	Total
	1	
TH-232	1.85E+00	1.85E+00
TH-228	2.48E-01	2.48E-01
RA-228	1.03E-01	1.03E-01
CO-60	2.65E-01	2.65E-01
MN-54	2.48E-04	2.48E-04
H-3	1.25E-06	1.25E-06

Source: 5

Nuclide	Receptor	Total
	1	
TH-232	1.06E+00	1.06E+00
TH-228	1.41E-01	1.41E-01
RA-228	5.85E-02	5.85E-02
CO-60	1.10E-01	1.10E-01
MN-54	8.88E-05	8.88E-05
H-3	7.16E-07	7.16E-07

Source: 6

Nuclide	Receptor	Total
	1	
TH-232	1.06E+00	1.06E+00
TH-228	1.41E-01	1.41E-01
RA-228	5.85E-02	5.85E-02
CO-60	1.10E-01	1.10E-01
MN-54	8.88E-06	8.88E-06
H-3	7.16E-07	7.16E-07

Assessment for Time: 5
Time =3.00E+01 yr

Source Information

Source: 1  
Location:: Room : 1 x: 1.60 y: 2.80 z: 0.00 [m]  
Geometry:: Type: Area Length[m]:3.20E+00 Width[m]:5.60E+00 Direction: z  
Pathway ::  
Direct Ingestion Rate: 3.060E-06 [1/hr]  
Fraction released to air: 3.570E-01  
Removable fraction: 0.000E+00  
Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration
		[dpm/m2]
	TH-232	0.000E+00
	TH-228	0.000E+00
	RA-228	0.000E+00
	CO-60	0.000E+00
	MN-54	0.000E+00
	H-3	0.000E+00

Source: 2  
Location:: Room : 1 x: 1.60 y: 2.80 z: 4.00 [m]  
Geometry:: Type: Area Length[m]:3.20E+00 Width[m]:5.60E+00 Direction: z  
Pathway ::  
Direct Ingestion Rate: 3.060E-06 [1/hr]  
Fraction released to air: 3.570E-01  
Removable fraction: 0.000E+00  
Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration
		[dpm/m2]
	TH-232	0.000E+00
	TH-228	0.000E+00
	AC-227	0.000E+00
	RA-228	0.000E+00
	CO-60	0.000E+00

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL Redo Mn54 100 percent removable.bld

Evaluation Time: 30.0000000 years

MN-54	0.000E+00
H-3	0.000E+00

Source: 3

Location:: Room : 1 x: 0.00 y: 2.80 z: 2.00 [m]

Geometry:: Type: Area Length[m]:5.60E+00 Width[m]:4.00E+00 Direction: x

Pathway ::

Direct Ingestion Rate:	3.060E-06 [1/hr]
Fraction released to air:	3.570E-01
Removable fraction:	0.000E+00
Time to Remove:	1.000E+04 [day]

Contamination::	Nuclide	Concentration
		[dpm/m2]
	TH-232	0.000E+00
	TH-228	0.000E+00
	RA-228	0.000E+00
	CO-60	0.000E+00
	MN-54	0.000E+00
	H-3	0.000E+00

Source: 4

Location:: Room : 1 x: 3.20 y: 2.80 z: 2.00 [m]

Geometry:: Type: Area Length[m]:5.60E+00 Width[m]:4.00E+00 Direction: x

Pathway ::

Direct Ingestion Rate:	3.060E-06 [1/hr]
Fraction released to air:	3.570E-01
Removable fraction:	0.000E+00
Time to Remove:	1.000E+04 [day]

Contamination::	Nuclide	Concentration
		[dpm/m2]
	TH-232	0.000E+00
	TH-228	0.000E+00
	RA-228	0.000E+00
	CO-60	0.000E+00
	MN-54	0.000E+00
	H-3	0.000E+00

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL Redo Mn54 100 percent removable.bld

Evaluation Time: 30.0000000 years

Source: 5

Location:: Room : 1 x: 1.60 y: 0.00 z: 2.00 [m]

Geometry:: Type: Area Length[m]:3.20E+00 Width[m]:4.00E+00 Direction: y

Pathway ::

Direct Ingestion Rate: 3.060E-06 [1/hr]

Fraction released to air: 3.570E-01

Removable fraction: 0.000E+00

Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	0.000E+00
	TH-228	0.000E+00
	RA-228	0.000E+00
	CO-60	0.000E+00
	MN-54	0.000E+00
	H-3	0.000E+00

Source: 6

Location:: Room : 1 x: 1.60 y: 5.60 z: 2.00 [m]

Geometry:: Type: Area Length[m]:3.20E+00 Width[m]:4.00E+00 Direction: y

Pathway ::

Direct Ingestion Rate: 3.060E-06 [1/hr]

Fraction released to air: 3.570E-01

Removable fraction: 0.000E+00

Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	0.000E+00
	TH-228	0.000E+00
	RA-228	0.000E+00
	CO-60	0.000E+00
	MN-54	0.000E+00
	H-3	0.000E+00

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL Redo Mn54 100 percent removable.bld

Evaluation Time: 100.000008 years

```

=====
=====
=====
Assessment for Time: 6
Time =1.00E+02 yr
=====
=====
=====

```

===== Source Information =====

Source: 1

Location:: Room : 1 x: 1.60 y: 2.80 z: 0.00 [m]

Geometry:: Type: Area Length[m]:3.20E+00 Width[m]:5.60E+00 Direction: z

Pathway ::

Direct Ingestion Rate: 3.060E-06 [1/hr]

Fraction released to air: 3.570E-01

Removable fraction: 0.000E+00

Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	0.000E+00
	TH-228	0.000E+00
	RA-228	0.000E+00
	CO-60	0.000E+00
	MN-54	0.000E+00
	H-3	0.000E+00

Source: 2

Location:: Room : 1 x: 1.60 y: 2.80 z: 4.00 [m]

Geometry:: Type: Area Length[m]:3.20E+00 Width[m]:5.60E+00 Direction: z

Pathway ::

Direct Ingestion Rate: 3.060E-06 [1/hr]

Fraction released to air: 3.570E-01

Removable fraction: 0.000E+00

Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	0.000E+00
	TH-228	0.000E+00
	AC-227	0.000E+00
	RA-228	0.000E+00
	CO-60	0.000E+00

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL Redo Mn54 100 percent removable.bld

Evaluation Time: 100.000008 years

MN-54	0.000E+00
H-3	0.000E+00

Source: 3

Location:: Room : 1 x: 0.00 y: 2.80 z: 2.00 [m]

Geometry:: Type: Area Length[m]:5.60E+00 Width[m]:4.00E+00 Direction: x

Pathway ::

Direct Ingestion Rate: 3.060E-06 [1/hr]

Fraction released to air: 3.570E-01

Removable fraction: 0.000E+00

Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration
		[dpm/m2]
	TH-232	0.000E+00
	TH-228	0.000E+00
	RA-228	0.000E+00
	CO-60	0.000E+00
	MN-54	0.000E+00
	H-3	0.000E+00

Source: 4

Location:: Room : 1 x: 3.20 y: 2.80 z: 2.00 [m]

Geometry:: Type: Area Length[m]:5.60E+00 Width[m]:4.00E+00 Direction: x

Pathway ::

Direct Ingestion Rate: 3.060E-06 [1/hr]

Fraction released to air: 3.570E-01

Removable fraction: 0.000E+00

Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration
		[dpm/m2]
	TH-232	0.000E+00
	TH-228	0.000E+00
	RA-228	0.000E+00
	CO-60	0.000E+00
	MN-54	0.000E+00
	H-3	0.000E+00



Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL Redo Mn54 100 percent removable.bld

Evaluation Time: 100.000008 years

Source: 5

Location:: Room : 1 x: 1.60 y: 0.00 z: 2.00 [m]

Geometry:: Type: Area Length[m]:3.20E+00 Width[m]:4.00E+00 Direction: y

Pathway ::

Direct Ingestion Rate: 3.060E-06 [1/hr]

Fraction released to air: 3.570E-01

Removable fraction: 0.000E+00

Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	0.000E+00
	TH-228	0.000E+00
	RA-228	0.000E+00
	CO-60	0.000E+00
	MN-54	0.000E+00
	H-3	0.000E+00

Source: 6

Location:: Room : 1 x: 1.60 y: 5.60 z: 2.00 [m]

Geometry:: Type: Area Length[m]:3.20E+00 Width[m]:4.00E+00 Direction: y

Pathway ::

Direct Ingestion Rate: 3.060E-06 [1/hr]

Fraction released to air: 3.570E-01

Removable fraction: 0.000E+00

Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	0.000E+00
	TH-228	0.000E+00
	RA-228	0.000E+00
	CO-60	0.000E+00
	MN-54	0.000E+00
	H-3	0.000E+00

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL Redo Mn54 100 percent removable.bld

Evaluation Time: 300.000092 years

Assessment for Time: 7

Time =3.00E+02 yr

Source Information

Source: 1

Location:: Room : 1 x: 1.60 y: 2.80 z: 0.00 [m]

Geometry:: Type: Area Length[m]:3.20E+00 Width[m]:5.60E+00 Direction: z

Pathway ::

Direct Ingestion Rate: 3.060E-06 [1/hr]

Fraction released to air: 3.570E-01

Removable fraction: 0.000E+00

Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	0.000E+00
	TH-228	0.000E+00
	RA-228	0.000E+00
	CO-60	0.000E+00
	MN-54	0.000E+00
	H-3	0.000E+00

Source: 2

Location:: Room : 1 x: 1.60 y: 2.80 z: 4.00 [m]

Geometry:: Type: Area Length[m]:3.20E+00 Width[m]:5.60E+00 Direction: z

Pathway ::

Direct Ingestion Rate: 3.060E-06 [1/hr]

Fraction released to air: 3.570E-01

Removable fraction: 0.000E+00

Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	0.000E+00
	TH-228	0.000E+00
	AC-227	0.000E+00
	RA-228	0.000E+00
	CO-60	0.000E+00

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL Redo Mn54 100 percent removable.bld

Evaluation Time: 300.000092 years

MN-54	0.000E+00
H-3	0.000E+00

Source: 3

Location:: Room : 1 x: 0.00 y: 2.80 z: 2.00 [m]

Geometry:: Type: Area Length[m]:5.60E+00 Width[m]:4.00E+00 Direction: x

Pathway ::

Direct Ingestion Rate: 3.060E-06 [1/hr]

Fraction released to air: 3.570E-01

Removable fraction: 0.000E+00

Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration
		[dpm/m2]
	TH-232	0.000E+00
	TH-228	0.000E+00
	RA-228	0.000E+00
	CO-60	0.000E+00
	MN-54	0.000E+00
	H-3	0.000E+00

Source: 4

Location:: Room : 1 x: 3.20 y: 2.80 z: 2.00 [m]

Geometry:: Type: Area Length[m]:5.60E+00 Width[m]:4.00E+00 Direction: x

Pathway ::

Direct Ingestion Rate: 3.060E-06 [1/hr]

Fraction released to air: 3.570E-01

Removable fraction: 0.000E+00

Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration
		[dpm/m2]
	TH-232	0.000E+00
	TH-228	0.000E+00
	RA-228	0.000E+00
	CO-60	0.000E+00
	MN-54	0.000E+00
	H-3	0.000E+00

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL Redo Mn54 100 percent removable.bld

Evaluation Time: 300.000092 years

Source: 5

Location:: Room : 1 x: 1.60 y: 0.00 z: 2.00 [m]

Geometry:: Type: Area Length[m]:3.20E+00 Width[m]:4.00E+00 Direction: y

Pathway ::

Direct Ingestion Rate: 3.060E-06 [1/hr]

Fraction released to air: 3.570E-01

Removable fraction: 0.000E+00

Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	0.000E+00
	TH-228	0.000E+00
	RA-228	0.000E+00
	CO-60	0.000E+00
	MN-54	0.000E+00
	H-3	0.000E+00

Source: 6

Location:: Room : 1 x: 1.60 y: 5.60 z: 2.00 [m]

Geometry:: Type: Area Length[m]:3.20E+00 Width[m]:4.00E+00 Direction: y

Pathway ::

Direct Ingestion Rate: 3.060E-06 [1/hr]

Fraction released to air: 3.570E-01

Removable fraction: 0.000E+00

Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	0.000E+00
	TH-228	0.000E+00
	RA-228	0.000E+00
	CO-60	0.000E+00
	MN-54	0.000E+00
	H-3	0.000E+00

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL Redo Mn54 100 percent removable.bld

Evaluation Time: 1000.00000 years

```
=====
=====
=====
Assessment for Time: 8
Time =1.00E+03 yr
=====
=====
```

===== Source Information =====

Source: 1

Location:: Room : 1 x: 1.60 y: 2.80 z: 0.00 [m]

Geometry:: Type: Area Length[m]:3.20E+00 Width[m]:5.60E+00 Direction: z

Pathway ::

Direct Ingestion Rate: 3.060E-06 [l/hr]

Fraction released to air: 3.570E-01

Removable fraction: 0.000E+00

Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	0.000E+00
	TH-228	0.000E+00
	RA-228	0.000E+00
	CO-60	0.000E+00
	MN-54	0.000E+00
	H-3	0.000E+00

Source: 2

Location:: Room : 1 x: 1.60 y: 2.80 z: 4.00 [m]

Geometry:: Type: Area Length[m]:3.20E+00 Width[m]:5.60E+00 Direction: z

Pathway ::

Direct Ingestion Rate: 3.060E-06 [l/hr]

Fraction released to air: 3.570E-01

Removable fraction: 0.000E+00

Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	0.000E+00
	TH-228	0.000E+00
	AC-227	0.000E+00
	RA-228	0.000E+00
	CO-60	0.000E+00

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL Redo Mn54 100 percent removable.bld

Evaluation Time: 1000.00000 years

MN-54	0.000E+00
H-3	0.000E+00

Source: 3

Location:: Room : 1 x: 0.00 y: 2.80 z: 2.00 [m]

Geometry:: Type: Area Length[m]:5.60E+00 Width[m]:4.00E+00 Direction: x

Pathway ::

Direct Ingestion Rate:	3.060E-06 [l/hr]
Fraction released to air:	3.570E-01
Removable fraction:	0.000E+00
Time to Remove:	1.000E+04 [day]

Contamination::	Nuclide	Concentration
		[dpm/m2]
	TH-232	0.000E+00
	TH-228	0.000E+00
	RA-228	0.000E+00
	CO-60	0.000E+00
	MN-54	0.000E+00
	H-3	0.000E+00

Source: 4

Location:: Room : 1 x: 3.20 y: 2.80 z: 2.00 [m]

Geometry:: Type: Area Length[m]:5.60E+00 Width[m]:4.00E+00 Direction: x

Pathway ::

Direct Ingestion Rate:	3.060E-06 [l/hr]
Fraction released to air:	3.570E-01
Removable fraction:	0.000E+00
Time to Remove:	1.000E+04 [day]

Contamination::	Nuclide	Concentration
		[dpm/m2]
	TH-232	0.000E+00
	TH-228	0.000E+00
	RA-228	0.000E+00
	CO-60	0.000E+00
	MN-54	0.000E+00
	H-3	0.000E+00

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL Redo Mn54 100 percent removable.bld

Evaluation Time: 1000.00000 years

Source: 5

Location:: Room : 1 x: 1.60 y: 0.00 z: 2.00 [m]

Geometry:: Type: Area Length[m]:3.20E+00 Width[m]:4.00E+00 Direction: y

Pathway ::

Direct Ingestion Rate: 3.060E-06 [1/hr]

Fraction released to air: 3.570E-01

Removable fraction: 0.000E+00

Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	0.000E+00
	TH-228	0.000E+00
	RA-228	0.000E+00
	CO-60	0.000E+00
	MN-54	0.000E+00
	H-3	0.000E+00

Source: 6

Location:: Room : 1 x: 1.60 y: 5.60 z: 2.00 [m]

Geometry:: Type: Area Length[m]:3.20E+00 Width[m]:4.00E+00 Direction: y

Pathway ::

Direct Ingestion Rate: 3.060E-06 [1/hr]

Fraction released to air: 3.570E-01

Removable fraction: 0.000E+00

Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	0.000E+00
	TH-228	0.000E+00
	RA-228	0.000E+00
	CO-60	0.000E+00
	MN-54	0.000E+00
	H-3	0.000E+00

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL Redo Mn54 100 percent removable.bld

Evaluation Time: 3000.00000 years

Assessment for Time: 9

Time =3.00E+03 yr

Source Information

Source: 1

Location:: Room : 1 x: 1.60 y: 2.80 z: 0.00 [m]

Geometry:: Type: Area Length[m]:3.20E+00 Width[m]:5.60E+00 Direction: z

Pathway ::

Direct Ingestion Rate: 3.060E-06 [1/hr]

Fraction released to air: 3.570E-01

Removable fraction: 0.000E+00

Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	0.000E+00
	TH-228	0.000E+00
	RA-228	0.000E+00
	CO-60	0.000E+00
	MN-54	0.000E+00
	H-3	0.000E+00

Source: 2

Location:: Room : 1 x: 1.60 y: 2.80 z: 4.00 [m]

Geometry:: Type: Area Length[m]:3.20E+00 Width[m]:5.60E+00 Direction: z

Pathway ::

Direct Ingestion Rate: 3.060E-06 [1/hr]

Fraction released to air: 3.570E-01

Removable fraction: 0.000E+00

Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	0.000E+00
	TH-228	0.000E+00
	AC-227	0.000E+00
	RA-228	0.000E+00
	CO-60	0.000E+00



Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL Redo Mn54 100 percent removable.bld

Evaluation Time: 3000.00000 years

MN-54	0.000E+00
H-3	0.000E+00

Source: 3

Location:: Room : 1 x: 0.00 y: 2.80 z: 2.00 [m]

Geometry:: Type: Area Length[m]:5.60E+00 Width[m]:4.00E+00 Direction: x

Pathway ::

Direct Ingestion Rate:	3.060E-06 [1/hr]
Fraction released to air:	3.570E-01
Removable fraction:	0.000E+00
Time to Remove:	1.000E+04 [day]

Contamination::	Nuclide	Concentration
		[dpm/m2]
	TH-232	0.000E+00
	TH-228	0.000E+00
	RA-228	0.000E+00
	CO-60	0.000E+00
	MN-54	0.000E+00
	H-3	0.000E+00

Source: 4

Location:: Room : 1 x: 3.20 y: 2.80 z: 2.00 [m]

Geometry:: Type: Area Length[m]:5.60E+00 Width[m]:4.00E+00 Direction: x

Pathway ::

Direct Ingestion Rate:	3.060E-06 [1/hr]
Fraction released to air:	3.570E-01
Removable fraction:	0.000E+00
Time to Remove:	1.000E+04 [day]

Contamination::	Nuclide	Concentration
		[dpm/m2]
	TH-232	0.000E+00
	TH-228	0.000E+00
	RA-228	0.000E+00
	CO-60	0.000E+00
	MN-54	0.000E+00
	H-3	0.000E+00

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL Redo Mn54 100 percent removable.bld

Evaluation Time: 3000.00000 years

Source: 5

Location:: Room : 1 x: 1.60 y: 0.00 z: 2.00 [m]

Geometry:: Type: Area Length[m]:3.20E+00 Width[m]:4.00E+00 Direction: y

Pathway ::

Direct Ingestion Rate: 3.060E-06 [1/hr]

Fraction released to air: 3.570E-01

Removable fraction: 0.000E+00

Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	0.000E+00
	TH-228	0.000E+00
	RA-228	0.000E+00
	CO-60	0.000E+00
	MN-54	0.000E+00
	H-3	0.000E+00

Source: 6

Location:: Room : 1 x: 1.60 y: 5.60 z: 2.00 [m]

Geometry:: Type: Area Length[m]:3.20E+00 Width[m]:4.00E+00 Direction: y

Pathway ::

Direct Ingestion Rate: 3.060E-06 [1/hr]

Fraction released to air: 3.570E-01

Removable fraction: 0.000E+00

Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	0.000E+00
	TH-228	0.000E+00
	RA-228	0.000E+00
	CO-60	0.000E+00
	MN-54	0.000E+00
	H-3	0.000E+00

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL Redo Mn54 100 percent removable.bld

Evaluation Time: 10000.0000 years

Assessment for Time: 10

Time =1.00E+04 yr

Source Information

Source: 1

Location:: Room : 1 x: 1.60 y: 2.80 z: 0.00 [m]

Geometry:: Type: Area Length[m]:3.20E+00 Width[m]:5.60E+00 Direction: z

Pathway ::

Direct Ingestion Rate: 3.060E-06 [1/hr]

Fraction released to air: 3.570E-01

Removable fraction: 0.000E+00

Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	0.000E+00
	TH-228	0.000E+00
	RA-228	0.000E+00
	CO-60	0.000E+00
	MN-54	0.000E+00
	H-3	0.000E+00

Source: 2

Location:: Room : 1 x: 1.60 y: 2.80 z: 4.00 [m]

Geometry:: Type: Area Length[m]:3.20E+00 Width[m]:5.60E+00 Direction: z

Pathway ::

Direct Ingestion Rate: 3.060E-06 [1/hr]

Fraction released to air: 3.570E-01

Removable fraction: 0.000E+00

Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	0.000E+00
	TH-228	0.000E+00
	AC-227	0.000E+00
	RA-228	0.000E+00
	CO-60	0.000E+00

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL Redo Mn54 100 percent removable.bld

Evaluation Time: 10000.0000 years

MN-54	0.000E+00
H-3	0.000E+00

Source: 3

Location:: Room : 1 x: 0.00 y: 2.80 z: 2.00 [m]

Geometry:: Type: Area Length[m]:5.60E+00 Width[m]:4.00E+00 Direction: x

Pathway ::

Direct Ingestion Rate:	3.060E-06 [1/hr]
Fraction released to air:	3.570E-01
Removable fraction:	0.000E+00
Time to Remove:	1.000E+04 [day]

Contamination::	Nuclide	Concentration
		[dpm/m2]
	TH-232	0.000E+00
	TH-228	0.000E+00
	RA-228	0.000E+00
	CO-60	0.000E+00
	MN-54	0.000E+00
	H-3	0.000E+00

Source: 4

Location:: Room : 1 x: 3.20 y: 2.80 z: 2.00 [m]

Geometry:: Type: Area Length[m]:5.60E+00 Width[m]:4.00E+00 Direction: x

Pathway ::

Direct Ingestion Rate:	3.060E-06 [1/hr]
Fraction released to air:	3.570E-01
Removable fraction:	0.000E+00
Time to Remove:	1.000E+04 [day]

Contamination::	Nuclide	Concentration
		[dpm/m2]
	TH-232	0.000E+00
	TH-228	0.000E+00
	RA-228	0.000E+00
	CO-60	0.000E+00
	MN-54	0.000E+00
	H-3	0.000E+00

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL Redo Mn54 100 percent removable.bld

Evaluation Time: 10000.0000 years

Source: 5

Location:: Room : 1 x: 1.60 y: 0.00 z: 2.00 [m]

Geometry:: Type: Area Length[m]:3.20E+00 Width[m]:4.00E+00 Direction: y

Pathway ::

Direct Ingestion Rate: 3.060E-06 [1/hr]

Fraction released to air: 3.570E-01

Removable fraction: 0.000E+00

Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	0.000E+00
	TH-228	0.000E+00
	RA-228	0.000E+00
	CO-60	0.000E+00
	MN-54	0.000E+00
	H-3	0.000E+00

Source: 6

Location:: Room : 1 x: 1.60 y: 5.60 z: 2.00 [m]

Geometry:: Type: Area Length[m]:3.20E+00 Width[m]:4.00E+00 Direction: y

Pathway ::

Direct Ingestion Rate: 3.060E-06 [1/hr]

Fraction released to air: 3.570E-01

Removable fraction: 0.000E+00

Time to Remove: 1.000E+04 [day]

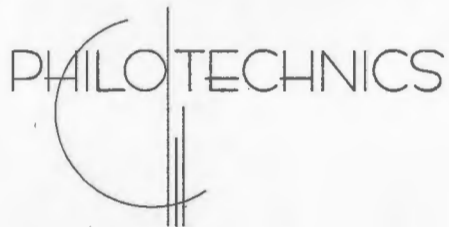
Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	0.000E+00
	TH-228	0.000E+00
	RA-228	0.000E+00
	CO-60	0.000E+00
	MN-54	0.000E+00
	H-3	0.000E+00



**CDC**

**RAW Room #1**

**Final Status Survey Report Appendix**



Prepared by:

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**Oak Ridge, TN 37830**

**Appendix H.2 –  
RESRAD Build Results**

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL End of Project.bld

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Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL End of Project.bld

---



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RESRAD-BUILD Input Parameters

---



---

Number of Sources : 6  
 Number of Receptors: 1  
 Total Time : 3.650000E+02 days  
 Fraction Inside : 2.300000E-01

---

Receptor Information

---

Receptor	Room	x [m]	y [m]	z [m]	FracTime	Inhalation [m3/day]	Ingestion(Dust) [m2/hr]
1	1	1.600	2.800	1.000	1.000	1.80E+01	1.12E-04

---

Receptor-Source Shielding Relationship

---

Receptor	Source	Density [g/cm3]	Thickness [cm]	Material
1	1	2.40E+00	0.00E+00	Concrete
1	2	2.40E+00	0.00E+00	Concrete
1	3	2.40E+00	0.00E+00	Concrete
1	4	2.40E+00	0.00E+00	Concrete
1	5	2.40E+00	0.00E+00	Concrete
1	6	2.40E+00	0.00E+00	Concrete

===== Building Information =====

Building Air Exchange Rate: 8.00E-01 1/hr

Height[m]	Air Exchanges [m3/hr]	
Area [m2]		
	*****	
	*	*
	*	*
	*	<=Q01: 5.76E+01
H1: 4.000	* Room 1	* Q10 : 5.76E+01
	* LAMBDA: 8.00E-01	*
Area 18.000	*	*
	*	*
	*****	

Deposition velocity: 1.00E-02 [m/s]    Resuspension Rate: 3.70E-06 [1/s]

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL End of Project.bld

===== Source Information =====

Source: 1

Location:: Room : 1 x: 1.60 y: 2.80 z: 0.00[m]

Geometry:: Type: Area Length[m]:3.20E+00 Width[m]:5.60E+00 Direction: z

Pathway ::

Direct Ingestion Rate: 3.060E-06 [1/hr]

Fraction released to air: 3.570E-01

Removable fraction: 1.000E-01

Time to Remove: 1.000E+04 [day]

Radon Release Fraction: 1.000E-01

Contamination::

Nuclide Concentration Dose Conversion Factor (Library: FGR 11)

		Ingestion	Inhalation	Submersion
	[dpm/m2]	[mrem/dpm]	[mrem/dpm]	[mrem/yr/ (dpm/m3)]
TH-232	2.460E+03	1.230E-03	7.387E-01	4.588E-07
TH-228	0.000E+00	3.642E-04	1.556E-01	4.224E-03
RA-228	0.000E+00	6.496E-04	2.287E-03	2.515E-03
CO-60	3.390E+05	1.212E-05	9.865E-05	6.629E-03
MN-54	4.170E+05	1.248E-06	3.018E-06	2.152E-03
H-3	9.000E+02	2.883E-08	2.883E-08	1.741E-08

Source: 2

Location:: Room : 1 x: 1.60 y: 2.80 z: 4.00[m]

Geometry:: Type: Area Length[m]:3.20E+00 Width[m]:5.60E+00 Direction: z

Pathway ::

Direct Ingestion Rate: 3.060E-06 [1/hr]

Fraction released to air: 3.570E-01

Removable fraction: 1.000E-01

Time to Remove: 1.000E+04 [day]

Radon Release Fraction: 1.000E-01

Contamination::

Nuclide Concentration Dose Conversion Factor (Library: FGR 11)

		Ingestion	Inhalation	Submersion
	[dpm/m2]	[mrem/dpm]	[mrem/dpm]	[mrem/yr/ (dpm/m3)]

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL End of Project.bld

TH-232	2.460E+03	1.230E-03	7.387E-01	4.588E-07
TH-228	0.000E+00	3.642E-04	1.556E-01	4.224E-03
RA-228	0.000E+00	6.496E-04	2.287E-03	2.515E-03
CO-60	3.390E+05	1.212E-05	9.865E-05	6.629E-03
MN-54	4.170E+05	1.248E-06	3.018E-06	2.152E-03
H-3	9.000E+02	2.883E-08	2.883E-08	1.741E-08

Source: 3

Location:: Room : 1 x: 0.00 y: 2.80 z: 2.00[m]

Geometry:: Type: Area Length[m]:5.60E+00 Width[m]:4.00E+00 Direction: x

Pathway ::

Direct Ingestion Rate: 3.060E-06 [1/hr]

Fraction released to air: 3.570E-01

Removable fraction: 1.000E-01

Time to Remove: 1.000E+04 [day]

Radon Release Fraction: 1.000E-01

Contamination::

Nuclide Concentration Dose Conversion Factor (Library: FGR 11)

		Ingestion	Inhalation	Submersion
	[dpm/m2]	[mrem/dpm]	[mrem/dpm]	[mrem/yr/ (dpm/m3)]
TH-232	2.460E+03	1.230E-03	7.387E-01	4.588E-07
TH-228	0.000E+00	3.642E-04	1.556E-01	4.224E-03
RA-228	0.000E+00	6.496E-04	2.287E-03	2.515E-03
CO-60	3.390E+05	1.212E-05	9.865E-05	6.629E-03
MN-54	4.170E+05	1.248E-06	3.018E-06	2.152E-03
H-3	9.000E+02	2.883E-08	2.883E-08	1.741E-08

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL End of Project.bld

Source: 4

Location:: Room : 1 x: 3.20 y: 2.80 z: 2.00[m]  
 Geometry:: Type: Area Length[m]:5.60E+00 Width[m]:4.00E+00 Direction: x  
 Pathway ::  
 Direct Ingestion Rate: 3.060E-06 [1/hr]  
 Fraction released to air: 3.570E-01  
 Removable fraction: 1.000E-01  
 Time to Remove: 1.000E+04 [day]  
 Radon Release Fraction: 1.000E-01

Contamination::

Nuclide Concentration Dose Conversion Factor (Library: FGR 11)

		Ingestion	Inhalation	Submersion
	[dpm/m2]	[mrem/dpm]	[mrem/dpm]	[mrem/yr/ (dpm/m3)]
TH-232	2.460E+03	1.230E-03	7.387E-01	4.588E-07
TH-228	0.000E+00	3.642E-04	1.556E-01	4.224E-03
RA-228	0.000E+00	6.496E-04	2.287E-03	2.515E-03
CO-60	3.390E+05	1.212E-05	9.865E-05	6.629E-03
MN-54	4.170E+05	1.248E-06	3.018E-06	2.152E-03
H-3	9.000E+02	2.883E-08	2.883E-08	1.741E-08

Source: 5

Location:: Room : 1 x: 1.60 y: 0.00 z: 2.00[m]  
 Geometry:: Type: Area Length[m]:3.20E+00 Width[m]:4.00E+00 Direction: y  
 Pathway ::  
 Direct Ingestion Rate: 3.060E-06 [1/hr]  
 Fraction released to air: 3.570E-01  
 Removable fraction: 1.000E-01  
 Time to Remove: 1.000E+04 [day]  
 Radon Release Fraction: 1.000E-01

Contamination::

Nuclide Concentration Dose Conversion Factor (Library: FGR 11)

		Ingestion	Inhalation	Submersion
	[dpm/m2]	[mrem/dpm]	[mrem/dpm]	[mrem/yr/ (dpm/m3)]
TH-232	2.460E+03	1.230E-03	7.387E-01	4.588E-07
TH-228	0.000E+00	3.642E-04	1.556E-01	4.224E-03
RA-228	0.000E+00	6.496E-04	2.287E-03	2.515E-03

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL End of Project.bld

CO-60	3.390E+05	1.212E-05	9.865E-05	6.629E-03
MN-54	4.170E+05	1.248E-06	3.018E-06	2.152E-03
H-3	9.000E+02	2.883E-08	2.883E-08	1.741E-08

Source: 6

Location:: Room : 1 x: 1.60 y: 5.60 z: 2.00[m]

Geometry:: Type: Area Length[m]:3.20E+00 Width[m]:4.00E+00 Direction: y

Pathway ::

Direct Ingestion Rate: 3.060E-06 [1/hr]

Fraction released to air: 3.570E-01

Removable fraction: 1.000E-01

Time to Remove: 1.000E+04 [day]

Radon Release Fraction: 1.000E-01

Contamination::

Nuclide Concentration Dose Conversion Factor (Library: FGR 11)

		Ingestion	Inhalation	Submersion
	[dpm/m2]	[mrem/dpm]	[mrem/dpm]	[mrem/yr/ (dpm/m3)]
TH-232	2.460E+03	1.230E-03	7.387E-01	4.588E-07
TH-228	0.000E+00	3.642E-04	1.556E-01	4.224E-03
RA-228	0.000E+00	6.496E-04	2.287E-03	2.515E-03
CO-60	3.390E+05	1.212E-05	9.865E-05	6.629E-03
MN-54	4.170E+05	1.248E-06	3.018E-06	2.152E-03
H-3	9.000E+02	2.883E-08	2.883E-08	1.741E-08

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL End of Project.bld

Evaluation Time: 0.00000000E+00 years

```

=====
=====
=====
Assessment for Time: 1
Time =0.00E+00 yr
=====
=====
=====

```

===== Source Information =====

Source: 1

Location:: Room : 1 x: 1.60 y: 2.80 z: 0.00 [m]  
 Geometry:: Type: Area Length[m]:3.20E+00 Width[m]:5.60E+00 Direction: z  
 Pathway ::  
 Direct Ingestion Rate: 3.060E-06 [1/hr]  
 Fraction released to air: 3.570E-01  
 Removable fraction: 1.000E-01  
 Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	2.460E+03
	TH-228	0.000E+00
	RA-228	0.000E+00
	CO-60	3.390E+05
	MN-54	4.170E+05
	H-3	9.000E+02

Source: 2

Location:: Room : 1 x: 1.60 y: 2.80 z: 4.00 [m]  
 Geometry:: Type: Area Length[m]:3.20E+00 Width[m]:5.60E+00 Direction: z  
 Pathway ::  
 Direct Ingestion Rate: 3.060E-06 [1/hr]  
 Fraction released to air: 3.570E-01  
 Removable fraction: 1.000E-01  
 Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	2.460E+03
	TH-228	0.000E+00
	RA-228	0.000E+00
	CO-60	3.390E+05
	MN-54	4.170E+05



Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL End of Project.bld

Evaluation Time: 0.0000000E+00 years

H-3 9.000E+02

Source: 3

Location:: Room : 1 x: 0.00 y: 2.80 z: 2.00 [m]

Geometry:: Type: Area Length[m]:5.60E+00 Width[m]:4.00E+00 Direction: x

Pathway ::

Direct Ingestion Rate: 3.060E-06 [l/hr]

Fraction released to air: 3.570E-01

Removable fraction: 1.000E-01

Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	2.460E+03
	TH-228	0.000E+00
	RA-228	0.000E+00
	CO-60	3.390E+05
	MN-54	4.170E+05
	H-3	9.000E+02

Source: 4

Location:: Room : 1 x: 3.20 y: 2.80 z: 2.00 [m]

Geometry:: Type: Area Length[m]:5.60E+00 Width[m]:4.00E+00 Direction: x

Pathway ::

Direct Ingestion Rate: 3.060E-06 [l/hr]

Fraction released to air: 3.570E-01

Removable fraction: 1.000E-01

Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	2.460E+03
	TH-228	0.000E+00
	RA-228	0.000E+00
	CO-60	3.390E+05
	MN-54	4.170E+05
	H-3	9.000E+02

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL End of Project.bld

Evaluation Time: 0.0000000E+00 years

Source: 5

Location:: Room : 1 x: 1.60 y: 0.00 z: 2.00 [m]

Geometry:: Type: Area Length[m]:3.20E+00 Width[m]:4.00E+00 Direction: y

Pathway ::

Direct Ingestion Rate: 3.060E-06 [1/hr]

Fraction released to air: 3.570E-01

Removable fraction: 1.000E-01

Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	2.460E+03
	TH-228	0.000E+00
	RA-228	0.000E+00
	CO-60	3.390E+05
	MN-54	4.170E+05
	H-3	9.000E+02

Source: 6

Location:: Room : 1 x: 1.60 y: 5.60 z: 2.00 [m]

Geometry:: Type: Area Length[m]:3.20E+00 Width[m]:4.00E+00 Direction: y

Pathway ::

Direct Ingestion Rate: 3.060E-06 [1/hr]

Fraction released to air: 3.570E-01

Removable fraction: 1.000E-01

Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	2.460E+03
	TH-228	0.000E+00
	RA-228	0.000E+00
	CO-60	3.390E+05
	MN-54	4.170E+05
	H-3	9.000E+02

Title : CDC Chamblee FINAL Status Survey  
Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL End of Project.bld  
Evaluation Time: 0.00000000E+00 years

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RESRAD-BUILD Dose Tables

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Source Contributions to Receptor Doses

[mrem]							
=====							
	Source	Source	Source	Source	Source	Source	Total
	1	2	3	4	5	6	
Receptor 1	2.24E+00	7.37E-01	1.60E+00	1.60E+00	5.83E-01	5.83E-01	7.34E+00
Total	2.24E+00	7.37E-01	1.60E+00	1.60E+00	5.83E-01	5.83E-01	7.34E+00

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL End of Project.bld

Evaluation Time: 0.0000000E+00 years

Pathway Detail of Doses

[mrem]

Source: 1

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	2.03E+00	2.48E-04	2.82E-05	1.29E-01	1.58E-04	7.97E-02
Total	2.03E+00	2.48E-04	2.82E-05	1.29E-01	1.58E-04	7.97E-02

Source: 2

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	5.28E-01	2.48E-04	2.82E-05	1.29E-01	1.58E-04	7.97E-02
Total	5.28E-01	2.48E-04	2.82E-05	1.29E-01	1.58E-04	7.97E-02

Source: 3

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	1.34E+00	3.10E-04	3.53E-05	1.62E-01	1.97E-04	9.97E-02
Total	1.34E+00	3.10E-04	3.53E-05	1.62E-01	1.97E-04	9.97E-02

Source: 4

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	1.34E+00	3.10E-04	3.53E-05	1.62E-01	1.97E-04	9.97E-02
Total	1.34E+00	3.10E-04	3.53E-05	1.62E-01	1.97E-04	9.97E-02

Source: 5

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	4.33E-01	1.77E-04	2.02E-05	9.25E-02	1.13E-04	5.69E-02
Total	4.33E-01	1.77E-04	2.02E-05	9.25E-02	1.13E-04	5.69E-02

Source: 6

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	4.33E-01	1.77E-04	2.02E-05	9.25E-02	1.13E-04	5.69E-02
Total	4.33E-01	1.77E-04	2.02E-05	9.25E-02	1.13E-04	5.69E-02

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL End of Project.bld

Evaluation Time: 0.00000000E+00 years

Nuclide Detail of Doses

[mrem]

Source: 1

Nuclide	Receptor	Total
	1	
TH-232	1.60E-01	1.60E-01
TH-228	4.33E-04	4.33E-04
RA-228	1.30E-03	1.30E-03
CO-60	1.59E+00	1.59E+00
MN-54	4.91E-01	4.91E-01
H-3	2.77E-07	2.77E-07

Source: 2

Nuclide	Receptor	Total
	1	
TH-232	1.60E-01	1.60E-01
TH-228	3.99E-04	3.99E-04
RA-228	1.09E-03	1.09E-03
CO-60	4.45E-01	4.45E-01
MN-54	1.31E-01	1.31E-01
H-3	2.77E-07	2.77E-07

Source: 3

Nuclide	Receptor	Total
	1	
TH-232	2.00E-01	2.00E-01
TH-228	5.15E-04	5.15E-04
RA-228	1.46E-03	1.46E-03
CO-60	1.07E+00	1.07E+00
MN-54	3.25E-01	3.25E-01
H-3	3.46E-07	3.46E-07

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL End of Project.bld

Evaluation Time: 0.0000000E+00 years

Source: 4

Nuclide	Receptor	Total
	1	
TH-232	2.00E-01	2.00E-01
TH-228	5.15E-04	5.15E-04
RA-228	1.46E-03	1.46E-03
CO-60	1.07E+00	1.07E+00
MN-54	3.25E-01	3.25E-01
H-3	3.46E-07	3.46E-07

Source: 5

Nuclide	Receptor	Total
	1	
TH-232	1.14E-01	1.14E-01
TH-228	2.87E-04	2.87E-04
RA-228	7.90E-04	7.90E-04
CO-60	3.61E-01	3.61E-01
MN-54	1.07E-01	1.07E-01
H-3	1.98E-07	1.98E-07

Source: 6

Nuclide	Receptor	Total
	1	
TH-232	1.14E-01	1.14E-01
TH-228	2.87E-04	2.87E-04
RA-228	7.90E-04	7.90E-04
CO-60	3.61E-01	3.61E-01
MN-54	1.07E-01	1.07E-01
H-3	1.98E-07	1.98E-07

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL End of Project.bld

Evaluation Time: 1.00000000 years

```
=====
=====
=====
Assessment for Time: 2
Time =1.00E+00 yr
=====
=====
```

===== Source Information =====

Source: 1

Location:: Room : 1 x: 1.60 y: 2.80 z: 0.00 [m]

Geometry:: Type: Area Length[m]:3.20E+00 Width[m]:5.60E+00 Direction: z

Pathway ::

Direct Ingestion Rate: 3.060E-06 [1/hr]

Fraction released to air: 3.570E-01

Removable fraction: 9.670E-02

Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	2.451E+03
	TH-228	4.576E+01
	RA-228	2.783E+02
	CO-60	2.961E+05
	MN-54	1.849E+05
	H-3	8.480E+02

Source: 2

Location:: Room : 1 x: 1.60 y: 2.80 z: 4.00 [m]

Geometry:: Type: Area Length[m]:3.20E+00 Width[m]:5.60E+00 Direction: z

Pathway ::

Direct Ingestion Rate: 3.060E-06 [1/hr]

Fraction released to air: 3.570E-01

Removable fraction: 9.670E-02

Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	2.451E+03
	TH-228	4.576E+01
	RA-228	2.783E+02
	CO-60	2.961E+05
	MN-54	1.849E+05

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL End of Project.bld

Evaluation Time: 1.00000000 years

H-3 8.480E+02

Source: 3

Location:: Room : 1 x: 0.00 y: 2.80 z: 2.00 [m]

Geometry:: Type: Area Length[m]:5.60E+00 Width[m]:4.00E+00 Direction: x

Pathway ::

Direct Ingestion Rate: 3.060E-06 [1/hr]

Fraction released to air: 3.570E-01

Removable fraction: 9.670E-02

Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	2.451E+03
	TH-228	4.576E+01
	RA-228	2.783E+02
	CO-60	2.961E+05
	MN-54	1.849E+05
	H-3	8.480E+02

Source: 4

Location:: Room : 1 x: 3.20 y: 2.80 z: 2.00 [m]

Geometry:: Type: Area Length[m]:5.60E+00 Width[m]:4.00E+00 Direction: x

Pathway ::

Direct Ingestion Rate: 3.060E-06 [1/hr]

Fraction released to air: 3.570E-01

Removable fraction: 9.670E-02

Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	2.451E+03
	TH-228	4.576E+01
	RA-228	2.783E+02
	CO-60	2.961E+05
	MN-54	1.849E+05
	H-3	8.480E+02



Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL End of Project.bld

Evaluation Time: 1.00000000 years

Source: 5

Location:: Room : 1 x: 1.60 y: 0.00 z: 2.00 [m]

Geometry:: Type: Area Length[m]:3.20E+00 Width[m]:4.00E+00 Direction: y

Pathway ::

Direct Ingestion Rate: 3.060E-06 [1/hr]

Fraction released to air: 3.570E-01

Removable fraction: 9.670E-02

Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	2.451E+03
	TH-228	4.576E+01
	RA-228	2.783E+02
	CO-60	2.961E+05
	MN-54	1.849E+05
	H-3	8.480E+02

Source: 6

Location:: Room : 1 x: 1.60 y: 5.60 z: 2.00 [m]

Geometry:: Type: Area Length[m]:3.20E+00 Width[m]:4.00E+00 Direction: y

Pathway ::

Direct Ingestion Rate: 3.060E-06 [1/hr]

Fraction released to air: 3.570E-01

Removable fraction: 9.670E-02

Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	2.451E+03
	TH-228	4.576E+01
	RA-228	2.783E+02
	CO-60	2.961E+05
	MN-54	1.849E+05
	H-3	8.480E+02

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RESRAD-BUILD Dose Tables

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Source Contributions to Receptor Doses

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[mrem]

	Source	Source	Source	Source	Source	Source	Total
	1	2	3	4	5	6	
Receptor 1	1.77E+00	6.10E-01	1.28E+00	1.28E+00	4.79E-01	4.79E-01	5.90E+00
Total	1.77E+00	6.10E-01	1.28E+00	1.28E+00	4.79E-01	4.79E-01	5.90E+00

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL End of Project.bld

Evaluation Time: 1.00000000 years

Pathway Detail of Doses

=====

[mrem]

Source: 1

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	1.56E+00	1.93E-04	2.22E-05	1.30E-01	9.66E-04	7.18E-02
Total	1.56E+00	1.93E-04	2.22E-05	1.30E-01	9.66E-04	7.18E-02

Source: 2

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	4.07E-01	1.93E-04	2.22E-05	1.30E-01	9.66E-04	7.18E-02
Total	4.07E-01	1.93E-04	2.22E-05	1.30E-01	9.66E-04	7.18E-02

Source: 3

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	1.03E+00	2.41E-04	2.77E-05	1.63E-01	1.21E-03	8.98E-02
Total	1.03E+00	2.41E-04	2.77E-05	1.63E-01	1.21E-03	8.98E-02

Source: 4

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	1.03E+00	2.41E-04	2.77E-05	1.63E-01	1.21E-03	8.98E-02
Total	1.03E+00	2.41E-04	2.77E-05	1.63E-01	1.21E-03	8.98E-02

Source: 5

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	3.34E-01	1.38E-04	1.58E-05	9.29E-02	6.90E-04	5.13E-02
Total	3.34E-01	1.38E-04	1.58E-05	9.29E-02	6.90E-04	5.13E-02

Source: 6

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	3.34E-01	1.38E-04	1.58E-05	9.29E-02	6.90E-04	5.13E-02
Total	3.34E-01	1.38E-04	1.58E-05	9.29E-02	6.90E-04	5.13E-02

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL End of Project.bld

Evaluation Time: 1.00000000 years

Nuclide Detail of Doses

[mrem]

Source: 1

Nuclide	Receptor	Total
	1	
TH-232	1.59E-01	1.59E-01
TH-228	2.64E-03	2.64E-03
RA-228	3.61E-03	3.61E-03
CO-60	1.38E+00	1.38E+00
MN-54	2.18E-01	2.18E-01
H-3	2.52E-07	2.52E-07

Source: 2

Nuclide	Receptor	Total
	1	
TH-232	1.59E-01	1.59E-01
TH-228	2.44E-03	2.44E-03
RA-228	3.02E-03	3.02E-03
CO-60	3.88E-01	3.88E-01
MN-54	5.79E-02	5.79E-02
H-3	2.52E-07	2.52E-07

Source: 3

Nuclide	Receptor	Total
	1	
TH-232	1.98E-01	1.98E-01
TH-228	3.14E-03	3.14E-03
RA-228	4.04E-03	4.04E-03
CO-60	9.33E-01	9.33E-01
MN-54	1.44E-01	1.44E-01
H-3	3.16E-07	3.16E-07

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL End of Project.bld

Evaluation Time: 1.00000000 years

Source: 4

Nuclide	Receptor	Total
	1	
TH-232	1.98E-01	1.98E-01
TH-228	3.14E-03	3.14E-03
RA-228	4.04E-03	4.04E-03
CO-60	9.33E-01	9.33E-01
MN-54	1.44E-01	1.44E-01
H-3	3.16E-07	3.16E-07

Source: 5

Nuclide	Receptor	Total
	1	
TH-232	1.13E-01	1.13E-01
TH-228	1.75E-03	1.75E-03
RA-228	2.18E-03	2.18E-03
CO-60	3.14E-01	3.14E-01
MN-54	4.73E-02	4.73E-02
H-3	1.80E-07	1.80E-07

Source: 6

Nuclide	Receptor	Total
	1	
TH-232	1.13E-01	1.13E-01
TH-228	1.75E-03	1.75E-03
RA-228	2.18E-03	2.18E-03
CO-60	3.14E-01	3.14E-01
MN-54	4.73E-02	4.73E-02
H-3	1.80E-07	1.80E-07

[illegible]

## Source Information

```
Location:: Room : 1 x: 1.60 y: 2.80 z: 0.00 [m]
Geometry:: Type: Area Length[m]:3.20E+00 Width[m]:5.60E+00 Direction: z
Pathway ::
    Direct Ingestion Rate: 3.060E-06 [1/hr]
    Fraction released to air: 3.570E-01
    Removable fraction: 9.003E-02
    Time to Remove: 1.000E+04 [day]
```

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	2.433E+03
	TH-228	3.028E+02
	RA-228	7.384E+02
	CO-60	2.260E+05
	MN-54	3.634E+04
	H-3	7.527E+02

```
Location:: Room : 1 x: 1.60 y: 2.80 z: 4.00 [m]
Geometry:: Type: Area Length[m]:3.20E+00 Width[m]:5.60E+00 Direction: z
Pathway ::
    Direct Ingestion Rate: 3.060E-06 [l/hr]
    Fraction released to air: 3.570E-01
    Removable fraction: 9.003E-02
    Time to Remove: 1.000E+04 [day]
```

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	2.433E+03
	TH-228	3.028E+02
	RA-228	7.384E+02
	CO-60	2.260E+05
	MN-54	3.634E+04

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL End of Project.bld

Evaluation Time: 3.00000000 years

H-3 7.527E+02

Source: 3

Location:: Room : 1 x: 0.00 y: 2.80 z: 2.00 [m]

Geometry:: Type: Area Length[m]:5.60E+00 Width[m]:4.00E+00 Direction: x

Pathway ::

Direct Ingestion Rate: 3.060E-06 [1/hr]

Fraction released to air: 3.570E-01

Removable fraction: 9.003E-02

Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	2.433E+03
	TH-228	3.028E+02
	RA-228	7.384E+02
	CO-60	2.260E+05
	MN-54	3.634E+04
	H-3	7.527E+02

Source: 4

Location:: Room : 1 x: 3.20 y: 2.80 z: 2.00 [m]

Geometry:: Type: Area Length[m]:5.60E+00 Width[m]:4.00E+00 Direction: x

Pathway ::

Direct Ingestion Rate: 3.060E-06 [1/hr]

Fraction released to air: 3.570E-01

Removable fraction: 9.003E-02

Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	2.433E+03
	TH-228	3.028E+02
	RA-228	7.384E+02
	CO-60	2.260E+05
	MN-54	3.634E+04
	H-3	7.527E+02

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL End of Project.bld

Evaluation Time: 3.00000000 years

Source: 5

Location:: Room : 1 x: 1.60 y: 0.00 z: 2.00 [m]

Geometry:: Type: Area Length[m]:3.20E+00 Width[m]:4.00E+00 Direction: y

Pathway ::

Direct Ingestion Rate: 3.060E-06 [1/hr]

Fraction released to air: 3.570E-01

Removable fraction: 9.003E-02

Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	2.433E+03
	TH-228	3.028E+02
	RA-228	7.384E+02
	CO-60	2.260E+05
	MN-54	3.634E+04
	H-3	7.527E+02

Source: 6

Location:: Room : 1 x: 1.60 y: 5.60 z: 2.00 [m]

Geometry:: Type: Area Length[m]:3.20E+00 Width[m]:4.00E+00 Direction: y

Pathway ::

Direct Ingestion Rate: 3.060E-06 [1/hr]

Fraction released to air: 3.570E-01

Removable fraction: 9.003E-02

Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	2.433E+03
	TH-228	3.028E+02
	RA-228	7.384E+02
	CO-60	2.260E+05
	MN-54	3.634E+04
	H-3	7.527E+02



Title : CDC Chamblee FINAL Status Survey  
Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL End of Project.bld  
Evaluation Time: 3.00000000 years

RESRAD-BUILD Dose Tables	
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Source Contributions to Receptor Doses

[mrem]

		Source	Source	Source	Source	Source	Source	Total
		1	2	3	4	5	6	
Receptor	1	1.27E+00	4.77E-01	9.54E-01	9.54E-01	3.71E-01	3.71E-01	4.40E+00
Total		1.27E+00	4.77E-01	9.54E-01	9.54E-01	3.71E-01	3.71E-01	4.40E+00

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL End of Project.bld

Evaluation Time: 3.00000000 years

Pathway Detail of Doses

[mrem]

Source: 1

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	1.07E+00	1.34E-04	1.55E-05	1.33E-01	3.81E-03	6.13E-02
Total	1.07E+00	1.34E-04	1.55E-05	1.33E-01	3.81E-03	6.13E-02

Source: 2

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	2.79E-01	1.34E-04	1.55E-05	1.33E-01	3.81E-03	6.13E-02
Total	2.79E-01	1.34E-04	1.55E-05	1.33E-01	3.81E-03	6.13E-02

Source: 3

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	7.06E-01	1.68E-04	1.94E-05	1.66E-01	4.77E-03	7.66E-02
Total	7.06E-01	1.68E-04	1.94E-05	1.66E-01	4.77E-03	7.66E-02

Source: 4

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	7.06E-01	1.68E-04	1.94E-05	1.66E-01	4.77E-03	7.66E-02
Total	7.06E-01	1.68E-04	1.94E-05	1.66E-01	4.77E-03	7.66E-02

Source: 5

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	2.29E-01	9.59E-05	1.11E-05	9.48E-02	2.72E-03	4.38E-02
Total	2.29E-01	9.59E-05	1.11E-05	9.48E-02	2.72E-03	4.38E-02

Source: 6

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	2.29E-01	9.59E-05	1.11E-05	9.48E-02	2.72E-03	4.38E-02
Total	2.29E-01	9.59E-05	1.11E-05	9.48E-02	2.72E-03	4.38E-02

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL End of Project.bld

Evaluation Time: 3.00000000 years

Nuclide Detail of Doses

[mrem]

Source: 1

Nuclide	Receptor	Total
	1	
TH-232	1.56E-01	1.56E-01
TH-228	1.04E-02	1.04E-02
RA-228	7.07E-03	7.07E-03
CO-60	1.05E+00	1.05E+00
MN-54	4.27E-02	4.27E-02
H-3	2.08E-07	2.08E-07

Source: 2

Nuclide	Receptor	Total
	1	
TH-232	1.56E-01	1.56E-01
TH-228	9.55E-03	9.55E-03
RA-228	5.86E-03	5.86E-03
CO-60	2.94E-01	2.94E-01
MN-54	1.14E-02	1.14E-02
H-3	2.08E-07	2.08E-07

Source: 3

Nuclide	Receptor	Total
	1	
TH-232	1.95E-01	1.95E-01
TH-228	1.23E-02	1.23E-02
RA-228	7.87E-03	7.87E-03
CO-60	7.10E-01	7.10E-01
MN-54	2.83E-02	2.83E-02
H-3	2.61E-07	2.61E-07

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL End of Project.bld

Evaluation Time: 3.00000000 years

Source: 4

Nuclide	Receptor	Total
	1	
TH-232	1.95E-01	1.95E-01
TH-228	1.23E-02	1.23E-02
RA-228	7.87E-03	7.87E-03
CO-60	7.10E-01	7.10E-01
MN-54	2.83E-02	2.83E-02
H-3	2.61E-07	2.61E-07

Source: 5

Nuclide	Receptor	Total
	1	
TH-232	1.12E-01	1.12E-01
TH-228	6.85E-03	6.85E-03
RA-228	4.23E-03	4.23E-03
CO-60	2.39E-01	2.39E-01
MN-54	9.29E-03	9.29E-03
H-3	1.49E-07	1.49E-07

Source: 6

Nuclide	Receptor	Total
	1	
TH-232	1.12E-01	1.12E-01
TH-228	6.85E-03	6.85E-03
RA-228	4.23E-03	4.23E-03
CO-60	2.39E-01	2.39E-01
MN-54	9.29E-03	9.29E-03
H-3	1.49E-07	1.49E-07

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL End of Project.bld

Evaluation Time: 10.0000000 years

```
=====
=====
=====
Assessment for Time: 4
Time =1.00E+01 yr
=====
=====
```

===== Source Information =====

Source: 1

Location:: Room : 1 x: 1.60 y: 2.80 z: 0.00 [m]

Geometry:: Type: Area Length[m]:3.20E+00 Width[m]:5.60E+00 Direction: z

Pathway ::

Direct Ingestion Rate: 3.060E-06 [1/hr]

Fraction released to air: 3.570E-01

Removable fraction: 6.588E-02

Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	2.370E+03
	TH-228	1.338E+03
	RA-228	1.660E+03
	CO-60	8.766E+04
	MN-54	1.223E+02
	H-3	4.958E+02

Source: 2

Location:: Room : 1 x: 1.60 y: 2.80 z: 4.00 [m]

Geometry:: Type: Area Length[m]:3.20E+00 Width[m]:5.60E+00 Direction: z

Pathway ::

Direct Ingestion Rate: 3.060E-06 [1/hr]

Fraction released to air: 3.570E-01

Removable fraction: 6.588E-02

Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	2.370E+03
	TH-228	1.338E+03
	RA-228	1.660E+03
	CO-60	8.766E+04
	MN-54	1.223E+02

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL End of Project.bld

Evaluation Time: 10.0000000 years

H-3 4.958E+02

Source: 3

Location:: Room : 1 x: 0.00 y: 2.80 z: 2.00 [m]

Geometry:: Type: Area Length[m]:5.60E+00 Width[m]:4.00E+00 Direction: x

Pathway ::

Direct Ingestion Rate: 3.060E-06 [1/hr]

Fraction released to air: 3.570E-01

Removable fraction: 6.588E-02

Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	2.370E+03
	TH-228	1.338E+03
	RA-228	1.660E+03
	CO-60	8.766E+04
	MN-54	1.223E+02
	H-3	4.958E+02

Source: 4

Location:: Room : 1 x: 3.20 y: 2.80 z: 2.00 [m]

Geometry:: Type: Area Length[m]:5.60E+00 Width[m]:4.00E+00 Direction: x

Pathway ::

Direct Ingestion Rate: 3.060E-06 [1/hr]

Fraction released to air: 3.570E-01

Removable fraction: 6.588E-02

Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	2.370E+03
	TH-228	1.338E+03
	RA-228	1.660E+03
	CO-60	8.766E+04
	MN-54	1.223E+02
	H-3	4.958E+02

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL End of Project.bld

Evaluation Time: 10.000000 years

Source: 5

Location:: Room : 1 x: 1.60 y: 0.00 z: 2.00 [m]

Geometry:: Type: Area Length[m]:3.20E+00 Width[m]:4.00E+00 Direction: y

Pathway ::

Direct Ingestion Rate: 3.060E-06 [1/hr]

Fraction released to air: 3.570E-01

Removable fraction: 6.588E-02

Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	2.370E+03
	TH-228	1.338E+03
	RA-228	1.660E+03
	CO-60	8.766E+04
	MN-54	1.223E+02
	H-3	4.958E+02

Source: 6

Location:: Room : 1 x: 1.60 y: 5.60 z: 2.00 [m]

Geometry:: Type: Area Length[m]:3.20E+00 Width[m]:4.00E+00 Direction: y

Pathway ::

Direct Ingestion Rate: 3.060E-06 [1/hr]

Fraction released to air: 3.570E-01

Removable fraction: 6.588E-02

Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	2.370E+03
	TH-228	1.338E+03
	RA-228	1.660E+03
	CO-60	8.766E+04
	MN-54	1.223E+02
	H-3	4.958E+02

Title : CDC Chamblee FINAL Status Survey  
Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL End of Project.bld  
Evaluation Time: 10.0000000 years

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RESRAD-BUILD Dose Tables

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Source Contributions to Receptor Doses

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[mrem]

	Source	Source	Source	Source	Source	Source	Total
	1	2	3	4	5	6	
Receptor 1	6.02E-01	3.02E-01	5.13E-01	5.13E-01	2.27E-01	2.27E-01	2.38E+00
Total	6.02E-01	3.02E-01	5.13E-01	5.13E-01	2.27E-01	2.27E-01	2.38E+00



Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL End of Project.bld

Evaluation Time: 10.0000000 years

Pathway Detail of Doses

[mrem]

Source: 1

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	4.06E-01	5.23E-05	6.06E-06	1.43E-01	1.39E-02	3.92E-02
Total	4.06E-01	5.23E-05	6.06E-06	1.43E-01	1.39E-02	3.92E-02

Source: 2

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	1.06E-01	5.23E-05	6.06E-06	1.43E-01	1.39E-02	3.92E-02
Total	1.06E-01	5.23E-05	6.06E-06	1.43E-01	1.39E-02	3.92E-02

Source: 3

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	2.67E-01	6.54E-05	7.57E-06	1.79E-01	1.73E-02	4.90E-02
Total	2.67E-01	6.54E-05	7.57E-06	1.79E-01	1.73E-02	4.90E-02

Source: 4

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	2.67E-01	6.54E-05	7.57E-06	1.79E-01	1.73E-02	4.90E-02
Total	2.67E-01	6.54E-05	7.57E-06	1.79E-01	1.73E-02	4.90E-02

Source: 5

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	8.68E-02	3.74E-05	4.33E-06	1.02E-01	9.89E-03	2.80E-02
Total	8.68E-02	3.74E-05	4.33E-06	1.02E-01	9.89E-03	2.80E-02

Source: 6

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	8.68E-02	3.74E-05	4.33E-06	1.02E-01	9.89E-03	2.80E-02
Total	8.68E-02	3.74E-05	4.33E-06	1.02E-01	9.89E-03	2.80E-02

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL End of Project.bld

Evaluation Time: 10.0000000 years

Nuclide Detail of Doses

[mrem]

Source: 1

Nuclide	Receptor	Total
	1	
TH-232	1.48E-01	1.48E-01
TH-228	3.67E-02	3.67E-02
RA-228	1.14E-02	1.14E-02
CO-60	4.06E-01	4.06E-01
MN-54	1.44E-04	1.44E-04
H-3	1.00E-07	1.00E-07

Source: 2

Nuclide	Receptor	Total
	1	
TH-232	1.48E-01	1.48E-01
TH-228	3.37E-02	3.37E-02
RA-228	8.99E-03	8.99E-03
CO-60	1.11E-01	1.11E-01
MN-54	3.79E-05	3.79E-05
H-3	1.00E-07	1.00E-07

Source: 3

Nuclide	Receptor	Total
	1	
TH-232	1.85E-01	1.85E-01
TH-228	4.35E-02	4.35E-02
RA-228	1.23E-02	1.23E-02
CO-60	2.72E-01	2.72E-01
MN-54	9.49E-05	9.49E-05
H-3	1.25E-07	1.25E-07

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL End of Project.bld

Evaluation Time: 10.0000000 years

Source: 4

Nuclide	Receptor	Total
	1	
TH-232	1.85E-01	1.85E-01
TH-228	4.35E-02	4.35E-02
RA-228	1.23E-02	1.23E-02
CO-60	2.72E-01	2.72E-01
MN-54	9.49E-05	9.49E-05
H-3	1.25E-07	1.25E-07

Source: 5

Nuclide	Receptor	Total
	1	
TH-232	1.06E-01	1.06E-01
TH-228	2.42E-02	2.42E-02
RA-228	6.51E-03	6.51E-03
CO-60	9.07E-02	9.07E-02
MN-54	3.10E-05	3.10E-05
H-3	7.16E-08	7.16E-08

Source: 6

Nuclide	Receptor	Total
	1	
TH-232	1.06E-01	1.06E-01
TH-228	2.42E-02	2.42E-02
RA-228	6.51E-03	6.51E-03
CO-60	9.07E-02	9.07E-02
MN-54	3.10E-05	3.10E-05
H-3	7.16E-08	7.16E-08

```

=====
Assessment for Time: 5
Time =3.00E+01 yr
=====

```

### Source Information

```
Location:: Room : 1 x: 1.60 y: 2.80 z: 0.00 [m]
Geometry:: Type: Area Length[m]:3.20E+00 Width[m]:5.60E+00 Direction: z
Pathway ::
    Direct Ingestion Rate: 3.060E-06 [1/hr]
    Fraction released to air: 3.570E-01
    Removable fraction: 0.000E+00
    Time to Remove: 1.000E+04 [day]
```

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	2.214E+03
	TH-228	2.125E+03
	RA-228	2.154E+03
	CO-60	5.899E+03
	MN-54	1.057E-05
	H-3	1.514E+02

```
Location:: Room : 1 x: 1.60 y: 2.80 z: 4.00 [m]
Geometry:: Type: Area Length[m]:3.20E+00 Width[m]:5.60E+00 Direction: z
Pathway ::
    Direct Ingestion Rate: 3.060E-06 [1/hr]
    Fraction released to air: 3.570E-01
    Removable fraction: 0.000E+00
    Time to Remove: 1.000E+04 [day]
```

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	2.214E+03
	TH-228	2.125E+03
	RA-228	2.154E+03
	CO-60	5.899E+03
	MN-54	1.057E-05

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL End of Project.bld

Evaluation Time: 30.0000000 years

H-3 1.514E+02

Source: 3

Location:: Room : 1 x: 0.00 y: 2.80 z: 2.00 [m]

Geometry:: Type: Area Length[m]:5.60E+00 Width[m]:4.00E+00 Direction: x

Pathway ::

Direct Ingestion Rate: 3.060E-06 [1/hr]

Fraction released to air: 3.570E-01

Removable fraction: 0.000E+00

Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	2.214E+03
	TH-228	2.125E+03
	RA-228	2.154E+03
	CO-60	5.899E+03
	MN-54	1.057E-05
	H-3	1.514E+02

Source: 4

Location:: Room : 1 x: 3.20 y: 2.80 z: 2.00 [m]

Geometry:: Type: Area Length[m]:5.60E+00 Width[m]:4.00E+00 Direction: x

Pathway ::

Direct Ingestion Rate: 3.060E-06 [1/hr]

Fraction released to air: 3.570E-01

Removable fraction: 0.000E+00

Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	2.214E+03
	TH-228	2.125E+03
	RA-228	2.154E+03
	CO-60	5.899E+03
	MN-54	1.057E-05
	H-3	1.514E+02

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL End of Project.bld

Evaluation Time: 30.0000000 years

Source: 5

Location:: Room : 1 x: 1.60 y: 0.00 z: 2.00 [m]

Geometry:: Type: Area Length[m]:3.20E+00 Width[m]:4.00E+00 Direction: y

Pathway ::

Direct Ingestion Rate: 3.060E-06 [1/hr]

Fraction released to air: 3.570E-01

Removable fraction: 0.000E+00

Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	2.214E+03
	TH-228	2.125E+03
	RA-228	2.154E+03
	CO-60	5.899E+03
	MN-54	1.057E-05
	H-3	1.514E+02

Source: 6

Location:: Room : 1 x: 1.60 y: 5.60 z: 2.00 [m]

Geometry:: Type: Area Length[m]:3.20E+00 Width[m]:4.00E+00 Direction: y

Pathway ::

Direct Ingestion Rate: 3.060E-06 [1/hr]

Fraction released to air: 3.570E-01

Removable fraction: 0.000E+00

Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	2.214E+03
	TH-228	2.125E+03
	RA-228	2.154E+03
	CO-60	5.899E+03
	MN-54	1.057E-05
	H-3	1.514E+02

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD Family\BUILD\35\CDC Chamblee FINAL End of Project.bld

Evaluation Time: 30.0000000 years

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RESRAD-BUILD Dose Tables

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Source Contributions to Receptor Doses

[mrem]

	Source	Source	Source	Source	Source	Source	Total
	1	2	3	4	5	6	
Receptor 1	5.84E-02	3.09E-02	5.10E-02	5.10E-02	2.31E-02	2.31E-02	2.38E-01
Total	5.84E-02	3.09E-02	5.10E-02	5.10E-02	2.31E-02	2.31E-02	2.38E-01

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL End of Project.bld

Evaluation Time: 30.0000000 years

Pathway Detail of Doses

[mrem]

Source: 1

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	3.72E-02	0.00E+00	0.00E+00	0.00E+00	2.12E-02	0.00E+00
Total	3.72E-02	0.00E+00	0.00E+00	0.00E+00	2.12E-02	0.00E+00

Source: 2

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	9.69E-03	0.00E+00	0.00E+00	0.00E+00	2.12E-02	0.00E+00
Total	9.69E-03	0.00E+00	0.00E+00	0.00E+00	2.12E-02	0.00E+00

Source: 3

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	2.45E-02	0.00E+00	0.00E+00	0.00E+00	2.65E-02	0.00E+00
Total	2.45E-02	0.00E+00	0.00E+00	0.00E+00	2.65E-02	0.00E+00

Source: 4

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	2.45E-02	0.00E+00	0.00E+00	0.00E+00	2.65E-02	0.00E+00
Total	2.45E-02	0.00E+00	0.00E+00	0.00E+00	2.65E-02	0.00E+00

Source: 5

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	7.96E-03	0.00E+00	0.00E+00	0.00E+00	1.51E-02	0.00E+00
Total	7.96E-03	0.00E+00	0.00E+00	0.00E+00	1.51E-02	0.00E+00

Source: 6

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	7.96E-03	0.00E+00	0.00E+00	0.00E+00	1.51E-02	0.00E+00
Total	7.96E-03	0.00E+00	0.00E+00	0.00E+00	1.51E-02	0.00E+00



Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL End of Project.bld

Evaluation Time: 30.0000000 years

Nuclide Detail of Doses

[mrem]

Source: 1

Nuclide	Receptor	Total
	1	
TH-232	6.37E-06	6.37E-06
TH-228	2.73E-02	2.73E-02
RA-228	4.22E-03	4.22E-03
CO-60	2.69E-02	2.69E-02
MN-54	1.24E-11	1.24E-11
H-3	0.00E+00	0.00E+00

Source: 2

Nuclide	Receptor	Total
	1	
TH-232	1.27E-06	1.27E-06
TH-228	2.28E-02	2.28E-02
RA-228	1.10E-03	1.10E-03
CO-60	6.99E-03	6.99E-03
MN-54	3.22E-12	3.22E-12
H-3	0.00E+00	0.00E+00

Source: 3

Nuclide	Receptor	Total
	1	
TH-232	3.79E-06	3.79E-06
TH-228	3.05E-02	3.05E-02
RA-228	2.78E-03	2.78E-03
CO-60	1.77E-02	1.77E-02
MN-54	8.14E-12	8.14E-12
H-3	0.00E+00	0.00E+00

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL End of Project.bld

Evaluation Time: 30.000000 years

Source: 4

Nuclide	Receptor	Total
	1	
TH-232	3.79E-06	3.79E-06
TH-228	3.05E-02	3.05E-02
RA-228	2.78E-03	2.78E-03
CO-60	1.77E-02	1.77E-02
MN-54	8.14E-12	8.14E-12
H-3	0.00E+00	0.00E+00

Source: 5

Nuclide	Receptor	Total
	1	
TH-232	1.08E-06	1.08E-06
TH-228	1.64E-02	1.64E-02
RA-228	9.02E-04	9.02E-04
CO-60	5.74E-03	5.74E-03
MN-54	2.64E-12	2.64E-12
H-3	0.00E+00	0.00E+00

Source: 6

Nuclide	Receptor	Total
	1	
TH-232	1.08E-06	1.08E-06
TH-228	1.64E-02	1.64E-02
RA-228	9.02E-04	9.02E-04
CO-60	5.74E-03	5.74E-03
MN-54	2.64E-12	2.64E-12
H-3	0.00E+00	0.00E+00

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL End of Project.bld

Evaluation Time: 100.000008 years

Assessment for Time: 6

Time =1.00E+02 yr

Source Information

Source: 1

Location:: Room : 1 x: 1.60 y: 2.80 z: 0.00 [m]

Geometry:: Type: Area Length[m]:3.20E+00 Width[m]:5.60E+00 Direction: z

Pathway ::

Direct Ingestion Rate: 3.060E-06 [1/hr]

Fraction released to air: 3.570E-01

Removable fraction: 0.000E+00

Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	2.214E+03
	TH-228	2.214E+03
	RA-228	2.214E+03
	CO-60	5.920E-01
	MN-54	2.555E-30
	H-3	3.026E+00

Source: 2

Location:: Room : 1 x: 1.60 y: 2.80 z: 4.00 [m]

Geometry:: Type: Area Length[m]:3.20E+00 Width[m]:5.60E+00 Direction: z

Pathway ::

Direct Ingestion Rate: 3.060E-06 [1/hr]

Fraction released to air: 3.570E-01

Removable fraction: 0.000E+00

Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	2.214E+03
	TH-228	2.214E+03
	RA-228	2.214E+03
	CO-60	5.920E-01
	MN-54	2.555E-30

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL End of Project.bld

Evaluation Time: 100.000008 years

H-3 3.026E+00

Source: 3

Location:: Room : 1 x: 0.00 y: 2.80 z: 2.00 [m]

Geometry:: Type: Area Length[m]:5.60E+00 Width[m]:4.00E+00 Direction: x

Pathway ::

Direct Ingestion Rate: 3.060E-06 [l/hr]

Fraction released to air: 3.570E-01

Removable fraction: 0.000E+00

Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	2.214E+03
	TH-228	2.214E+03
	RA-228	2.214E+03
	CO-60	5.920E-01
	MN-54	2.555E-30
	H-3	3.026E+00

Source: 4

Location:: Room : 1 x: 3.20 y: 2.80 z: 2.00 [m]

Geometry:: Type: Area Length[m]:5.60E+00 Width[m]:4.00E+00 Direction: x

Pathway ::

Direct Ingestion Rate: 3.060E-06 [l/hr]

Fraction released to air: 3.570E-01

Removable fraction: 0.000E+00

Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	2.214E+03
	TH-228	2.214E+03
	RA-228	2.214E+03
	CO-60	5.920E-01
	MN-54	2.555E-30
	H-3	3.026E+00

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL End of Project.bld

Evaluation Time: 100.000008 years

Source: 5

Location:: Room : 1 x: 1.60 y: 0.00 z: 2.00 [m]

Geometry:: Type: Area Length[m]:3.20E+00 Width[m]:4.00E+00 Direction: y

Pathway ::

Direct Ingestion Rate: 3.060E-06 [1/hr]

Fraction released to air: 3.570E-01

Removable fraction: 0.000E+00

Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	2.214E+03
	TH-228	2.214E+03
	RA-228	2.214E+03
	CO-60	5.920E-01
	MN-54	2.555E-30
	H-3	3.026E+00

Source: 6

Location:: Room : 1 x: 1.60 y: 5.60 z: 2.00 [m]

Geometry:: Type: Area Length[m]:3.20E+00 Width[m]:4.00E+00 Direction: y

Pathway ::

Direct Ingestion Rate: 3.060E-06 [1/hr]

Fraction released to air: 3.570E-01

Removable fraction: 0.000E+00

Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	2.214E+03
	TH-228	2.214E+03
	RA-228	2.214E+03
	CO-60	5.920E-01
	MN-54	2.555E-30
	H-3	3.026E+00

Title : CDC Chamblee FINAL Status Survey  
Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL End of Project.bld  
Evaluation Time: 100.000008 years

RESRAD-BUILD Dose Tables

Source Contributions to Receptor Doses

[mrem]

	Source	Source	Source	Source	Source	Source	Total
	1	2	3	4	5	6	
Receptor 1	3.27E-02	2.48E-02	3.46E-02	3.46E-02	1.80E-02	1.80E-02	1.63E-01
Total	3.27E-02	2.48E-02	3.46E-02	3.46E-02	1.80E-02	1.80E-02	1.63E-01

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL End of Project.bld

Evaluation Time: 100.000008 years

Pathway Detail of Doses

[mrem]

Source: 1

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	1.07E-02	0.00E+00	0.00E+00	0.00E+00	2.20E-02	0.00E+00
Total	1.07E-02	0.00E+00	0.00E+00	0.00E+00	2.20E-02	0.00E+00

Source: 2

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	2.79E-03	0.00E+00	0.00E+00	0.00E+00	2.20E-02	0.00E+00
Total	2.79E-03	0.00E+00	0.00E+00	0.00E+00	2.20E-02	0.00E+00

Source: 3

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	7.05E-03	0.00E+00	0.00E+00	0.00E+00	2.75E-02	0.00E+00
Total	7.05E-03	0.00E+00	0.00E+00	0.00E+00	2.75E-02	0.00E+00

Source: 4

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	7.05E-03	0.00E+00	0.00E+00	0.00E+00	2.75E-02	0.00E+00
Total	7.05E-03	0.00E+00	0.00E+00	0.00E+00	2.75E-02	0.00E+00

Source: 5

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	2.29E-03	0.00E+00	0.00E+00	0.00E+00	1.57E-02	0.00E+00
Total	2.29E-03	0.00E+00	0.00E+00	0.00E+00	1.57E-02	0.00E+00

Source: 6

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	2.29E-03	0.00E+00	0.00E+00	0.00E+00	1.57E-02	0.00E+00
Total	2.29E-03	0.00E+00	0.00E+00	0.00E+00	1.57E-02	0.00E+00

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL End of Project.bld

Evaluation Time: 100.000008 years

# Nuclide Detail of Doses

[mrem]

Source: 1

Nuclide	Receptor	Total
	1	
TH-232	6.37E-06	6.37E-06
TH-228	2.84E-02	2.84E-02
RA-228	4.33E-03	4.33E-03
CO-60	2.70E-06	2.70E-06
MN-54	0.00E+00	0.00E+00
H-3	0.00E+00	0.00E+00

Source: 2

Nuclide	Receptor	Total
	1	
TH-232	1.27E-06	1.27E-06
TH-228	2.37E-02	2.37E-02
RA-228	1.13E-03	1.13E-03
CO-60	7.02E-07	7.02E-07
MN-54	0.00E+00	0.00E+00
H-3	0.00E+00	0.00E+00

Source: 3

Nuclide	Receptor	Total
	1	
TH-232	3.79E-06	3.79E-06
TH-228	3.17E-02	3.17E-02
RA-228	2.85E-03	2.85E-03
CO-60	1.78E-06	1.78E-06
MN-54	0.00E+00	0.00E+00
H-3	0.00E+00	0.00E+00



Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL End of Project.bld

Evaluation Time: 100.000008 years

Source: 4

Nuclide	Receptor	Total
	1	
TH-232	3.79E-06	3.79E-06
TH-228	3.17E-02	3.17E-02
RA-228	2.85E-03	2.85E-03
CO-60	1.78E-06	1.78E-06
MN-54	0.00E+00	0.00E+00
H-3	0.00E+00	0.00E+00

Source: 5

Nuclide	Receptor	Total
	1	
TH-232	1.08E-06	1.08E-06
TH-228	1.71E-02	1.71E-02
RA-228	9.25E-04	9.25E-04
CO-60	5.76E-07	5.76E-07
MN-54	0.00E+00	0.00E+00
H-3	0.00E+00	0.00E+00

Source: 6

Nuclide	Receptor	Total
	1	
TH-232	1.08E-06	1.08E-06
TH-228	1.71E-02	1.71E-02
RA-228	9.25E-04	9.25E-04
CO-60	5.76E-07	5.76E-07
MN-54	0.00E+00	0.00E+00
H-3	0.00E+00	0.00E+00

## Time =3.00E+02 yr

## Source Information

Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	2.214E+03
	TH-228	2.214E+03
	RA-228	2.214E+03
	CO-60	2.228E-12
	MN-54	0.000E+00
	H-3	4.222E-05

Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	2.214E+03
	TH-228	2.214E+03
	RA-228	2.214E+03
	CO-60	2.228E-12
	MN-54	0.000E+00

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL End of Project.bld

Evaluation Time: 300.000092 years

H-3 4.222E-05

Source: 3

Location:: Room : 1 x: 0.00 y: 2.80 z: 2.00 [m]

Geometry:: Type: Area Length[m]:5.60E+00 Width[m]:4.00E+00 Direction: x

Pathway ::

Direct Ingestion Rate: 3.060E-06 [1/hr]

Fraction released to air: 3.570E-01

Removable fraction: 0.000E+00

Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	2.214E+03
	TH-228	2.214E+03
	RA-228	2.214E+03
	CO-60	2.228E-12
	MN-54	0.000E+00
	H-3	4.222E-05

Source: 4

Location:: Room : 1 x: 3.20 y: 2.80 z: 2.00 [m]

Geometry:: Type: Area Length[m]:5.60E+00 Width[m]:4.00E+00 Direction: x

Pathway ::

Direct Ingestion Rate: 3.060E-06 [1/hr]

Fraction released to air: 3.570E-01

Removable fraction: 0.000E+00

Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	2.214E+03
	TH-228	2.214E+03
	RA-228	2.214E+03
	CO-60	2.228E-12
	MN-54	0.000E+00
	H-3	4.222E-05

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL End of Project.bld

Evaluation Time: 300.000092 years

Source: 5

Location:: Room : 1 x: 1.60 y: 0.00 z: 2.00 [m]

Geometry:: Type: Area Length[m]:3.20E+00 Width[m]:4.00E+00 Direction: y

Pathway ::

Direct Ingestion Rate: 3.060E-06 [1/hr]

Fraction released to air: 3.570E-01

Removable fraction: 0.000E+00

Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	2.214E+03
	TH-228	2.214E+03
	RA-228	2.214E+03
	CO-60	2.228E-12
	MN-54	0.000E+00
	H-3	4.222E-05

Source: 6

Location:: Room : 1 x: 1.60 y: 5.60 z: 2.00 [m]

Geometry:: Type: Area Length[m]:3.20E+00 Width[m]:4.00E+00 Direction: y

Pathway ::

Direct Ingestion Rate: 3.060E-06 [1/hr]

Fraction released to air: 3.570E-01

Removable fraction: 0.000E+00

Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	2.214E+03
	TH-228	2.214E+03
	RA-228	2.214E+03
	CO-60	2.228E-12
	MN-54	0.000E+00
	H-3	4.222E-05

Title : CDC Chamblee FINAL Status Survey  
Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL End of Project.bld  
Evaluation Time: 300.000092 years

RESRAD-BUILD Dose Tables	
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Source Contributions to Receptor Doses

[mrem]

		Source	Source	Source	Source	Source	Source	Total
		1	2	3	4	5	6	
Receptor	1	3.27E-02	2.48E-02	3.46E-02	3.46E-02	1.80E-02	1.80E-02	1.63E-01
Total		3.27E-02	2.48E-02	3.46E-02	3.46E-02	1.80E-02	1.80E-02	1.63E-01

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL End of Project.bld

Evaluation Time: 300.000092 years

Pathway Detail of Doses

[mrem]

Source: 1

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	1.07E-02	0.00E+00	0.00E+00	0.00E+00	2.20E-02	0.00E+00
Total	1.07E-02	0.00E+00	0.00E+00	0.00E+00	2.20E-02	0.00E+00

Source: 2

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	2.79E-03	0.00E+00	0.00E+00	0.00E+00	2.20E-02	0.00E+00
Total	2.79E-03	0.00E+00	0.00E+00	0.00E+00	2.20E-02	0.00E+00

Source: 3

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	7.05E-03	0.00E+00	0.00E+00	0.00E+00	2.75E-02	0.00E+00
Total	7.05E-03	0.00E+00	0.00E+00	0.00E+00	2.75E-02	0.00E+00

Source: 4

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	7.05E-03	0.00E+00	0.00E+00	0.00E+00	2.75E-02	0.00E+00
Total	7.05E-03	0.00E+00	0.00E+00	0.00E+00	2.75E-02	0.00E+00

Source: 5

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	2.29E-03	0.00E+00	0.00E+00	0.00E+00	1.57E-02	0.00E+00
Total	2.29E-03	0.00E+00	0.00E+00	0.00E+00	1.57E-02	0.00E+00

Source: 6

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	2.29E-03	0.00E+00	0.00E+00	0.00E+00	1.57E-02	0.00E+00
Total	2.29E-03	0.00E+00	0.00E+00	0.00E+00	1.57E-02	0.00E+00

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL End of Project.bld

Evaluation Time: 300.000092 years

Nuclide Detail of Doses

[mrem]

Source: 1

Nuclide	Receptor	Total
	1	
TH-232	6.37E-06	6.37E-06
TH-228	2.84E-02	2.84E-02
RA-228	4.33E-03	4.33E-03
CO-60	1.02E-17	1.02E-17
H-3	0.00E+00	0.00E+00

Source: 2

Nuclide	Receptor	Total
	1	
TH-232	1.27E-06	1.27E-06
TH-228	2.37E-02	2.37E-02
RA-228	1.13E-03	1.13E-03
CO-60	2.64E-18	2.64E-18
H-3	0.00E+00	0.00E+00

Source: 3

Nuclide	Receptor	Total
	1	
TH-232	3.79E-06	3.79E-06
TH-228	3.17E-02	3.17E-02
RA-228	2.85E-03	2.85E-03
CO-60	6.68E-18	6.68E-18
H-3	0.00E+00	0.00E+00

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL End of Project.bld

Evaluation Time: 300.000092 years

Source: 4

Nuclide	Receptor	Total
1		
TH-232	3.79E-06	3.79E-06
TH-228	3.17E-02	3.17E-02
RA-228	2.85E-03	2.85E-03
CO-60	6.68E-18	6.68E-18
H-3	0.00E+00	0.00E+00

Source: 5

Nuclide	Receptor	Total
1		
TH-232	1.08E-06	1.08E-06
TH-228	1.71E-02	1.71E-02
RA-228	9.25E-04	9.25E-04
CO-60	2.17E-18	2.17E-18
H-3	0.00E+00	0.00E+00

Source: 6

Nuclide	Receptor	Total
1		
TH-232	1.08E-06	1.08E-06
TH-228	1.71E-02	1.71E-02
RA-228	9.25E-04	9.25E-04
CO-60	2.17E-18	2.17E-18
H-3	0.00E+00	0.00E+00



Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL End of Project.bld

Evaluation Time: 1000.00000 years

=====

Assessment for Time: 8

Time =1.00E+03 yr

=====

===== Source Information =====

Source: 1

Location:: Room : 1 x: 1.60 y: 2.80 z: 0.00 [m]

Geometry:: Type: Area Length[m]:3.20E+00 Width[m]:5.60E+00 Direction: z

Pathway ::

Direct Ingestion Rate: 3.060E-06 [1/hr]

Fraction released to air: 3.570E-01

Removable fraction: 0.000E+00

Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	2.214E+03
	TH-228	2.214E+03
	RA-228	2.214E+03
	CO-60	0.000E+00
	MN-54	0.000E+00
	H-3	4.284E-22

Source: 2

Location:: Room : 1 x: 1.60 y: 2.80 z: 4.00 [m]

Geometry:: Type: Area Length[m]:3.20E+00 Width[m]:5.60E+00 Direction: z

Pathway ::

Direct Ingestion Rate: 3.060E-06 [1/hr]

Fraction released to air: 3.570E-01

Removable fraction: 0.000E+00

Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	2.214E+03
	TH-228	2.214E+03
	RA-228	2.214E+03
	CO-60	0.000E+00
	MN-54	0.000E+00

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL End of Project.bld

Evaluation Time: 1000.00000 years

H-3 4.284E-22

Source: 3

Location:: Room : 1 x: 0.00 y: 2.80 z: 2.00 [m]

Geometry:: Type: Area Length[m]:5.60E+00 Width[m]:4.00E+00 Direction: x

Pathway ::

Direct Ingestion Rate: 3.060E-06 [1/hr]

Fraction released to air: 3.570E-01

Removable fraction: 0.000E+00

Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	2.214E+03
	TH-228	2.214E+03
	RA-228	2.214E+03
	CO-60	0.000E+00
	MN-54	0.000E+00
	H-3	4.284E-22

Source: 4

Location:: Room : 1 x: 3.20 y: 2.80 z: 2.00 [m]

Geometry:: Type: Area Length[m]:5.60E+00 Width[m]:4.00E+00 Direction: x

Pathway ::

Direct Ingestion Rate: 3.060E-06 [1/hr]

Fraction released to air: 3.570E-01

Removable fraction: 0.000E+00

Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	2.214E+03
	TH-228	2.214E+03
	RA-228	2.214E+03
	CO-60	0.000E+00
	MN-54	0.000E+00
	H-3	4.284E-22

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL End of Project.bld

Evaluation Time: 1000.00000 years

Source: 5

Location:: Room : 1 x: 1.60 y: 0.00 z: 2.00 [m]

Geometry:: Type: Area Length[m]:3.20E+00 Width[m]:4.00E+00 Direction: y

Pathway ::

Direct Ingestion Rate: 3.060E-06 [1/hr]

Fraction released to air: 3.570E-01

Removable fraction: 0.000E+00

Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration
		[dpm/m2]
	TH-232	2.214E+03
	TH-228	2.214E+03
	RA-228	2.214E+03
	CO-60	0.000E+00
	MN-54	0.000E+00
	H-3	4.284E-22

Source: 6

Location:: Room : 1 x: 1.60 y: 5.60 z: 2.00 [m]

Geometry:: Type: Area Length[m]:3.20E+00 Width[m]:4.00E+00 Direction: y

Pathway ::

Direct Ingestion Rate: 3.060E-06 [1/hr]

Fraction released to air: 3.570E-01

Removable fraction: 0.000E+00

Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration
		[dpm/m2]
	TH-232	2.214E+03
	TH-228	2.214E+03
	RA-228	2.214E+03
	CO-60	0.000E+00
	MN-54	0.000E+00
	H-3	4.284E-22

RESRAD-BUILD Dose Tables

Source Contributions to Receptor Doses

[mrem]

		Source	Source	Source	Source	Source	Source	Total
		1	2	3	4	5	6	
Receptor	1	3.27E-02	2.48E-02	3.46E-02	3.46E-02	1.80E-02	1.80E-02	1.63E-01
Total		3.27E-02	2.48E-02	3.46E-02	3.46E-02	1.80E-02	1.80E-02	1.63E-01

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL End of Project.bld

Evaluation Time: 1000.00000 years

Pathway Detail of Doses

[mrem]

Source: 1

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	1.07E-02	0.00E+00	0.00E+00	0.00E+00	2.20E-02	0.00E+00
Total	1.07E-02	0.00E+00	0.00E+00	0.00E+00	2.20E-02	0.00E+00

Source: 2

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	2.79E-03	0.00E+00	0.00E+00	0.00E+00	2.20E-02	0.00E+00
Total	2.79E-03	0.00E+00	0.00E+00	0.00E+00	2.20E-02	0.00E+00

Source: 3

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	7.05E-03	0.00E+00	0.00E+00	0.00E+00	2.75E-02	0.00E+00
Total	7.05E-03	0.00E+00	0.00E+00	0.00E+00	2.75E-02	0.00E+00

Source: 4

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	7.05E-03	0.00E+00	0.00E+00	0.00E+00	2.75E-02	0.00E+00
Total	7.05E-03	0.00E+00	0.00E+00	0.00E+00	2.75E-02	0.00E+00

Source: 5

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	2.29E-03	0.00E+00	0.00E+00	0.00E+00	1.57E-02	0.00E+00
Total	2.29E-03	0.00E+00	0.00E+00	0.00E+00	1.57E-02	0.00E+00

Source: 6

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	2.29E-03	0.00E+00	0.00E+00	0.00E+00	1.57E-02	0.00E+00
Total	2.29E-03	0.00E+00	0.00E+00	0.00E+00	1.57E-02	0.00E+00

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL End of Project.bld

Evaluation Time: 1000.00000 years

# Nuclide Detail of Doses

[mrem]

Source: 1

Nuclide	Receptor	Total
	1	
TH-232	6.37E-06	6.37E-06
TH-228	2.84E-02	2.84E-02
RA-228	4.33E-03	4.33E-03
H-3	0.00E+00	0.00E+00

Source: 2

Nuclide	Receptor	Total
	1	
TH-232	1.27E-06	1.27E-06
TH-228	2.37E-02	2.37E-02
RA-228	1.13E-03	1.13E-03
H-3	0.00E+00	0.00E+00

Source: 3

Nuclide	Receptor	Total
	1	
TH-232	3.79E-06	3.79E-06
TH-228	3.17E-02	3.17E-02
RA-228	2.85E-03	2.85E-03
H-3	0.00E+00	0.00E+00

Source: 4

Nuclide	Receptor	Total
	1	
TH-232	3.79E-06	3.79E-06

Title : CDC Chamblee FINAL Status Survey  
 Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL End of Project.bld  
 Evaluation Time: 1000.00000 years

TH-228	3.17E-02	3.17E-02
RA-228	2.85E-03	2.85E-03
H-3	0.00E+00	0.00E+00

Source: 5

Nuclide	Receptor	Total
	1	
TH-232	1.08E-06	1.08E-06
TH-228	1.71E-02	1.71E-02
RA-228	9.25E-04	9.25E-04
H-3	0.00E+00	0.00E+00

Source: 6

Nuclide	Receptor	Total
	1	
TH-232	1.08E-06	1.08E-06
TH-228	1.71E-02	1.71E-02
RA-228	9.25E-04	9.25E-04
H-3	0.00E+00	0.00E+00





Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL End of Project.bld

Evaluation Time: 3000.00000 years

H-3 0.000E+00

Source: 3

Location:: Room : 1 x: 0.00 y: 2.80 z: 2.00 [m]

Geometry:: Type: Area Length[m]:5.60E+00 Width[m]:4.00E+00 Direction: x

Pathway ::

Direct Ingestion Rate: 3.060E-06 [1/hr]

Fraction released to air: 3.570E-01

Removable fraction: 0.000E+00

Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	2.214E+03
	TH-228	2.214E+03
	RA-228	2.214E+03
	CO-60	0.000E+00
	MN-54	0.000E+00
	H-3	0.000E+00

Source: 4

Location:: Room : 1 x: 3.20 y: 2.80 z: 2.00 [m]

Geometry:: Type: Area Length[m]:5.60E+00 Width[m]:4.00E+00 Direction: x

Pathway ::

Direct Ingestion Rate: 3.060E-06 [1/hr]

Fraction released to air: 3.570E-01

Removable fraction: 0.000E+00

Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	2.214E+03
	TH-228	2.214E+03
	RA-228	2.214E+03
	CO-60	0.000E+00
	MN-54	0.000E+00
	H-3	0.000E+00

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL End of Project.bld

Evaluation Time: 3000.00000 years

Source: 5

Location:: Room : 1 x: 1.60 y: 0.00 z: 2.00 [m]

Geometry:: Type: Area Length[m]:3.20E+00 Width[m]:4.00E+00 Direction: y

Pathway ::

Direct Ingestion Rate: 3.060E-06 [1/hr]

Fraction released to air: 3.570E-01

Removable fraction: 0.000E+00

Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	2.214E+03
	TH-228	2.214E+03
	RA-228	2.214E+03
	CO-60	0.000E+00
	MN-54	0.000E+00
	H-3	0.000E+00

Source: 6

Location:: Room : 1 x: 1.60 y: 5.60 z: 2.00 [m]

Geometry:: Type: Area Length[m]:3.20E+00 Width[m]:4.00E+00 Direction: y

Pathway ::

Direct Ingestion Rate: 3.060E-06 [1/hr]

Fraction released to air: 3.570E-01

Removable fraction: 0.000E+00

Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	2.214E+03
	TH-228	2.214E+03
	RA-228	2.214E+03
	CO-60	0.000E+00
	MN-54	0.000E+00
	H-3	0.000E+00

Title : CDC Chamblee FINAL Status Survey  
Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL End of Project.bld  
Evaluation Time: 3000.00000 years

RESRAD-BUILD Dose Tables	
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Source Contributions to Receptor Doses

[mrem]							
Source		Source	Source	Source	Source	Source	Total
1		2	3	4	5	6	
Receptor 1	3.27E-02	2.48E-02	3.46E-02	3.46E-02	1.80E-02	1.80E-02	1.63E-01
Total	3.27E-02	2.48E-02	3.46E-02	3.46E-02	1.80E-02	1.80E-02	1.63E-01

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL End of Project.bld

Evaluation Time: 3000.00000 years

Pathway Detail of Doses

[mrem]

Source: 1

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	1.07E-02	0.00E+00	0.00E+00	0.00E+00	2.20E-02	0.00E+00
Total	1.07E-02	0.00E+00	0.00E+00	0.00E+00	2.20E-02	0.00E+00

Source: 2

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	2.79E-03	0.00E+00	0.00E+00	0.00E+00	2.20E-02	0.00E+00
Total	2.79E-03	0.00E+00	0.00E+00	0.00E+00	2.20E-02	0.00E+00

Source: 3

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	7.05E-03	0.00E+00	0.00E+00	0.00E+00	2.75E-02	0.00E+00
Total	7.05E-03	0.00E+00	0.00E+00	0.00E+00	2.75E-02	0.00E+00

Source: 4

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	7.05E-03	0.00E+00	0.00E+00	0.00E+00	2.75E-02	0.00E+00
Total	7.05E-03	0.00E+00	0.00E+00	0.00E+00	2.75E-02	0.00E+00

Source: 5

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	2.29E-03	0.00E+00	0.00E+00	0.00E+00	1.57E-02	0.00E+00
Total	2.29E-03	0.00E+00	0.00E+00	0.00E+00	1.57E-02	0.00E+00

Source: 6

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	2.29E-03	0.00E+00	0.00E+00	0.00E+00	1.57E-02	0.00E+00
Total	2.29E-03	0.00E+00	0.00E+00	0.00E+00	1.57E-02	0.00E+00

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL End of Project.bld

Evaluation Time: 3000.00000 years

Nuclide Detail of Doses

[mrem]

Source: 1

Nuclide	Receptor	Total
	1	
TH-232	6.37E-06	6.37E-06
TH-228	2.84E-02	2.84E-02
RA-228	4.33E-03	4.33E-03

Source: 2

Nuclide	Receptor	Total
	1	
TH-232	1.27E-06	1.27E-06
TH-228	2.37E-02	2.37E-02
RA-228	1.13E-03	1.13E-03

Source: 3

Nuclide	Receptor	Total
	1	
TH-232	3.79E-06	3.79E-06
TH-228	3.17E-02	3.17E-02
RA-228	2.85E-03	2.85E-03

Source: 4

Nuclide	Receptor	Total
	1	
TH-232	3.79E-06	3.79E-06
TH-228	3.17E-02	3.17E-02
RA-228	2.85E-03	2.85E-03

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL End of Project.bld

Evaluation Time: 3000.00000 years

Source: 5

Nuclide	Receptor	Total
	1	
TH-232	1.08E-06	1.08E-06
TH-228	1.71E-02	1.71E-02
RA-228	9.25E-04	9.25E-04

Source: 6

Nuclide	Receptor	Total
	1	
TH-232	1.08E-06	1.08E-06
TH-228	1.71E-02	1.71E-02
RA-228	9.25E-04	9.25E-04

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL End of Project.bld

Evaluation Time: 10000.0000 years

```
=====
=====
=====
Assessment for Time: 10
Time =1.00E+04 yr
=====
=====
```

===== Source Information =====

Source: 1

Location:: Room : 1 x: 1.60 y: 2.80 z: 0.00 [m]

Geometry:: Type: Area Length[m]:3.20E+00 Width[m]:5.60E+00 Direction: z

Pathway ::

Direct Ingestion Rate: 3.060E-06 [1/hr]

Fraction released to air: 3.570E-01

Removable fraction: 0.000E+00

Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	2.214E+03
	TH-228	2.214E+03
	RA-228	2.214E+03
	CO-60	0.000E+00
	MN-54	0.000E+00
	H-3	0.000E+00

Source: 2

Location:: Room : 1 x: 1.60 y: 2.80 z: 4.00 [m]

Geometry:: Type: Area Length[m]:3.20E+00 Width[m]:5.60E+00 Direction: z

Pathway ::

Direct Ingestion Rate: 3.060E-06 [1/hr]

Fraction released to air: 3.570E-01

Removable fraction: 0.000E+00

Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	2.214E+03
	TH-228	2.214E+03
	RA-228	2.214E+03
	CO-60	0.000E+00
	MN-54	0.000E+00

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL End of Project.bld

Evaluation Time: 10000.0000 years

H-3 0.000E+00

Source: 3

Location:: Room : 1 x: 0.00 y: 2.80 z: 2.00 [m]

Geometry:: Type: Area Length[m]:5.60E+00 Width[m]:4.00E+00 Direction: x

Pathway ::

Direct Ingestion Rate: 3.060E-06 [1/hr]

Fraction released to air: 3.570E-01

Removable fraction: 0.000E+00

Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	2.214E+03
	TH-228	2.214E+03
	RA-228	2.214E+03
	CO-60	0.000E+00
	MN-54	0.000E+00
	H-3	0.000E+00

Source: 4

Location:: Room : 1 x: 3.20 y: 2.80 z: 2.00 [m]

Geometry:: Type: Area Length[m]:5.60E+00 Width[m]:4.00E+00 Direction: x

Pathway ::

Direct Ingestion Rate: 3.060E-06 [1/hr]

Fraction released to air: 3.570E-01

Removable fraction: 0.000E+00

Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration [dpm/m2]
	TH-232	2.214E+03
	TH-228	2.214E+03
	RA-228	2.214E+03
	CO-60	0.000E+00
	MN-54	0.000E+00
	H-3	0.000E+00



Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL End of Project.bld

Evaluation Time: 10000.0000 years

Source: 5

Location:: Room : 1 x: 1.60 y: 0.00 z: 2.00 [m]

Geometry:: Type: Area Length[m]:3.20E+00 Width[m]:4.00E+00 Direction: y

Pathway ::

Direct Ingestion Rate: 3.060E-06 [1/hr]

Fraction released to air: 3.570E-01

Removable fraction: 0.000E+00

Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration
		[dpm/m2]
	TH-232	2.214E+03
	TH-228	2.214E+03
	RA-228	2.214E+03
	CO-60	0.000E+00
	MN-54	0.000E+00
	H-3	0.000E+00

Source: 6

Location:: Room : 1 x: 1.60 y: 5.60 z: 2.00 [m]

Geometry:: Type: Area Length[m]:3.20E+00 Width[m]:4.00E+00 Direction: y

Pathway ::

Direct Ingestion Rate: 3.060E-06 [1/hr]

Fraction released to air: 3.570E-01

Removable fraction: 0.000E+00

Time to Remove: 1.000E+04 [day]

Contamination::	Nuclide	Concentration
		[dpm/m2]
	TH-232	2.214E+03
	TH-228	2.214E+03
	RA-228	2.214E+03
	CO-60	0.000E+00
	MN-54	0.000E+00
	H-3	0.000E+00

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL End of Project.bld

Evaluation Time: 10000.0000 years

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RESRAD-BUILD Dose Tables

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Source Contributions to Receptor Doses

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[mrem]

	Source	Source	Source	Source	Source	Source	Total
	1	2	3	4	5	6	
Receptor 1	3.27E-02	2.48E-02	3.46E-02	3.46E-02	1.80E-02	1.80E-02	1.63E-01
Total	3.27E-02	2.48E-02	3.46E-02	3.46E-02	1.80E-02	1.80E-02	1.63E-01

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL End of Project.bld

Evaluation Time: 10000.0000 years

Pathway Detail of Doses

[mrem]

Source: 1

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	1.07E-02	0.00E+00	0.00E+00	0.00E+00	2.20E-02	0.00E+00
Total	1.07E-02	0.00E+00	0.00E+00	0.00E+00	2.20E-02	0.00E+00

Source: 2

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	2.79E-03	0.00E+00	0.00E+00	0.00E+00	2.20E-02	0.00E+00
Total	2.79E-03	0.00E+00	0.00E+00	0.00E+00	2.20E-02	0.00E+00

Source: 3

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	7.05E-03	0.00E+00	0.00E+00	0.00E+00	2.75E-02	0.00E+00
Total	7.05E-03	0.00E+00	0.00E+00	0.00E+00	2.75E-02	0.00E+00

Source: 4

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	7.05E-03	0.00E+00	0.00E+00	0.00E+00	2.75E-02	0.00E+00
Total	7.05E-03	0.00E+00	0.00E+00	0.00E+00	2.75E-02	0.00E+00

Source: 5

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	2.29E-03	0.00E+00	0.00E+00	0.00E+00	1.57E-02	0.00E+00
Total	2.29E-03	0.00E+00	0.00E+00	0.00E+00	1.57E-02	0.00E+00

Source: 6

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	2.29E-03	0.00E+00	0.00E+00	0.00E+00	1.57E-02	0.00E+00
Total	2.29E-03	0.00E+00	0.00E+00	0.00E+00	1.57E-02	0.00E+00

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL End of Project.bld

Evaluation Time: 10000.0000 years

Nuclide Detail of Doses

[mrem]

Source: 1

Nuclide	Receptor	Total
	1	
TH-232	6.37E-06	6.37E-06
TH-228	2.84E-02	2.84E-02
RA-228	4.33E-03	4.33E-03

Source: 2

Nuclide	Receptor	Total
	1	
TH-232	1.27E-06	1.27E-06
TH-228	2.37E-02	2.37E-02
RA-228	1.13E-03	1.13E-03

Source: 3

Nuclide	Receptor	Total
	1	
TH-232	3.79E-06	3.79E-06
TH-228	3.17E-02	3.17E-02
RA-228	2.85E-03	2.85E-03

Source: 4

Nuclide	Receptor	Total
	1	
TH-232	3.79E-06	3.79E-06
TH-228	3.17E-02	3.17E-02
RA-228	2.85E-03	2.85E-03

Title : CDC Chamblee FINAL Status Survey

Input File : C:\RESRAD\_Family\BUILD\35\CDC Chamblee FINAL End of Project.bld

Evaluation Time: 10000.0000 years

Source: 5

Nuclide	Receptor	Total
	1	
TH-232	1.08E-06	1.08E-06
TH-228	1.71E-02	1.71E-02
RA-228	9.25E-04	9.25E-04

Source: 6

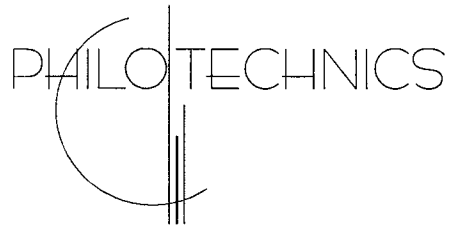
Nuclide	Receptor	Total
	1	
TH-232	1.08E-06	1.08E-06
TH-228	1.71E-02	1.71E-02
RA-228	9.25E-04	9.25E-04



**CDC**

**RAW Room #1**

# **Final Status Survey Report Appendix**



Prepared by:  
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201 Renovare Blvd.  
Oak Ridge, TN 37830

## **Appendix I – Analytical Lab Report**

## Generic Data Report

### 16-06132

InternalID	InternalWorkOrder	Fraction	AnalysisCode	Isotope	Run	ClientName	SampleType	ClientID	ReportUnits	Result	Uncertainty	MDA
16-06132-01	16-06132	01	Gamma	CO-60	1	Philotechnics	LCS	LCS	pCi/g	2.43E+02	1.37E+01	1.06E+00
16-06132-01	16-06132	01	Gamma	CS-137	1	Philotechnics	LCS	LCS	pCi/g	1.52E+02	1.26E+01	1.23E+00
16-06132-02	16-06132	02	Gamma	AC-228	1	Philotechnics	MBL	BLANK	pCi/g	3.11E-02	8.92E-02	1.65E-01
16-06132-02	16-06132	02	Gamma	BI-214	1	Philotechnics	MBL	BLANK	pCi/g	0.00E+00	5.16E-02	8.34E-02
16-06132-02	16-06132	02	Gamma	K-40	1	Philotechnics	MBL	BLANK	pCi/g	-5.89E-02	3.12E-01	4.55E-01
16-06132-02	16-06132	02	Gamma	PB-212	1	Philotechnics	MBL	BLANK	pCi/g	4.56E-02	3.81E-02	6.74E-02
16-06132-02	16-06132	02	Gamma	PB-214	1	Philotechnics	MBL	BLANK	pCi/g	-4.33E-02	6.64E-02	9.16E-02
16-06132-02	16-06132	02	Gamma	RA-226	1	Philotechnics	MBL	BLANK	pCi/g	0.00E+00	5.16E-02	8.34E-02
16-06132-02	16-06132	02	Gamma	RA-228	1	Philotechnics	MBL	BLANK	pCi/g	3.11E-02	8.92E-02	1.65E-01
16-06132-02	16-06132	02	Gamma	TH-234	1	Philotechnics	MBL	BLANK	pCi/g	4.36E-01	4.32E-01	6.49E-01
16-06132-02	16-06132	02	Gamma	TL-208	1	Philotechnics	MBL	BLANK	pCi/g	5.24E-02	6.44E-02	1.23E-01
16-06132-03	16-06132	03	Gamma	AC-228	1	Philotechnics	DUP	CDC-1-BRK-001	pCi/g	6.37E+00	7.93E-01	1.28E+00
16-06132-03	16-06132	03	Gamma	BI-214	1	Philotechnics	DUP	CDC-1-BRK-001	pCi/g	4.96E+00	6.19E-01	7.13E-01
16-06132-03	16-06132	03	Gamma	K-40	1	Philotechnics	DUP	CDC-1-BRK-001	pCi/g	3.44E+01	4.91E+00	3.03E+00
16-06132-03	16-06132	03	Gamma	PB-212	1	Philotechnics	DUP	CDC-1-BRK-001	pCi/g	6.96E+00	7.16E-01	7.46E-01
16-06132-03	16-06132	03	Gamma	PB-214	1	Philotechnics	DUP	CDC-1-BRK-001	pCi/g	5.29E+00	5.50E-01	7.58E-01
16-06132-03	16-06132	03	Gamma	RA-226	1	Philotechnics	DUP	CDC-1-BRK-001	pCi/g	4.96E+00	6.19E-01	7.13E-01
16-06132-03	16-06132	03	Gamma	RA-228	1	Philotechnics	DUP	CDC-1-BRK-001	pCi/g	6.37E+00	7.93E-01	1.28E+00
16-06132-03	16-06132	03	Gamma	TH-234	1	Philotechnics	DUP	CDC-1-BRK-001	pCi/g	5.43E+00	4.32E+00	7.15E+00
16-06132-03	16-06132	03	Gamma	TL-208	1	Philotechnics	DUP	CDC-1-BRK-001	pCi/g	4.85E+00	6.60E-01	1.06E-01
16-06132-04	16-06132	04	Gamma	AC-228	1	Philotechnics	DO	CDC-1-BRK-001	pCi/g	6.21E+00	8.00E-01	1.50E+00
16-06132-04	16-06132	04	Gamma	BI-214	1	Philotechnics	DO	CDC-1-BRK-001	pCi/g	4.48E+00	5.76E-01	6.15E-01
16-06132-04	16-06132	04	Gamma	K-40	1	Philotechnics	DO	CDC-1-BRK-001	pCi/g	3.25E+01	4.72E+00	2.89E+00
16-06132-04	16-06132	04	Gamma	PB-212	1	Philotechnics	DO	CDC-1-BRK-001	pCi/g	7.11E+00	7.18E-01	7.12E-01
16-06132-04	16-06132	04	Gamma	PB-214	1	Philotechnics	DO	CDC-1-BRK-001	pCi/g	5.10E+00	5.18E-01	6.70E-01
16-06132-04	16-06132	04	Gamma	RA-226	1	Philotechnics	DO	CDC-1-BRK-001	pCi/g	4.48E+00	5.76E-01	6.15E-01
16-06132-04	16-06132	04	Gamma	RA-228	1	Philotechnics	DO	CDC-1-BRK-001	pCi/g	6.21E+00	8.00E-01	1.50E+00
16-06132-04	16-06132	04	Gamma	TH-234	1	Philotechnics	DO	CDC-1-BRK-001	pCi/g	4.11E+00	4.87E+00	8.16E+00
16-06132-04	16-06132	04	Gamma	TL-208	1	Philotechnics	DO	CDC-1-BRK-001	pCi/g	4.51E+00	6.74E-01	7.61E-01





## ACKNOWLEDGEMENT - RECEIPT OF CORRESPONDENCE

## Name and Address of Applicant and/or Licensee

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## Date

8/29/2016

## License Number(s)

10-06772-01

## Mail Control Number(s)

591780

## Licensing and/or Technical Reviewer or Branch

Comm, Industrial, R&amp;D, and Academic Branch

This is to acknowledge receipt of your: ☒ Letter and/or ☐ Application Dated: 08/24/2016

The initial processing, which included an administrative review, has been performed.

☒ Amendment ☐ Termination ☐ New License ☐ Renewal☒ There were no administrative omissions identified during our initial review.☐ This is to acknowledge receipt of your application for renewal of the material(s) license identified above. Your application is deemed timely filed, and accordingly, the license will not expire until final action has been taken by this office.☐ Your application for a new NRC license did not include your taxpayer identification number. Please complete and submit NRC Form 531, Request for Taxpayer Identification Number, located at the following link: <http://www.nrc.gov/reading-rm/doc-collections/forms/nrc531.pdf>  
Follow the instructions on the form for submission.☐ The following administrative omissions have been identified:

Your application has been assigned the above listed MAIL CONTROL NUMBER. When calling to inquire about this action, please refer to this control number. Your application has been forwarded to a technical reviewer. Please note that the technical review, which is normally completed within 180 days for a renewal application (90 days for all other requests), may identify additional omissions or require additional information. If you have any questions concerning the processing of your application, our contact information is listed below:

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U. S. Nuclear Regulatory Commission  
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(610) 337-5398, or (610) 337-5239