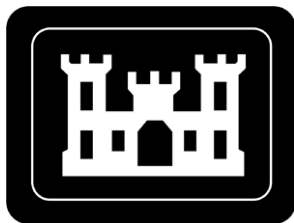

REVISION 1

FINAL STATUS SURVEY PLAN FOR SOIL, STRUCTURES, AND SEDIMENT AT THE ST. LOUIS FUSRAP SITES

ST. LOUIS, MISSOURI

JUNE 12, 2024



**U.S. Army Corps of Engineers
St. Louis District Office
Formerly Utilized Sites Remedial Action Program**



10-50% Recycled Fiber

REVISION 1

FINAL STATUS SURVEY PLAN FOR SOIL, STRUCTURES, AND SEDIMENT AT THE ST. LOUIS FUSRAP SITES

ST. LOUIS, MISSOURI

JUNE 12, 2024

prepared by

U.S. Army Corps of Engineers St. Louis District Office
Formerly Utilized Sites Remedial Action Program

with assistance from

Leidos, Inc.
under Contract No. W912P923C0012

This document provides an interim change to Appendix B in the *Final Status Survey Plan for Soil, Structures, and Sediment at the St. Louis FUSRAP Sites*, Revision 1, dated June 12, 2024. A correction is made on page 19 in Section B-3.2.19 to clarify scanning will be performed using one (rather than all) of the listed approaches. This document will remain effective until the plan is revised or these instructions are retracted in writing.

Instructions for changes to the *Final Status Survey Plan for Soil, Structures, and Sediment at the St. Louis FUSRAP Sites*, Revision 1, follow.

1. Place this page before the Table of Contents.
2. Replace page 19 with the attached page 19.

.....

TABLE OF CONTENTS

<u>SECTION</u>	<u>PAGE</u>
LIST OF TABLES	ii
LIST OF FIGURES	ii
LIST OF APPENDICES	iii
ACRONYMS AND ABBREVIATIONS.....	v
UNIT ABBREVIATIONS	x
DEFINITIONS	xi
1.0 INTRODUCTION.....	1
1.1 PURPOSE	1
1.2 SCOPE	1
1.3 APPLICABILITY	1
1.4 ORGANIZATION AND RESPONSIBILITIES	2
1.5 SITE HISTORY	3
2.0 PROPERTY DESCRIPTIONS.....	5
2.1 ST. LOUIS DOWNTOWN SITE	5
2.1.1 St. Louis Downtown Site Accessible Soil Operable Unit.....	5
2.1.2 St. Louis Downtown Site Inaccessible Soil Operable Unit	5
2.2 NORTH ST. LOUIS COUNTY SITES	5
2.2.1 St. Louis Airport Site (Operable Unit 1).....	5
2.2.2 Latty Avenue Properties (Operable Unit 3)	6
2.2.3 St. Louis Airport Site Vicinity Properties (Operable Unit 2)	6
2.2.4 St. Louis Airport Site Vicinity Properties – Roads (Operable Unit 4)	6
2.2.5 St. Louis Airport Site Vicinity Properties – Mainline Railroads (Operable Unit 5).....	6
2.2.6 St. Louis Airport Site Vicinity Properties – Coldwater Creek Corridor and Floodplain North of Dunn Road to the Missouri River (Operable Unit 6).....	6
3.0 DATA QUALITY OBJECTIVES	7
3.1 STATE THE PROBLEM	7
3.2 IDENTIFY THE DECISION.....	7
3.3 IDENTIFY INPUTS TO THE DECISION	7
3.3.1 Classify Survey Units	8
3.3.2 Soil Gamma Scans	9
3.3.3 Number of Data Points for Radiological Contaminants of Concern	10
3.3.4 Number of Data Points for Non-Radiological Contaminants of Concern	12
3.3.5 Determine Grid Spacing	13
3.3.6 Area Factors for Elevated Measurement Comparison for Soil/Sediment.....	14
3.3.7 Biased Sample Stations Other than Gamma Walkover Surveys	14

TABLE OF CONTENTS (Continued)

<u>SECTION</u>	<u>PAGE</u>
3.3.8 Sampling Depths.....	16
3.3.9 Sample Analysis.....	17
3.4 DEFINE THE STUDY BOUNDARY.....	18
3.5 DEVELOP THE DECISION RULE	19
3.5.1 St. Louis Downtown Site	19
3.5.2 North St. Louis County Sites	26
3.6 SPECIFY TOLERABLE LIMITS ON DECISION ERROR	32
3.7 OPTIMIZE THE DESIGN FOR OBTAINING DATA	33
4.0 REPORT OF SURVEY FINDINGS	35
5.0 REFERENCES.....	37

LIST OF TABLES

<u>NUMBER</u>	<u>PAGE</u>
Table 1. Survey Unit Areas.....	8
Table 2. Typical Gamma Scan Instruments	9
Table 3. Gamma Walkover Survey Coverage Guidelines	10
Table 4. Final Status Survey Investigation Levels for Soil/Sediment	15
Table 5. Target Detection Limits	18
Table 6. SLDS Remediation Goals and Their Evaluation Criteria	19
Table 7. Input Parameters for SLDS Non-Radiological Risk Assessment	24
Table 8. North St. Louis County Sites Remediation Goals and Their Evaluation Criteria	26
Table 9. Input Parameters for North St. Louis County Sites Non-Radiological Risk Assessment.....	30

LIST OF FIGURES

<u>NUMBER</u>	
Figure 1.	St. Louis Downtown Site
Figure 2.	Operable Unit Designations South of Dunn Road
Figure 3.	Operable Unit Designations North of Dunn Road
Figure 4.	Deep-Soil Criterion Depth by Property for the St. Louis Downtown Site

LIST OF APPENDICES

APPENDIX A	FINAL STATUS SURVEY PLAN FOR STRUCTURES AND OTHER CONSOLIDATED MATERIAL LEFT IN PLACE AT THE ST. LOUIS SITES
APPENDIX B	INTEGRATED SURVEY PLAN FOR CONSOLIDATED MATERIALS, CRUSHATE, OVERBURDEN, EQUIPMENT, AND MATERIALS
APPENDIX C	FINAL STATUS SURVEY PLAN ADDENDUM—EVALUATION OF DIFFICULT-TO-ACCESS SOIL
APPENDIX D	DERIVED CONCENTRATION GUIDELINE LEVEL FOR STRUCTURES ON NORTH ST. LOUIS COUNTY SITES
APPENDIX E	DERIVED CONCENTRATION GUIDELINE LEVEL FOR STRUCTURES ON THE ST. LOUIS DOWNTOWN SITE
APPENDIX F	SODIUM IODIDE 2-INCH-BY-2-INCH SCINTILLATION DETECTOR SCAN MINIMUM DETECTABLE CONCENTRATIONS FOR RADIOLOGICAL CONTAMINANTS OF CONCERN AT THE ST. LOUIS FUSRAP SITES

BACK COVER

The primary distribution format for this document is electronic files. If printed copies are distributed, the following portions will be included on a CD-ROM on the back cover of the report instead of being printed: Attachments A-2, D-1, and E-1.

THIS PAGE INTENTIONALLY LEFT BLANK

ACRONYMS AND ABBREVIATIONS

α	alpha
β	beta
ϵ_i	instrument efficiency
Δ/σ	relative shift
Δ	shift
ϵ_s	surface efficiency
σ	standard deviation
6E	6 East
6EH	6 East Half
7N	7 North
7S	7 South
7W	7 West
ABS	absorption factor skin
AT_c	averaging time for cancer effects
Ac	actinium
ADAF	age-dependent adjustment factor
AEC	U.S. Atomic Energy Commission
AF	activity fraction
AF_{HI}	soil to skin adherence factor
Ag	silver
ALARA	as low as reasonably achievable
AT_{nc}	averaging time for non-cancer effects
ANL	Argonne National Laboratory
ANSI	American National Standards Institute
ARAM	adjusted reference area measurements
ARAR	applicable or relevant and appropriate requirement
ATSDR	Agency for Toxic Substances and Disease Registry
Bi	bismuth
bgs	below ground surface
BRA	<i>Baseline Risk Assessment for Exposure to Contaminants at the St. Louis Site, St. Louis, Missouri</i>
BW	body weight
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
Cf	californium
CF	conversion factor
CFR	<i>Code of Federal Regulations</i>
CHP	Certified Health Physicist
Cm	curium
CMSU	consolidated material survey unit
Co	cobalt
COC	contaminant of concern
CPMR	count rate to exposure rate ratio
Cs	cesium
CSF_o	cancer slope factor oral ingestion
CSM	conceptual site model
CWC	Coldwater Creek

ACRONYMS AND ABBREVIATIONS (Continued)

DCGL	derived concentration guideline level
DCGL _{EMC}	derived concentration guideline level for small areas of elevated activity (used with the elevated measurement comparison)
DCGL _W	derived concentration guideline level for average concentrations over a wide area (used with statistical tests)
DoD	U.S. Department of Defense
DOE	U.S. Department of Energy
DQA	data quality assessment
DQI	data quality indicator
DQO	data quality objective
DSR	dose-to-source ratio
ED	exposure duration
EF	exposure frequency
EFH	<i>Exposure Factors Handbook: 2011 Edition</i>
EMC	elevated measurement comparison
EPC	exposure point concentration
ERC	exposure rate concentration ratio
ET	exposure time
Eu	europium
Fr	francium
FSS	final status survey
FSSE	final status survey evaluation
FSSP	final status survey plan
FUSRAP	Formerly Utilized Sites Remedial Action Program
Futura	Futura Coatings Company
GIABS	gastrointestinal absorption fraction
GPS	global positioning system
GRAAA	Groundwater Remedial Action Alternative Assessment
GWS	gamma walkover survey
H ₀	null hypothesis
HHRAP	<i>Human Health Risk Assessment Protocol (HHRAP) for Hazardous Waste Combustion Facilities</i>
HI	hazard index
HISS	Hazelwood Interim Storage Site
HPS	Health Physics Society
HSA	historical site assessment
HTRW	hazardous, toxic, and radioactive waste
HU	hydrostratigraphic unit
I	Interstate
IA	investigation area
ICRP	International Commission on Radiological Protection
IL	investigation level
Ir	iridium
IR _{gp}	ingestion rate of garden produce
IR _s	ingestion rate soil
IRIS	Integrated Risk Information System
ISO	International Organization for Standardization

ACRONYMS AND ABBREVIATIONS (Continued)

ISOU	Inaccessible Soil Operating Unit
ISOU RI/BRA	<i>Remedial Investigation and Baseline Risk Assessment Report for the Inaccessible Soil Operable Unit at the St. Louis Downtown Site</i>
ISOU RI WP	<i>Remedial Investigation Work Plan for the Inaccessible Soil Operable Unit at the St. Louis Downtown Site</i>
ISOU1 ROD	<i>Record of Decision for the Inaccessible Soil Operable Unit Associated with Group 1 Properties at the St. Louis Downtown Site</i>
IUR	inhalation unit risk
LBGR	lower bound of the gray region
Leidos	Leidos, Inc.
LiDAR	Light Detection and Ranging
Mallinckrodt	Mallinckrodt LLC
MARSAME	<i>Multi-Agency Radiation Survey and Assessment of Materials and Equipment Manual</i>
MARSSIM	<i>Multi-Agency Radiation Survey and Site Investigation Manual</i>
MDA	minimum detectable activity
MDC	minimum detectable concentration
MDCR	minimum detectable count rate
MDCR _{surveyor}	surveyor's net minimum detectable count rate
MED	Manhattan Engineer District
MSDIS	<i>Missouri Spatial Data Information Service</i>
NA	not applicable
NAD	normalized absolute difference (unitless)
NaI	sodium iodide
NC FS	<i>Feasibility Study for the St. Louis North County Sites</i>
NC ROD	<i>Record of Decision for the North St. Louis County Sites</i>
NCRP	National Council on Radiation Protection and Measurements
NIST	National Institute of Standards and Technology
NORM	naturally occurring radioactive material
NPL	National Priorities List
NRC	U.S. Nuclear Regulatory Commission
NSC	non-significant change
NUREG	U.S. Nuclear Regulatory Commission Regulation
OEHHA	Office of Environmental Health Hazard Assessment
OSWER	Office of Solid Waste and Emergency Response
OU	Operable Unit
Pa	protactinium
Pb	lead
PDI	pre-design investigation
PEF	particulate emission factor
Po	polonium
PRAR	post-remedial action report
Pu	plutonium
QA	quality assurance
QC	quality control
QCSR	quality control summary report
Ra	radium

ACRONYMS AND ABBREVIATIONS (Continued)

RA	remedial action
RAC	remedial action contractor
RAGS Part E	<i>Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment)</i>
RAS	remedial action summary
RBA	relative bioavailability factor
RBDSCO	ROD-Based Deep Soil Criteria Option
RD	remedial design
RESRAD	RESidual RADioactivity (computer model)
RfC _i	chronic inhalation reference concentration
RfD _o	reference dose oral ingestion
RG	remediation goal
Rn	radon
ROD	record of decision
RPD	relative percent difference
RSLUG	“Regional Screening Levels (RLSs) – User’s Guide”
RSO	Radiation Safety Officer
RSR	risk-to-source ratio
R _{up}	root uptake multiplier
SA	skin surface area
SAG	<i>Sampling and Analysis Guide for the St. Louis Sites</i>
SAIC	Science Applications International Corporation
SARA	Superfund Amendments and Reauthorization Act
SLAPS	St. Louis Airport Site
SLDS	St. Louis Downtown Site
SLDS FS	<i>Feasibility Study for the St. Louis Downtown Site</i>
SLDS ROD	<i>Record of Decision for the St. Louis Downtown Site</i>
SLS	St. Louis Sites
SOF _N	net sum of fractions (unitless)
SOR _G	gross sum of ratios (unitless)
SOR _N	net sum of ratios (unitless)
Sr	strontium
SU	survey unit
SW	solid waste
TCLP	toxic characteristics leaching properties
TEDE	total effective dose equivalent
Th	thorium
Tl	thallium
U	uranium
UCL ₉₅	95 percent upper confidence limit
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey
UUUE	unlimited use and unrestricted exposure
VP	vicinity property

ACRONYMS AND ABBREVIATIONS (Continued)

WAC	Waste Acceptance Criteria
WP	work plan
WRS	Wilcoxon Rank Sum

UNIT ABBREVIATIONS

Both English and metric units are used in this report. The units used in a specific situation are based on common unit usage or regulatory language (e.g., depths are given in feet, and areas are given in square meters). Units included in the following list are not defined at first use in this report.

$(\mu\text{g}/\text{m}^3)^{-1}$	inverse of microgram(s) per cubic meter
μR	microRoentgen(s)
cm	centimeter(s)
cm^2	square centimeter(s)
cpm	count(s) per minute
cpm/dpm	count(s) per minute per disintegration per minute
cpm/ μR	count(s) per minute per microRoentgen(s)
cps	count(s) per second
dpm/100 cm^2	disintegration(s) per minute per 100 square centimeters
ft	foot/feet
g	gram(s)
g/m^3	gram(s) per cubic meter(s)
keV	kiloelectron Volt(s)
kg	kilogram(s)
kg/mg	kilogram(s) per milligram
m	meter(s)
m^2	square meter(s)
m^3	cubic meter(s)
m^3/kg	cubic meter(s) per kilogram
MeV	megaelectron Volt(s)
mg	milligram(s)
mg/cm^2	milligram(s) per square centimeter(s)
mg/kg	milligram(s) per kilogram
mg/kg-day	milligram(s) per kilogram-day
$(\text{mg}/\text{kg}\text{-day})^{-1}$	inverse of milligram(s) per kilogram per day
mg/m^3	milligram(s) per cubic meter
mR	milliRoentgen(s)
mrem	millirem
pCi/g	picocurie(s) per gram
pCi/m^2	picocurie(s) per square meter(s)
yd^3	cubic yard(s)

DEFINITIONS

a-priori	Calculated before the parameters that are specific to a particular sample are known.
acceptance criterion	<i>Multi-Agency Radiation Survey and Assessment of Materials and Equipment Manual</i> (MARSSIM) term for the derived concentration guideline levels (DCGLs); used in statistical testing.
area	A very general term that refers to any portion of a site, up to and including the entire site.
area of elevated activity	An area over which residual radioactivity exceeds a specified value (i.e., DCGL).
characterization survey	A type of survey that includes facility or site sampling, monitoring, and analysis activities to determine the extent and nature of contamination.
Class 1 area(s)	Areas that have, or had prior to remediation, a potential for radioactive contamination, or known contamination exceeding the DCGL.
Class 2 area(s)	Areas that have, or had prior to remediation, a potential for radioactive contamination, or known contamination, but are not expected to exceed the DCGL.
Class 3 area(s)	Any impacted areas that are not expected to contain any residual radioactivity, or are expected to contain levels of residual radioactivity at a small fraction of the DCGL, based on site operating history and previous radiological surveys.
clearance	The survey and subsequent removal of items or materials from any further institutional or administrative control.
consolidated material(s)	For the purposes of this document, pieces of concrete or asphalt that have at least one dimension that is greater than approximately 25 cm. This may also include items such as monoliths, railroad ties, metal beams, piping, etc.
contamination	For the purposes of this document, the term “contamination” refers to the presence of contaminants of concern (COCs) in concentrations that exceed the record of decision (ROD) limits.
crushate	Consolidated materials that have been crushed and are now in aggregate form (generally concrete or asphalt that is processed so that the size averages less than 25 cm).
data quality assessment (DQA)	The scientific and statistical evaluation of data to determine if the data are of the right type, quality, and quantity to support their intended use.
data quality indicators (DQI)	Measurable attributes of the attainment of the necessary quality for a particular decision.
data quality objective (DQO)	Qualitative and quantitative statements developed using the DQO process that clarify study objectives, define the appropriate type of data, and specify tolerable levels of potential decision errors that will be used as the basis for establishing the quality and quantity of data needed to support decisions.
derived concentration guideline level (DCGL)	A derived, radionuclide-specific activity concentration within a survey unit (SU) corresponding to the release criterion (i.e., remediation goal [RG]). DCGLs are generally derived from activity/dose relationships through various exposure pathway scenarios.
ex-situ	Not located in the original position; having been moved.

DEFINITIONS (Continued)

final status survey (FSS)	Measurements and sampling to describe the radiological conditions of a site following completion of decontamination activities, if any, in preparation for release.
impacted	Material(s) or area(s) with some potential for residual contamination.
impacted area	Any area that is not classified as non-impacted. Areas with a possibility of containing residual radioactivity exceeding natural background or fallout levels.
in-situ	Located in the original position; not having been moved.
investigation level (IL)	A radionuclide-specific level based on the release criterion or a fraction of the release criterion that, if exceeded, triggers some response such as further investigation or remediation.
land area	Any parcel of land being considered.
non-impacted area(s)	Areas that have no reasonable potential for residual contamination.
overburden	Material that is covering the soil of interest. This may consist of clean backfill, paving materials, sand, gravel, or any combination thereof. For the purposes of this document, overburden is considered potentially clean material.
release criterion	A regulatory limit expressed in terms of dose or risk. The release criterion is provided in a decision document and is often referred to in such documents as the RG. DCGLs are derived from the release criterion.
remediation goal (RG)	A regulatory limit expressed in terms of dose or risk. The RG is provided in a decision document.
site	Any installation, facility, or discrete, physically separate parcel of land, or any building or structure or portion thereof, that is being considered for survey and investigation.
site reconnaissance	A visit to the site to gather sufficient information to support a site decision regarding the need for further action, or to verify existing site data.
survey unit (SU)	A physical area consisting of structure or land areas of specified size and shape for which a separate decision will be made as to whether or not that area exceeds the release criterion.
unrestricted release	Release of a site from regulatory control without requirements for future radiological restrictions.
volumetric contamination	Contamination residing in or throughout the volume of an item.

1.0 INTRODUCTION

1.1 PURPOSE

The purpose of this final status survey plan (FSSP) is to provide the basis for conducting final status surveys (FSSs) within the Formerly Utilized Sites Remedial Action Program (FUSRAP) St. Louis Sites (SLS).

The objective of the FSS process is to validate that areas within the SLS that have been impacted by Manhattan Engineer District (MED)/U.S. Atomic Energy Commission (AEC) activities have achieved the appropriate record of decision (ROD) requirements, including remediation goals (RGs). Consolidated lists of applicable FUSRAP SLS RGs used in the FSS evaluation are provided in Tables 6, 8, and A-5.

1.2 SCOPE

This FSSP includes a process to evaluate levels of radiological and non-radiological contaminants of concern (COCs) for soil, sediment, structures/consolidated materials, crushate, overburden, and equipment/materials at the SLS based on the areas identified per the *Record of Decision for the St. Louis Downtown Site* (SLDS ROD) (USACE 1998a) and per the *Record of Decision for the North St. Louis County Sites* (NC ROD) (USACE 2005a). The guidance found in *Multi-Agency Radiation Survey and Site Investigation Manual* (MARSSIM) (DOD 2000), *Multi-Agency Radiation Survey and Assessment of Materials and Equipment Manual* (MARSAME) (DOD 2009), *Guidance on Systematic Planning Using the Data Quality Objective Process* (USEPA 2006), and the applicable RODs are used to perform FSSs and demonstrate compliance with RGs.

The plan provides guidance in the following areas:

- MARSSIM/MARSAME classification of an impacted site or impacted portions of a site,
- Planning and execution of FSSs,
- Survey data analysis, and
- Survey reporting.

1.3 APPLICABILITY

This plan is applicable to all impacted portions of the SLS except for SLDS Inaccessible Soil Operating Unit (ISOU) media (unless a ROD is issued for specified ISOU media that require an FSS).

Surveys of structures and in-situ consolidated materials left in place will be performed using the processes described in Appendix A.

Surveys of ex-situ consolidated materials, crushate, overburden, equipment and materials that will not be left in place will be performed using the processes described in Appendix B, in accordance with standard operating procedures of the FSS contractor and/or the remedial action contractor (RAC) or another approved plan. Items such as tools and equipment that are to be free released for unrestricted use are beyond the scope of this FSSP, except as described in Appendix B.

Evaluation of difficult-to-access soil¹ will be performed in accordance with Appendix C.

Calculation of a derived concentration guideline level (DCGL) for structures and consolidated material present on North St. Louis County Sites and on the St. Louis Downtown Site is documented in Appendix D and E, respectively.

This FSSP incorporates and supersedes the following plans, but it does not negate the adequacy of FSSs completed using those plans:

- *MARSSIM Based Final Status Survey Plan for the St. Louis Site Vicinity Property 56* (USACE 1999a);
- *Radiological Final Status Survey Plan for Accessible Soil within Plant 1, Plant 2 and the City Property at the St. Louis Downtown Site* (USACE 1999b);
- *MARSSIM-Based Final Status Survey Plan for the St. Denis Bridge Area* (USACE 1999c);
- *Radiological Final Status Survey Plan for the St. Louis Airport Site* (USACE 1999d);
- *Final Status Survey Plan for Accessible Soil Within Plants 3, 6, 6E, 7N, 7S, 7W, 8, 9, and the Vicinity Properties at the St. Louis Downtown Site* (USACE 1999e);
- *FUSRAP Final Status Survey Plan for the St. Louis North County Vicinity Properties* (USACE 1999f);
- *Final Status Survey Plan for the VP-2(L) Building Roof* (USACE 2001);
- *Radiological Final Status Survey Plan for Accessible Soil within the Mallinckrodt Property and the Vicinity Properties Excluding Plants 1, 2, and the City Property at the St. Louis Downtown Site* (USACE 2002a);
- *Final Status Survey Plan Addendum—Evaluation of Difficult to Access Soils* (USACE 2003a);
- *Final Status Survey Plan for Structures and Other Consolidated Material Left in Place at the St. Louis Sites* (USACE 2003b); and
- *Integrated Survey Plan for Consolidated Materials, Crushate, Overburden, Equipment and Materials* (USACE 2003c).

Several FSSs have been completed for SLS properties under the plans listed previously.

1.4 ORGANIZATION AND RESPONSIBILITIES

The U.S. Army Corps of Engineers (USACE) (or designee) is responsible for the implementation of the FSS as detailed in this FSSP and will remain independent in the FSS process consistent with USACE policy. The FSS may be performed by the USACE, or verification contractor or RAC, with direct oversight by the USACE (or a designated USACE representative). The USACE may utilize identification and mapping of depositional areas, scans, and supplemental survey information to identify biased sampling locations. The RAC should generally have no knowledge of FSS

¹ Difficult-to-access soil may occur when an excavation requires shielding or shoring to protect entrants or to prevent the collapse of the faces of the excavation; when the soil volume to be evaluated is beneath the surface of an excavation; when the soil volume to be evaluated is beneath the surface of the foundation of adjacent buildings or structures; or when other situations necessitate as determined by the USACE.

sampling locations prior to or during remedial action (RA). Modifications to this FSSP require documented USACE authorization.

1.5 SITE HISTORY

From 1942 to 1957, Mallinckrodt LLC (Mallinckrodt) processed uranium feed materials to produce various forms of uranium compounds and uranium metal for U.S. military purposes under contract to the MED/AEC. Mallinckrodt performed this processing at its facilities in downtown St. Louis, Missouri.

In 1946, the MED acquired the 21.7-acre tract of land now known as the St. Louis Airport Site (SLAPS) to store residues and scrap from uranium processing at the Mallinckrodt facility (now on the St. Louis Downtown Site [SLDS]). In 1966, residues associated with the production and refining of uranium materials were purchased by Continental Mining and Milling Company of Chicago, removed from the SLAPS, and placed in storage at the Hazelwood Interim Storage Site (HISS) and Futura Coatings Company (Futura) under an AEC license (DOE 1987). The main route for transportation of contaminated materials in North St. Louis County was likely from the SLAPS to James S McDonnell Boulevard (which was named Brown Road until October 1980) to Eva Avenue to Frost Avenue to Hazelwood Avenue to Latty Avenue. An alternate route likely used during inclement weather was James S McDonnell Boulevard to Lindbergh Boulevard to Pershall Road to Hazelwood Avenue to Latty Avenue. In 1967, Commercial Discount Corporation, which obtained possession of the HISS and Futura properties and residuals, began drying residues and shipping them to Cotter Corporation in Canon City, Colorado (DOE 1987). In 1969, residues remaining at the HISS and Futura were sold to Cotter Corporation. In 1970, Cotter Corporation dried and shipped some of the remaining residues from the HISS and Futura to Canon City (DOE 1994).

In April 1974, the U.S. Nuclear Regulatory Commission (NRC) was informed by Cotter Corporation that the remaining Colorado raffinate had been shipped in mid-1973 to Canon City without drying, and that the leached barium sulfate had been diluted with 1.0 to 1.5 ft of soil and transported to a landfill in St. Louis County.

In October 1989, the U.S. Environmental Protection Agency (USEPA) placed the SLAPS, the HISS, and Futura on the National Priorities List (NPL). This list required the cleanup to proceed under the guidelines of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) as amended by the Superfund Amendments and Reauthorization Act (SARA).

In 1998, the SLDS ROD (USACE 1998a) for accessible soil was signed by the USEPA and the USACE. A non-significant change (NSC) to the SLDS ROD was issued by the USACE via the Memorandum for Record, *Non-Significant Change to the Record of Decision for the St. Louis Downtown Site* (USACE 2005b). The NSC is a clarification of the boundary of the SLDS impacted area.

In 2014, the *Record of Decision for the Inaccessible Soil Operable Unit Associated with Group 1 Properties at the St. Louis Downtown Site* (ISOU1 ROD) (USACE 2014) was issued. The ROD documented the decision that no further action was required for the ISOU media at the Group 1 properties. The ISOU media are inaccessible soil and sewers (i.e., soil and sewers located under buildings, railroads, roads, or other permanent structures, including the subsoil adjacent to the structure that cannot be disturbed without affecting the stability of the structure), and soil on building/structural surfaces. The Group 1 properties follow: Plant 3, Plant 8, Plant 9, Plant 11, Mallinckrodt Parking Lots, Mallinckrodt Security Gate Number 49, DT-4 South, DT-5, DT-8,

DT-9 Levee, DT-13, DT-14, DT-15, DT-16, DT-17, DT-18, DT-20, DT-21, DT-22, DT-23, DT-24, DT-25, DT-26, DT-27, DT-28, DT-29, DT-30, DT-34, DT-35, and DT-36.

In 2005, the NC ROD (USACE 2005a) was signed by the USEPA and the USACE. The following two NSCs to the NC ROD were issued by the USACE. The NSCs reflected redesignation of the property identified as vicinity properties (VP)-40 as a SLAPS VP and division of the North St. Louis County Sites impacted area into six Operable Units (OUs).

- Memorandum for Record. *Non-significant change to the Record of Decision for the North St. Louis County Sites* (USACE 2021a).
- Memorandum for Record. *Non-significant change to the Record of Decision for the North St. Louis County Sites* (USACE 2021b).

2.0 PROPERTY DESCRIPTIONS

The SLS are located in the St. Louis, Missouri, area and consist of the SLDS and the North St. Louis County Sites, each of which contains multiple properties located in two distinct areas: St. Louis City and North St. Louis County.

2.1 ST. LOUIS DOWNTOWN SITE

The SLDS is located in an industrial area in north St. Louis City and consists of land currently owned by Mallinckrodt and surrounding land owned by various private and government entities. The properties not owned by Mallinckrodt are referred to as SLDS VPs. The SLDS is located on the western bank of the Mississippi River, approximately 12.5 miles downstream from the confluence of the Mississippi and Missouri Rivers. The SLDS is shown on Figure 1.

The SLDS is in the floodplain of the Mississippi River, but a levee established in the 1960s along the eastern boundary of the site now provides significant protection against flooding. Substantial industrial fill has been placed on the native soil during periods of development to raise the surface and attain a generally level surface. Manufacturing plants, support facilities, and other structures cover a large portion of the SLDS. Most of the remainder of the site is covered with asphalt or concrete.

The SLDS encompasses the Accessible Soil and Groundwater OU, as well as the Inaccessible Soil Operable Unit (ISOU).

2.1.1 St. Louis Downtown Site Accessible Soil Operable Unit

The SLDS ROD (USACE 1998a) defines “accessible soil” as soil that is not beneath buildings or other permanent structures. Soil adhered to structures is also assumed in this definition, as well as inaccessible soil that has become accessible (e.g., soil made accessible when a building is demolished, etc.). This soil is available for a final status survey evaluation (FSSE) in accordance with this FSSP.

2.1.2 St. Louis Downtown Site Inaccessible Soil Operable Unit

The SLDS inaccessible soil is not available for an FSSE; however, a “No Further Action” selected remedy has been established for several SLDS properties (i.e., Group 1 Properties) based primarily on risk assessments meeting the CERCLA risk range as documented in the ISOU1 ROD (USACE 2014).

2.2 NORTH ST. LOUIS COUNTY SITES

2.2.1 St. Louis Airport Site (Operable Unit 1)

The SLAPS (OU-1) is a 21.7-acre property in St. Louis County, approximately 11 miles from downtown St. Louis. The SLAPS is located north of the Lambert–St. Louis International Airport. The SLAPS is bounded by the Norfolk Southern Railroad and Banshee Road to the south, Coldwater Creek (CWC) to the west, and James S McDonnell Boulevard to the north and east (as shown on Figure 2). Land adjacent to the property is generally used for transportation and commercial functions. The properties comprising the SLAPS were designated as Investigation Area (IA)-01 through IA-07.

2.2.2 Latty Avenue Properties (Operable Unit 3)

The Latty Avenue Properties (OU-3) include the HISS; Futura; 9 VPs designated as VP-01(L) through VP-06(L); and Parcels 10K530087, 10K530065, and 10K530076 (as shown on Figure 2). The majority of the VPs are located along Latty Avenue. The Latty Avenue Properties are 0.75 mile northeast of the SLAPS. The HISS and Futura properties, located at 9170 and 9200 Latty Avenue, respectively, cover an 11-acre tract of land. The Latty Avenue Properties are located in northern St. Louis County within the Cities of Hazelwood and Berkeley. Land use near these properties is primarily industrial.

2.2.3 St. Louis Airport Site Vicinity Properties (Operable Unit 2)

The SLAPS VPs consist of more than 78 properties, including properties along former haul routes from the SLAPS to the HISS; CWC from Banshee Road to Dunn Road and adjacent properties; the former Ballfields north of the SLAPS; and other SLAPS contiguous properties. The SLAPS VPs are located within the Cities of Berkeley and Hazelwood, Missouri. The properties surrounding the SLAPS were designated as IA-08 through IA-13, as shown on Figure 2. Land use at these properties is primarily industrial.

2.2.4 St. Louis Airport Site Vicinity Properties – Roads (Operable Unit 4)

The SLAPS VP Roads (OU-4) include paved roadways within the SLAPS VP boundaries as shown on Figure 2. Some of the main roads include Eva Avenue; Hazelwood Avenue; Pershall Road; Byassee Drive; Banshee Road; Ford Lane; Seeger Industrial Drive; Latty Avenue; James S McDonnell Boulevard; and portions of Interstate (I)-170, I-270, Lindbergh Boulevard, Dunn Road, and Hanley Road.

2.2.5 St. Louis Airport Site Vicinity Properties – Mainline Railroads (Operable Unit 5)

The SLAPS VP Mainline Railroads (OU-5) include mainline railroads within the ROD. Secondary rail lines and spurs are included with the associated property.

2.2.6 St. Louis Airport Site Vicinity Properties – Coldwater Creek Corridor and Floodplain North of Dunn Road to the Missouri River (Operable Unit 6)

Approximately 12 miles of the CWC corridor from top of bank to top of bank and the associated 10-year floodplain properties are included in OU-6 (as shown on Figure 3). The USACE may investigate the land area beyond the 10-year floodplain as substantiated information becomes available of additional impacted areas. While the CWC floodplain and most of the CWC corridor have soil as the impacted media, the land area under the mean water gradient of CWC itself has sediment as the impacted media. Per the NC ROD, sediment RGs apply only to material below the mean water gradient at CWC. Sediment applies only to CWC itself and not to tributaries. The land area under tributary water is handled as soil. The mean water gradient is a hydrological term that refers to the estimated surface water elevation while a stream is flowing at its mean annual discharge rate. In other words, the mean water gradient reflects the level of the creek during its normal flow conditions and stays wet throughout most of the year. For safety reasons, sediment sampling occurs during normal flow, so the log for the sample should identify when the sample is collected from under water and that the sample is sediment.

3.0 DATA QUALITY OBJECTIVES

The data quality objective (DQO) process is a strategic planning approach for a data collection activity. It provides a systematic method for defining the criteria that a data collection design should satisfy, including locations at which to collect soil samples (i.e., sample stations), quantities of soil samples to collect, and the tolerable level of decision errors for the study. The DQO process includes the following elements from the USEPA *Guidance on Systematic Planning Using the Data Quality Objectives Process* (USEPA 2006), and they are used in developing this FSSP.

1. State the Problem,
2. Identify the Decision,
3. Identify Inputs to the Decision,
4. Define the Study Boundaries,
5. Develop the Decision Rule,
6. Specify Tolerable Limits on Decision Error, and
7. Optimize the Design for Obtaining Data.

3.1 STATE THE PROBLEM

The SLDS and North St. Louis County Sites contain radiological and non-radiological contamination as a consequence of historical MED/AEC activities. The vertical and horizontal extent of the contamination at the properties varies based on the history of the property's use and location. The presence and extent of the contamination at individual properties at the SLS is determined via pre-design investigation (PDI) surveys and sampling that meet the MARSSIM FSS DQOs and support remedial design (RD) (if required) for an RA. An FSS must be performed for the properties impacted by MED/AEC activities to determine compliance with the applicable ROD RGs.

3.2 IDENTIFY THE DECISION

Decide if a bounded study area of impacted soil, structures/consolidated materials, sediment, crushate, or equipment/materials meets the applicable ROD selected remedy that is protective of human health and the environment.

3.3 IDENTIFY INPUTS TO THE DECISION

Inputs to the decision for soil and sediment will be gathered primarily using MARSSIM and *Methods for Evaluating the Attainment of Cleanup Standards, Volume 1: Soils and Solid Media* (USEPA 1989a) guidance. Inputs for in-situ structures/consolidated materials are addressed in Appendix A. Inputs for ex-situ structures/consolidated materials, crushate, overburden, and equipment/materials are addressed in Appendix B. Inputs for difficult to access soil are addressed in Appendix C.

The MARSSIM process emphasizes the use of DQO and data quality assessment (DQA) processes, along with a sound program of quality assurance (QA)/quality control (QC). The graded approach concept is used to ensure that survey efforts are maximized in those areas where the highest probability for residual contamination or greatest potential for adverse impacts of residual contamination exists. Examples of integrating the graded approach into the MARSSIM process include the use of site history, site conditions, equipment capabilities, and the results as the survey progresses to establish or adjust the degree of scanning coverage of a survey area, survey unit (SU) size, sampling frequency, and criteria for evaluation of elevated measurements.

In general, the inputs to the decision consist of sample results for COCs, scans for radioactivity, and/or fixed-point measurements for radioactivity. The location and frequency of these inputs are subject to the graded approach. Because of multiple COCs with background concentrations in soil, the analytical results for a sample are used to calculate the net sum of ratios (SOR_N) values for the sample. Survey activities will be conducted in accordance with standard operating procedures of the FSS contractor and/or the RAC, and in the *Sampling and Analysis Guide for the St. Louis Sites* (SAG) (USACE 2000) or in an approved work plan (WP).

3.3.1 Classify Survey Units

Consistent with MARSSIM guidance for a graded approach, SUs are classified based on a historical site assessment (HSA) and the results of scoping and characterization surveys. If an adequate amount of historical information and data exists, then the SU may be classified without performing scoping and characterization surveys. Otherwise, PDI, scoping, or characterization surveys will be performed prior to the SU classification to provide sufficient information such that justification can be made as to the FSS classification of the SU.

Soil and sediment SUs under MARSSIM are broken into three classes (Table 1). In addition to the separation of SUs by classification due to contamination potential, SUs will typically also be separated by media type (e.g., structure/consolidated material within a soil SU is evaluated as its own SU). These separate media SUs will be classified based on their contamination potential as discussed previously. Structure/consolidated material and equipment are addressed in subsequent appendices.

MARSSIM SUs do not apply to non-radiological COCs. Sampling areas for non-radiological COCs are assigned to the entire area of individual properties. Sample stations for non-radiological sample collection are randomly selected from the Class 1, 2, and 3 stations on the entire property at SLDS properties Plant 2, Plant 6 West Half (6WH), Plant 6 East Half (6EH), Plant 6 East (6E), Plant 7 North (7N), Plant 7 South (7S), and Plant 7 West (7W), and at North St. Louis County Sites properties IA-01/adjacent CWC corridor, IA-02, IA-03, IA-04, IA-05, IA-06, IA-07, IA-08, IA-09, IA-10, IA-11, IA-12, IA-13, the HISS, Futura, VP-02(L), and Parcel 10K530087 as referenced in Figure 5-7 of the SLDS ROD and Table 2-2 of the NC ROD.

Table 1. Survey Unit Areas

Area Classification	Contamination Potential	Soil and Sediment SU Area Limits (m ²)	Sample Station Selection
Class 1 ^a	Areas that have, or had prior to remediation, a potential for radiological contamination or known contamination above the DCGL. Class 1 SUs are typically established in areas that had prior remediation or have known contamination above the RGs. Samples with an SOR _N greater than or equal to 1.0 are not unexpected in Class 1 SUs.	2,000 ^b (1,000 at SLDS Mallinckrodt Properties) ^b	Systematic Grid Pattern within the Subject Area with a Random Starting Point
Class 2 ^a	Areas that have, or had prior to remediation, a potential for radiological contamination or known contamination but are not expected to exceed the DCGL.	10,000 ^b (5,000 at SLDS Mallinckrodt Properties) ^b	

Table 1. Survey Unit Areas (Continued)

Area Classification	Contamination Potential	Soil and Sediment SU Area Limits (m ²)	Sample Station Selection
Class 3 ^a	Any impacted areas that are not expected to contain any residual radioactivity, or are expected to contain levels of residual radioactivity at a small fraction of the DCGL, based on site operating history and previous radiation surveys.	No Limit	Randomly Selected Coordinates within the Subject Area

^a Classes 1, 2, and 3 apply to radiological COCs.

^b As additional data are collected and evaluated, the USACE may increase SU area limits up to those provided in MARSSIM plus 10 percent.

3.3.2 Soil Gamma Scans

The gamma radiation emitted by the radiological COCs can be used to identify the presence of contamination. Experience has shown that the radiological COCs are sufficiently present together to produce gamma radioactivity that is detectable at the level required by the RGs. Gamma walkover survey (GWS) detection sensitivities were determined following the guidance of MARSSIM and NUREG-1507, *Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions* (NRC 1998). Based on the methodology, parameters, and calculations contained in Appendix F of this FSSP, the collective scan minimum detectable concentrations (MDCs) for the radiological COCs are sufficient to reliably detect when the average SOR_N over 100 m² exceeds 1.0. Surface scans of soil for gross gamma radiation will be performed to identify locations of elevated external radiation that may represent potentially elevated residual radiological contamination.

Table 2 lists radiological field survey instruments that are commonly used (functional and performance equivalents may be used, as determined by a Health Physicist). FUSRAP-specific detection sensitivities have been determined following the guidance of NUREG-1507, using nominal literature values for background, response, and site conditions. Refinements to these detection sensitivity estimates will be made, as necessary, on the basis of actual radionuclide mixtures, instrument response, and background data gathered during site survey activities (e.g., when surface soil sample results and GWS results are inconsistent in identifying contamination).

Table 2. Typical Gamma Scan Instruments

Description	Application	Approximate Detection Sensitivity (pCi/g)
Ludlum Model 44-10; 2-inch-by-2-inch sodium iodide (NaI) gamma scintillation detector	Gamma scans of all surfaces	Th-230 (1.064), Ra-226 (1.11), Th-232 (1.07), Ac-227 (1.38), Pa-231 (17.8) and U-238 (18.6) ^{a,b}
Ludlum Model 2221; Scaler/ratemeter (with earphones)	Readout instrument for gamma scintillation detector	NA

^a Isotopic detection sensitivity is based on radiological characteristics of that isotope. The presence of other commingled radionuclides tends to increase the sensitivity to some radionuclides due to the detection of surrogates.

^b Derivation of site-specific scan MDCs is presented in Appendix F.

GWSs will generally be performed for surfaces of Class 1, 2, and 3 areas at the frequency listed in Table 3. For excavation areas, a GWS includes sidewalls that are present at the outer edge of the excavation or present internal to the excavation. Following any remediation, scanning will be repeated to demonstrate effectiveness of the RA. Locations for which safety considerations or other restrictions prevent access for normal scanning activities may exist. Reasonable efforts to scan such locations will be made. Alternative and innovative approaches (e.g., placing detectors in protective

sleeves, using excavating equipment to position and move detectors, etc.) will be considered. A GWS will not be conducted over sediment or soil covered with water because of shielding provided by the water; excavations containing water must be drained for the GWS.

Table 3. Gamma Walkover Survey Coverage Guidelines

Area Classification	Amount of Coverage	Notes
Class 1	100%	All accessible surfaces
Class 2	10 to 100%	Value based on the amount of concern for the presence of elevated activity.
Class 3	0 to 10%	Scans are biased toward areas with the greatest potential for contamination.

Consistent with the 0.5 m/second scan rate, the surveyor can walk at a speed of approximately 1.5 ft/second while passing the detector over the surface of the soil in a serpentine pattern. For a Class 1 area, the walking paths should be close enough that the sideways extent of the detector swing for one pass borders the sideways swing of the next or former pass. Audible response of the instrument will be continuously monitored during the survey, and locations of elevated audible response will be marked for investigation, such as biased sampling that represents an area of elevated cpm, reperforming the GWS, or identification of materials with elevated natural background radioactivity such as granite or brick. This elevated audible response corresponds to the surveyor's net minimum detectable count rate ($MDCR_{surveyor}$) of 1,000 cpm established in Appendix F.

Scanning results will be recorded in cpm. Where practicable, the detector should be coupled with a global positioning unit to record the coordinates and cpm every second. Otherwise, the GWS results should be recorded via a written survey record showing areas with results within a range of 1,000 cpm (e.g., an area with results of 9,500 to 10,500 cpm will be identified separately from areas with 10,500 to 11,500 cpm).

For the SLS, GWS data were analyzed at surface sampling locations where soil data had an SOR_N greater than 1.0 to determine an appropriate investigation level (IL). The IL for both the North St. Louis County Sites and the SLDS has been determined to be approximately 3,000 cpm exceeding background with an NaI 2-inch-by-2-inch detector. Areas that are marked for investigation may be identified as exceeding a certain cpm, such as "> 13,000" cpm.

All instrumentation will have current calibration (within the past 12 months, or more frequently if recommended by the manufacturer). Daily field performance checks will be conducted in accordance with instrument use procedures. These performance checks will be performed prior to and following daily field activities and at any time the instrument response appears questionable. Only data obtained using instruments that satisfy the performance requirements will be accepted for use in the evaluation.

3.3.3 Number of Data Points for Radiological Contaminants of Concern

The number of data points to be collected from an SU is estimated using a non-parametric statistical test for contaminants that are present in the background. The Wilcoxon Rank Sum (WRS) Test is used to compare measurements from the reference area and each SU. The Sign Test is used when the COC is not in the background or is at insignificant concentrations compared to the DCGL. The following steps ensure an adequate number of soil/sediment stations that are collectively representative of the COCs within each SU for these tests. Estimating the number of data points depends on decision errors and the standard deviation (σ) and mean of the dataset.

3.3.3.1 Specify Decision Errors

The USACE has established the Type I (α) (false negative) decision error to be used is 0.05. This provides a confidence level of 95 percent that the statistical tests will not incorrectly determine that an SU satisfies criteria when, in fact, it does not. The Type II (β) (false positive) decision error is set at 0.20. Type II errors, which would result in excess uncontaminated materials being removed, do not adversely impact public safety or health and thus are subject to change.

3.3.3.2 Estimate Standard Deviation and Mean of the Dataset

An estimate of the standard deviation of the eventual dataset should be based on site-specific data, when available, of the SU or similar SUs that have been previously sampled and shown to have sufficient data points. Historical, characterization, and PDI sample data may be used to estimate the standard deviation. In Class 1 SUs, screening samples collected from remediated areas may also be used to estimate the standard deviation. Choosing an appropriate value for the standard deviation is very important. If the value is grossly underestimated, the number of samples will be too few to obtain the desired power for the statistical test, and a resurvey may be recommended. If the value is overestimated, the number of samples determined will be unnecessarily large. If a calculated standard deviation seems unduly small, a margin may be added to a calculated standard deviation to arrive at the estimate.

Because of multiple COCs, an effective standard deviation is calculated for the North St. Louis County Sites and for the SLDS. The calculation uses the greater of the estimated standard deviation (σ) values for each radionuclide between the SU and the background reference area.

$$NC_{\sigma_{overall}} = \sqrt{\left(\frac{\sigma_{Ra-226}}{DCGL_{Ra-226}}\right)^2 + \left(\frac{\sigma_{Th-230}}{DCGL_{Th-230}}\right)^2 + \left(\frac{\sigma_{U-238}}{DCGL_{U-238}}\right)^2}$$

$$SLDS_{\sigma_{overall}} = \sqrt{\left(\frac{\sigma_{Ra-226}}{DCGL_{Ra-226}}\right)^2 + \left(\frac{\sigma_{Th-230}}{DCGL_{Th-230}}\right)^2 + \left(\frac{\sigma_{Th-232}}{DCGL_{Th-232}}\right)^2 + \left(\frac{\sigma_{U-238}}{DCGL_{U-238}}\right)^2}$$

As an example of this calculation, the effective standard deviation value (in pCi/g) for a North St. Louis County Sites SU is calculated. If a reference area standard deviation value for a COC is greater than or equal to its SU counterparts, then the reference area standard deviation is used. Unless all the data is for subsurface soil, the calculation treats all soil samples as surface samples, which ensures the estimated number of required soil sample stations is greater than the actual minimum.

$$\sigma_{eff}^{SU-1} = \sqrt{\frac{\sigma_{Ra-226}^2}{DCGL_{Ra-226}^2} + \frac{\sigma_{Th-230}^2}{DCGL_{Th-230}^2} + \frac{\sigma_{U-238}^2}{DCGL_{U-238}^2}} = \sqrt{\frac{1.19^2}{5^2} + \frac{1.37^2}{14^2} + \frac{1.28^2}{50^2}} = 0.26$$

An estimate of the mean of the eventual dataset should be based on the same dataset used to estimate the standard deviation. The lower bound of the gray region (LBGR) is set to the expected mean of the eventual dataset. Absent an adequate dataset, MARSSIM guidance may be used to initially set the LBGR to one half of the DCGL and then adjust the LBGR until the relative shift (Δ/σ) is between 1 and 3. Because of multiple COCs with background concentrations, the average of the SOR_N values for the dataset is used.

3.3.3.3 Calculate Relative Shift

The relative shift is an expression of the resolution of the measurements in units of measurement uncertainty. The following equation is used in this calculation. Because of multiple radionuclides, the DCGL has been set at an SOR_N of 1.0 for soil and sediment. The previously calculated effective standard deviation and a mean SU SOR_N of 0.45 are used as an example calculation.

$$Relative\ Shift = \frac{\Delta}{\sigma_{eff}} = \frac{DCGL - LBGR}{\sigma_{eff}} = \frac{DCGL - SOR_N^{mean}}{\sigma_{eff}} = \frac{1.0 - 0.45}{0.26} = 2.1$$

3.3.3.4 Calculate the Number of Data Points

The minimum number of data points (N) for SU statistical testing can be obtained directly from MARSSIM Table 5.3. Alternately, N may be calculated by using the following equations. The 1.645 value for $Z_{1-\alpha}$ is obtained from MARSSIM Table 5.2 based on the 0.05 value for the Type I (α) error. The 0.842 value for $Z_{1-\beta}$ is obtained from MARSSIM Table 5.2 based on the 0.2 value for the Type II (β) error. The 0.921319 value for P_r is obtained from MARSSIM Table 5.1 based on the 2.1 value for the relative shift. When the value for the relative shift is between two values in MARSSIM Table 5.1, the smaller P_r is selected. To address uncertainty associated with the calculation, N is increased by 20 percent and rounded up to yield N^* . Because the WRS Test compares SU and background reference area datasets, the N^* is divided by 2 to obtain the minimum number of data points in the SU dataset and in the background reference area dataset.

$$N_d = \frac{(Z_{1-\alpha} + Z_{1-\beta})^2}{3(P_r - 0.5)^2} = \frac{(1.645 + 0.842)^2}{3(0.921319 - 0.5)^2} = 11.6$$

$$N^* = N_d + 0.2(N_d) = 11.6 + 0.2(11.6) = 14$$

$$N^{SU} = \frac{N^*}{2} = \frac{14}{2} = 7\ Data\ Points$$

In Class 1 areas, the minimum number of systematic sample stations will be increased from N^{SU} to achieve at least 1 station per 100 m² area, unless N^{SU} already achieves that station density.

3.3.4 Number of Data Points for Non-Radiological Contaminants of Concern

The guidance in *Methods for Evaluating the Attainment of Cleanup Standards, Volume 1: Soils and Solid Media* (USEPA 1989a) is based on the normal distribution of the dataset. *ProUCL Version 5.2.0 Technical Guide: Statistical Software for Environmental Applications for Data Sets with and without Nondetect Observations* (USEPA 2022) includes additional guidance. The calculation must be separately performed for each non-radiological COC.

For WRS testing of a dataset, the following equation is used (equation 8-11 from the *ProUCL Version 5.2.0 Technical Guide*). The values for $Z_{1-\alpha}$ and $Z_{1-\beta}$ are the same values previously used for radiological COCs. The values for σ and μ are the estimated standard deviation and mean, respectively, of the dataset. As noted in the *ProUCL Version 5.2.0 Technical Guide: Statistical Software for Environmental Applications for Data Sets with and without Nondetect Observations*, this equation is the final number for the subject area without adjustment.

From the *Feasibility Study for the St. Louis North County Sites* (NC FS) (USACE 2003d) and *Feasibility Study for the St. Louis Downtown Site* (SLDS FS) (USACE 1998b), non-radiological COCs are commingled with the radiological COCs and will be removed when the radiological contaminants are excavated. Therefore, following excavation of Class 1 areas or in Class 2 areas

where radiological contamination is not expected, a reasonable assumption is that the non-radiological concentrations have a distribution similar to background. Because of its smaller difference in RG and mean compared to the other non-radiological COCs for the SLDS and the North St. Louis County Sites, the detected background data for North St. Louis County Sites arsenic is used for the example calculation. This North St. Louis County Sites arsenic dataset has an average of 7.48, σ of 3.21, and an RG (i.e., DCGL) of 36. To meet the data requirements in calculating the exposure point concentration (EPC) for risk estimate and hazard index (HI) calculations, 8 to 10 sample stations are recommended for a property, but 4 to 6 may be sufficient if those numbers meet the needs of the WRS Test or Sign Test (USEPA 2022). The following result of 2 samples should be increased based on the guidance, with 10 samples being optimal.

$$N = (1.16) \left[\sigma^2 \left(\frac{Z_{1-\alpha} + Z_{1-\beta}}{RG - \mu} \right)^2 + (0.5)(Z_{1-\alpha}^2) \right] \\ = 1.16 \left[(3.21^2) \left(\frac{1.645 + 0.842}{36 - 7.48} \right)^2 + (0.5)(1.645^2) \right] = 1.66, \text{rounded up to } 2$$

If a non-radiological COC background value is insignificant compared to the RG, then the Sign Test may be used and the number of data points is determined by the following equation (equation 8-9 from the *ProUCL Version 5.2.0 Technical Guide: Statistical Software for Environmental Applications for Data Sets with and without Nondetect Observations*). The North St. Louis County Sites background sample results for molybdenum are used for the example calculation. This North St. Louis County Sites molybdenum dataset for detects has an average of 1.37, σ of 0.40, and an RG (i.e., DCGL) of 1,000. The value for $Sign_p$ of 1 is obtained from MARSSIM Table 5.4 based on the 34.1 value for the relative shift ($[15-1.37]/0.4$). When the value for the relative shift is between two values in MARSSIM Table 5.1, the smaller $Sign_p$ is selected. While the following result of 7 samples meets minimum guidance, 10 samples would be optimal.

$$N = \frac{(Z_{1-\alpha} + Z_{1-\beta})^2}{4(Sign_p - 0.5)^2} = \frac{(1.645 + 0.842)^2}{4(1 - 0.5)^2} = 6.19, \text{rounded up to } 7$$

The MARSSIM guidance for SUs does not apply to non-radiological COCs; therefore, the size of the subject area for the estimated number of data points must be established. The subject areas at the SLDS are Plant 2, Plant 6WH, Plant 6EH, Plant 6E, Plant 7N, Plant 7S, and Plant 7W. The subject areas at the North St. Louis County Sites are IA-01/adjacent CWC corridor, IA-02, IA-03, IA-04, IA-05, IA-06, IA-07, IA-08, IA-09, IA-10, IA-11, IA-12, IA-13, the HISS, Futura, VP-02(L), and Parcel 10K530087.

3.3.5 Determine Grid Spacing

The grid spacing (L) for Class 1 or Class 2 SU radiological sampling stations is estimated in one of two ways, depending on the intended shape of the grid. No grid spacing is required for Class 3 SUs because the station coordinates are randomly selected. At properties where non-radiological sampling is required, non-radiological samples will be collected from randomly selected radiological sampling stations identified for the combined Class 1, 2, and 3 stations on the property.

For a triangular grid (preferred), the grid spacing for an SU area (A^{SU}) is calculated using the following equation.

$$L = \sqrt{\frac{A^{SU}}{0.866(N^{SU})}}$$

For a square grid, the following equation is used.

$$L = \sqrt{\frac{A^{SU}}{(N^{SU})}}$$

Because of the narrow width of CWC, grid spacing for CWC sediment SUs may be a square grid collapsed to a line(s). Because of the varying width and meandering nature of the creek and the typically long and narrow SUs, the systematic sample grid may also be established using evenly spaced samples in a line. The grid spacing along the flow of the creek will remain relatively constant; however, the sample location across the width of the creek may vary slightly because of the nature of the creek (e.g., water depth).

3.3.6 Area Factors for Elevated Measurement Comparison for Soil/Sediment

Because an applicable or relevant and appropriate requirement (ARAR) RG for both the North St. Louis County Sites and the SLDS provide for averaging SOR_N results for any 0.5-ft soil interval over a 100-m² area, area factors for the elevated measurement comparison that is described in MARSSIM have not been developed. The USACE may authorize the development and use of area factors as necessary based on the North St. Louis County Sites unlimited use and unrestricted exposure (UUUE) scenario and on the SLDS industrial use scenario of the industrial worker or the SLDS unrestricted use scenario.

3.3.7 Biased Sample Stations Other than Gamma Walkover Surveys

The following areas will be investigated by representative biased sampling.

3.3.7.1 Topographically Low-Lying Areas

Present day low-lying areas should be identified through a site visit and through geospatial analysis using Light Detection and Ranging (LiDAR)-based elevation data to measure the height of the ground surface. For historical low-lying areas, U.S. Geological Survey (USGS) topographic contours from the USGS and LiDAR-based contours from the 2012 LiDAR Missouri Spatial Data Information Service (MSDIS) (MSDIS 2018) should be used to identify potential elevation changes of 6 ft or greater indicating fill soil had been added. Aerial photographs should also be reviewed for areas of soil disturbance where fill or mounding activities may have occurred after the start of MED/AEC activities.

3.3.7.2 Biased Sample Stations Based on Investigating Other Sample Results

Areas around previously collected and analyzed samples with results that exceed an IL listed in Table 4 require additional investigation, which may include, but are not limited to, collecting additional samples, reviewing the background variability, evaluating the GWS, and reviewing historical data. The results of the investigation may result in the reclassification of all or part of the SU. In addition, areas around stations with at least one SOR_N exceeding 1.0 require additional sampling to provide areal bounding and data for averaging over 100-m² areas. This averaging over a 100-m² area for a 0.5-ft layer of soil is based on 40 *Code of Federal Regulations (CFR)* 192.12(a), which is identified as an ARAR in the RODs (USACE 1998a, 2005a). This ARAR forms the basis for the Class 1 and 2 ILs.

Table 4. Final Status Survey Investigation Levels for Soil/Sediment

SU Classification	North St. Louis County Sites Soil/Sediment	SLDS Soil/Sediment
Class 1 ^a	$SOR_N > 1.0$	$SOR_N \geq 1.0$
Class 2 ^a	$SOR_N > 1.0$	$SOR_N \geq 1.0$
Class 3	$SOR_N > 0.3$	$SOR_N \geq 0.5$
Non-Radiological	75 percent of RG	75 percent of RG

^a For Class 1 and Class 2 SUs, the IL is averaged over any area of 100 m² for a 0.5-ft layer of soil.

The Class 3 IL is based on the background variability of the soil, which is higher at the SLDS than at the North St. Louis County Sites. Within the SLDS, greater than normal variations in naturally occurring background radioactivity results from the various materials (e.g., coal, slag, cinders, fly ash, etc.) used as fill. A sample in a Class 3 area with an SOR_N greater than the IL does not necessarily indicate the SU must be reclassified. The SU should be investigated and reclassified if determined necessary based on the investigation. This SU investigation should consider whether the location(s) with an SOR_N exceeding the IL represent the edge of an area with higher COC concentrations.

3.3.7.3 Depositional Areas Along Coldwater Creek

Likely areas of sediment deposition along CWC will be identified based on a thorough evaluation of available historical data (e.g., aerial photos, topographical maps, LiDAR maps, etc.), including results of previous sediment and surface soil sampling in and around CWC, and a field reconnaissance survey. During the field survey, the following types of features will be noted and used to identify the depositional areas.

1. Channel width and depth. Deposition is expected to occur in the relatively wide and deep sections of the creek with slow-moving water.
2. Changes in channel direction. Deposition is generally associated with the inside loop of a meander.
3. Changes in channel slope. Depositional areas may be associated with a decrease in channel slope.
4. Flow velocity. Deposition typically occurs in areas with relatively low flow or restricted flow. Examples of this are pooled areas of the channel that have deeper water, lower velocity, and finer bed material than surrounding areas. Pools can form downstream from depositional bars and in backwater areas behind debris jams, bridges, and materials placed to reduce bank erosion.
5. Bank features. As a rule, deposition is not occurring in areas where evidence of severe erosion (i.e., gully, steep and unstable bank slopes, turbulent water) exists.
6. Dominant substrate. Depositional areas are more often associated with fine-grained (e.g., silt, clay) substrates than with coarser (e.g., rock, cobble) substrates. Historical sampling of CWC has shown that fine-grained materials have been held up or trapped in areas at which larger debris is present (e.g., concrete debris, fallen timber, etc.).

3.3.7.4 Preferential Pathway Migration Pathways

Class 1 excavations will be inspected by the RAC for potential preferential migration pathways prior to, or concurrent with, the area being released for an FSS. A preferential pathway is any deposition or structure that may have allowed contamination to migrate along a more permeable

pathway away from the excavation area. Examples of potential preferential pathways include utility trenches, sewer lines, and lenses of more permeable material including natural deposits and fill zones (e.g., gravel fill, sand deposits). Investigations of potential pathways will occur as appropriate to determine that contamination does not exist in the pathway exceeding RGs, and that evidence does not suggest contamination above pathways exists in concentrations that require RA. Preferential pathway investigations shall be performed by a qualified engineer, geologist, or other qualified personnel trained in soil science and identification. The final pathway analysis and conclusion shall be provided to the USACE by transmittal letter.

3.3.8 Sampling Depths

Borings at all locations on the North St. Louis County Sites and the SLDS will extend to at least 6 ft bgs with a surface sample (uppermost soil) collected and one subsurface sample collected from each 2-ft elevation length with all samples submitted for analysis, unless otherwise directed by the USACE.

A surface soil sample will be collected from the first 0.5-ft soil interval in the first 2-ft evaluation length at each soil boring location. If cover material (defined as consolidated material such as concrete or asphalt but not gravel or mulch) is present, this surface sample will be collected from the first 0.5 ft of soil directly beneath the cover material. The only situation in which the surface sample may not be located at the surface or directly under the cover material is when the soil is gravel that is known to be clean and placed on top of potentially impacted soil. In these cases, the historical surface underneath this clean gravel fill should be the first sample interval.

The remainder of the first 2-ft evaluation length (i.e., 0.5 to 2 ft) will be scanned using a sodium iodide (NaI) gamma scintillation detector or instrumentation with equal or greater sensitivity, and one additional 0.5-ft sample interval will be collected based on highest count rate, or, if count rates are uniform, from the deepest 0.5 ft of the first evaluation length.

Soil in subsequent 2-ft evaluation lengths will also be scanned using the methods described previously to determine which 0.5-ft interval will be sampled. The 0.5-ft span of soil with the highest count rate will be sampled unless the count rate is relatively uniform; then the deepest 0.5 ft of soil in the evaluation length will be collected. This method will be repeated at greater depths until the desired depth is obtained. The following variations apply at the SLS outside of excavations unless otherwise directed by a USACE-approved WP.

- Subsurface samples from depositional or historically topographically low-lying areas will be collected to a minimum of 6 ft. If native soil has not been reached, sampling will continue until native soil is reached or until the maximum depth achievable with the sampling equipment is obtained.
- Biased samples based on GWS readings will be collected from the first 0.5-ft soil layer and submitted for analysis.
- Non-radiological samples, when required, will be collected from the uppermost 0.5-ft soil layer that is not primarily gravel and submitted for analysis.
- Depth of sediment samples may be limited by sampling equipment and alternate sample depths may be specified in a USACE-approved WP.
- The field supervisor may add biased soil sample locations and/or increase the depths of soil sample locations (for either sample submittal to the analytical laboratory or archive) based on visual clues and suspect material to address low-lying areas, depositional areas, fill material, and other features not identified during the sample planning stage.

If field screening or historical data suggests that material with contamination exceeding RGs may lie deeper than a 6-ft depth greater than the original grade, additional subsurface soil samples will be collected as identified by a PDI WP or USACE authorization. Soil sampling will continue at 2-ft increments until the area of interest is reached or until an obstruction is met beneath the surface due to the presence of rock or similar material.

The following variations apply within excavations.

- Planned soil samples collected within excavation areas will be collected to a minimum depth of 6 ft greater than the original grade as described previously; therefore, in excavations greater than or equal to 6 ft, samples will be collected from only the excavation surface. All samples will be subject to laboratory analysis.
- Biased samples based on GWS readings will be collected from the first 0.5-ft soil layer and submitted for analysis.
- When required, non-radiological sample locations within excavations will be collected from the first 0.5-ft soil layer of the excavation and subject to laboratory analysis.

All sample location coordinates and elevations will be civil surveyed or collected with a centimeter-precision global positioning system (GPS) and recorded using the Missouri State Plane Coordinate System.

3.3.9 Sample Analysis

Samples are to be collected, shipped, tracked by chain-of-custody, analyzed, and validated as specified in this FSSP and the SAG (USACE 2000) and/or site-specific WPs, or equivalent. Soil and/or sediment samples of approximately 1,000 g, or other quantity approved by the laboratory, will be obtained.

To achieve the MDCs discussed in MARSSIM (DoD 2000), samples should be analyzed by chemical separation and alpha spectroscopy for thorium (Th)-228, Th-230, and Th-232, and by gamma spectroscopy for actinium (Ac)-227, protactinium (Pa)-231, radium (Ra)-226, Ra-228, uranium (U)-235, and U-238. The FUSRAP St. Louis Radioanalytical Laboratory is the primary laboratory. Split samples for interlaboratory comparison are generally analyzed by a certified commercial laboratory, such as the Eurofins St. Louis laboratory in Earth City, Missouri, using similar processes. Concentrations of lead (Pb)-210 and U-234 for the risk and dose analyses are calculated based on numerical relationships to Ra-226 and U-238 established in the *Baseline Risk Assessment for Exposure to Contaminants at the St. Louis Site, St. Louis, Missouri* (BRA) (DOE 1993) and the NC FS (USACE 2003d).

The FUSRAP St. Louis Radioanalytical Laboratory is not certified for non-radiological analyses. Standard non-radiological analyses of samples and split samples are performed by independent certified commercial laboratories. The laboratories should achieve decision levels for non-radiological COCs that are consistent with average background levels.

In accordance with MARSSIM, analytical techniques will provide a minimum detection level of 50 percent of the individual radionuclide RGs for all primary contaminants, with a preferred target minimum detection level of 10 percent of these individual radionuclide RGs (see Table 5).

Table 5. Target Detection Limits

Radionuclide	Maximum MDC (50 Percent ROD RGs)		Preferred MDC (10 Percent ROD RGs)	
	Surface Soil (pCi/g)	Subsurface Soil (pCi/g)	Surface Soil (pCi/g)	Subsurface Soil (pCi/g)
SLDS				
Ra-226	2.5	7.5	0.5	1.5
Ra-228	2.5	7.5	0.5	1.5
Th-230	2.5	7.5	0.5	1.5
Th-232	2.5	7.5	0.5	1.5
U-238	25	25	5.0	5.0
North St. Louis County Sites				
Ra-226	2.5	7.5	0.5	1.5
Th-230	7.0	7.5	1.4	1.5
U-238	25	25	5.0	5.0

3.4 DEFINE THE STUDY BOUNDARY

Study boundaries are defined by both horizontal (areal) and vertical parameters.

- The entire SLDS footprint, as established per the SLDS ROD and NSC, establishes the areal extent of the study boundary for MED/AEC radioactivity in SLDS accessible soil. The current SLDS footprint is shown on Figure 1.
- The entire North St. Louis County Sites footprint, as established per the NC ROD and NSCs, establishes the areal extent of the study boundary for MED/AEC radioactivity in North St. Louis County Sites media. The current North St. Louis County Sites footprint is shown on Figures 2 and 3.
- Subsections of these large footprints may be selected as study boundaries for individual FSS activities.
- SU areal boundaries are also limited by area size in this FSSP by Class 1, 2, or 3, as described as described in Section 3.3.1.
- Vertical boundaries for both the SLDS and the North St. Louis County Sites depend on the extent of potential MED/AEC radioactivity in subsurface soil. FSSP Section 3.3.8 identifies the methods used to investigate the vertical extent of potential contamination based on site-specific information.
- The areal extent of SLDS non-radiological COCs in accessible soil is a subset of the entire SLDS footprint. Per the SLDS ROD, “non-radiological COCs that may have been introduced by MED/AEC operations include arsenic and cadmium in uranium ore processing areas.” Mallinckrodt performed the uranium ore processing, and the Mallinckrodt properties involved in ore processing are shown on ISOU1 ROD Figure 5-7. Thus, non-radiological COCs apply only at SLDS properties Plant 2, Plant 6WH, Plant 6EH, Plant 6E, Plant 7N, Plant 7S, and Plant 7W. The shared property border for Plants 6 and 7 is within a former section of Destrehan Street, so that portion of Destrehan Street is included in the areal extent of non-radiological COCs. The shared property border for Plants 2 and 5 is within another former section of Destrehan Street, so that portion of Destrehan Street included with the Plant 2 property is included in the areal extent of non-radiological COCs. Because of the evidence that MED/AEC non-radiological COCs are commingled with MED/AEC radioactivity, the vertical extent

of non-radiological COCs is the same as the vertical extent of MED/AEC radioactivity in these specified areas.

- The areal extent of North St. Louis County Sites non-radiological COCs is a subset of the entire North St. Louis County Sites footprint. Per the NC ROD, the non-radiological COCs apply only at North St. Louis County Sites properties IA-01/adjacent CWC corridor, IA-02, IA-03, IA-04, IA-05, IA-06, IA-07, IA-08, IA-09, IA-10, IA-11, IA-12, IA-13, HISS, Futura, VP-02(L), and Parcel 10K530087. Because of the evidence that MED/AEC non-radiological COCs are commingled with MED/AEC radioactivity, the vertical extent of non-radiological COCs is the same as the vertical extent of MED/AEC radioactivity in these specified areas.
- Structures, including consolidated materials (e.g., piping, manholes, footings, conduits, concrete slabs, monoliths, railroad ties, sheet piling, and metal beams), within either ROD boundary are included in the study boundary only if they are impacted. Appendix A contains the criteria for determining whether a structure is impacted. Because of the scope of the SLDS ROD, structures on inaccessible soil are reserved for the ISOU. Soil is considered accessible if the structures have no future use and can be demolished. Surveys of the structure prior to demolition for release is a support action for accessible soil under the SLDS ROD.

3.5 DEVELOP THE DECISION RULE

Because of the varying requirements in the RODs, a set of decision rules applies to the SLDS and to the North St. Louis County Sites, as described in the following subsections. Areas suspected or determined by sample results to contain concentrations exceeding RGs will be removed; then the affected area will be re-examined, reclassified, and/or resurveyed as appropriate.

3.5.1 St. Louis Downtown Site

Table 6 contains the RGs and their evaluation criteria for the SLDS.

Table 6. SLDS Remediation Goals and Their Evaluation Criteria

RG Type	RG
Soil Radionuclide $SOR_N^{a,b}$ Note: Area-weighted average in a 0.5-ft layer of soil over a 100-m ² area ^b	$SOR_N < 1.0$ when averaged over any 100 m² for any 0.5-ft layer. The areas represented by each sample within the 100-m² area are estimated, and a weighted-average SOR_N for the 100-m² area is determined. $SOR_N < 1.0$ when non-biased soil sample analytical results are averaged over an SU. Equations for SOR_N calculations are provided in Section 3.5.1.1.
Non-Radionuclide RG Comparison	Surface and Subsurface Soil: Any depth, except for the depths when deep-soil criteria are authorized by the USACE. Total Concentration of Arsenic <60 mg/kg Total Concentration of Cadmium <17 mg/kg Deep Soil: Accessible soil deeper than 4 ft below ground surface (bgs) at Plants 6E, 6WH, and 6EH (except for the footprints of former Buildings 116 and 117) and deeper than 6 ft bgs at Plants 2, 7W, 7N, 7S, and the footprints of former Buildings 116 and 117 on Plant 6EH. Applied only when authorized by the USACE. Total Concentration of Arsenic <2,500 mg/kg Total Concentration of Cadmium <400 mg/kg

Table 6. SLDS Remediation Goals and Their Evaluation Criteria (Continued)

RG Type	RG
WRS Test (Soil)	Each radiological SU passes the MARSSIM WRS Test using the gross sum of ratios (SOR_G) values from non-biased samples. Soil collected from the uppermost 0.5 ft of a sample station will be used for the WRS Test. Total arsenic non-biased dataset for the subject property passes the WRS Test. Total cadmium non-biased dataset for the subject property passes the WRS Test. Methods and equations for WRS Test calculations are provided in Section 3.5.1.2. As described in MARSSIM Section 8.4.1, “some or all of the survey unit measurements may be larger than some reference area measurements, while still meeting the release criterion. Indeed, some survey unit measurements may exceed some reference area measurements by more than the [derived concentration guideline level for average concentrations over a wide area] DCGL_w” (DoD 2000).
Structure or Consolidated Material Surfaces	DCGL: 8,700 dpm/100 cm² total alpha radioactivity DCGL_{EMC}: 23,000 dpm/100 cm² total alpha radioactivity (50 m²) DCGL_{EMC}: 69,000 dpm/100 cm² total alpha radioactivity (10 m²) See Table A-5 for RGs and their evaluation criteria for structures and other consolidated materials left in place.
Sign Test (Consolidated Material Surfaces)	Because of the difficulty in establishing the background radioactivity of the consolidated materials themselves, the Sign Test is generally used instead of the WRS Test for the unbiased survey data from the surfaces of consolidated materials. When necessary, reference values (i.e., background activity) will be determined using MARSSIM and <i>Consolidated Decommissioning Guidance</i> (NRC 2022) values; net surface radioactivity will be calculated and the previously described WRS Test will be used. Pass the MARSSIM Sign Test using non-biased measurements. If the total surface area of consolidated material does not exceed 4 m², then a statistical test is not required because not enough data points can be collected for a statistical test. As described in MARSSIM Section 8.3.1, “some individual survey unit measurements may exceed the DCGL_w even when the survey unit as a whole meets the release criterion. In fact, a survey unit average that is close to the DCGL_w might have almost half of its individual measurements greater than the DCGL_w.” The method for the Sign Test is provided in Section 3.5.1.3.
Health Risk ^c	Sum of radiological risk for soil, radiological risk for structures, and non-radiological risk for soil do not exceed 10⁻⁴. Note that a risk of 3 x 10⁻⁴ was established for the SLDS in the SLDS FS (USACE 1998b) per USEPA guidance (USEPA 2014), but estimated risk not exceeding 3 x 10⁻⁴ is used only when necessary. Consolidated materials left in place within excavation areas with backfill covering at least 75 percent of the surveyed area that meet other consolidated material RGs in this table do not require a risk assessment. The risk from radiological COCs is calculated using RESidual RADioactivity (RESRAD) modeling software with the appropriate exposure scenario(s) (e.g., industrial, utility, residential, etc.), parameters, and methods consistent with the risk assessment approach described in Appendix C of the SLDS FS (USACE 1998b) for the SLDS. The risk from non-radiological risk is calculated consistent with the equations, parameters, and methods provided in Section 3.5.1.4.
Dose	Sum of the total effective dose equivalent (TEDE) for soil and TEDE for structure(s) do not exceed 25 mrem/year. The dose from radiological COCs is calculated using RESRAD model software using the appropriate exposure scenario(s) (e.g., industrial, utility, residential, etc.), parameters, and methods consistent with the dose assessment approach described in Appendix C of the SLDS FS (USACE 1998b) for the SLDS.
HI	HI does not exceed 1. The hazard index from non-radiological risk is calculated consistent with the equations, parameters, and methods provided in Section 3.5.1.4.

Table 6. SLDS Remediation Goals and Their Evaluation Criteria (Continued)

RG Type	RG
Groundwater	The ROD includes groundwater monitoring of the Mississippi Alluvial Aquifer (hydrostratigraphic [HU]-B). This aquifer is being addressed separately in a Groundwater Remedial Action Alternative Assessment (GRAAA). Phase I of the GRAAA has been completed (USACE 2003b). Subsequent phases of the GRAAA will be performed to assess the fate and transport of COCs and to determine if response actions for HU-B are required.

^a An individual SOR_N value exceeding 1.0 indicates further investigation and/or remediation could be necessary. Per a SLDS ROD RG provision (USACE 1998a), residual concentrations in soil averaged over any area of 100 m² shall be less than an SOR_N of 1.0 for a 0.5-ft layer of soil.

^b Based on 40 *CFR* 192, which is an ARAR.

^c When estimating cancer risk, predictions indicate a lifetime risk level for an exposed individual and how many additional cancer cases might occur in a population of exposed people (i.e., 1×10^{-6} is equal to one additional case in a population of one million). These cancers may or may not occur, but should they occur, they would be in addition to cancers from other causes, such as smoking tobacco or obesity.

3.5.1.1 Net Sum of Ratios Equations for Soil Samples

Per Section 7.3.7.1 of the SLDS ROD (USACE 1998a), the SOR_N RGs for surface and subsurface soil at the SLDS are specified for Ra-226, Ra-228, Th-230, Th-232, and U-238 to represent the other radionuclide COCs listed in the SLDS ROD. When multiple radiological contaminants are evaluated, the radionuclide concentration ratios are evaluated using a “unity rule.” In the SOR_N equations, the radioactivity (e.g., Ra-226) is measured as a concentration (i.e., pCi/g). The radioactivity concentration is divided by the concentration part of the SOR_N RG for that specific radionuclide (e.g., 5 pCi/g for Ra-226 for soil less than 0.5 ft below ground surface [bgs]). The subscript “N” represents the net concentration exceeding the average background concentration. The background reference soil sample analytical data are provided in the *Background Soils Characterization Report for the St. Louis Downtown Site* (USACE 1999g).

- **Surface:** Accessible soil not exceeding 0.5 ft bgs does not apply to excavation surfaces that will be backfilled by at least 0.5 ft of material. Unless cover material or gravel that is known to be clean and placed in recent times (see Section 3.3.8) is at least 0.5 ft thick, the surface equation is applied to the soil sample.

$$\begin{aligned}
 SOR_N^{depth \leq 0.5 \text{ ft bgs}} &= \frac{\text{greater of } Th - 230_N \text{ or } Ra - 226_N}{5 \text{ pCi/g}} \\
 &+ \frac{\text{greater of } Th - 232_N \text{ or } Ra - 228_N}{5 \text{ pCi/g}} + \frac{U - 238_N}{50 \text{ pCi/g}}
 \end{aligned}$$

- **Subsurface:** Accessible soil deeper than 0.5 ft bgs, except for the depths when deep-soil criteria or a ROD-Based Deep Soil Criteria Option (RBDSCO) is authorized by the USACE. Applies to excavation surfaces that will be backfilled by at least 0.5 ft of material.

$$\begin{aligned}
 SOR_N^{depth > 0.5 \text{ ft bgs}} &= \frac{\text{greater of } Th - 230_N \text{ or } Ra - 226_N}{15 \text{ pCi/g}} \\
 &+ \frac{\text{greater of } Th - 232_N \text{ or } Ra - 228_N}{15 \text{ pCi/g}} + \frac{U - 238_N}{50 \text{ pCi/g}}
 \end{aligned}$$

- **Deep-Soil:** May be applied to accessible soil deeper than 4 ft bgs at Plant 6E, 6WH, and 6EH (except for the footprints² of former Buildings 116 and 117) and deeper than 6 ft bgs at Plants 1, 2, 3, 8, 9, 11, and the footprints of former Buildings 116 and 117 on Plant 6EH

² Building footprints include the soil within 5 ft of the outer walls because that soil provides support to those walls.

(USACE 1998a) (Figure 4). The deep-soil criteria should be rarely used and only with USACE authorization. Data used with these criteria shall also be used in establishing EPCs for the radiological risk and dose estimates.

$$SOR_N^{depth>4 \text{ or } 6 \text{ ft bgs}} = \frac{Ra - 226_N}{50 \frac{pCi}{g}} + \frac{Th - 230_N}{100 \frac{pCi}{g}} + \frac{U - 238_N}{150 \frac{pCi}{g}}$$

- **RBDSCO:** Accessible soil deeper than 6 ft bgs at Plant 7W, 7N, and 7S. The RBDSCO should be rarely used and only with USACE authorization. This equation is documented in the *Post-Remedial Action Report and Final Status Survey Evaluation for the Accessible Soil within the St. Louis Downtown Site Plant 7 North and Plant 7 South Properties* (USACE 2017). Data used with these criteria shall also be used in establishing EPCs for the radiological risk and dose estimates.

$$SOR_N^{depth>6 \text{ ft bgs}} = \frac{Ra - 226_N}{15 \frac{pCi}{g}} + \frac{Th - 230_N}{40 \frac{pCi}{g}} + \frac{U - 238_N}{100 \frac{pCi}{g}}$$

3.5.1.2 Wilcoxon Rank Sum Test Method Equations

- **Automatically Passing the WRS Test.** Per MARSSIM Section 8.2.3, “if the difference between the largest survey unit measurement and the smallest reference area measurement is less than the DCGL_W, the WRS Test will always show that the survey unit meets the release criterion.” For this calculation, a value of 1.0 is used as the derived concentration guideline level for average concentrations over a wide area (DCGL_W), and the maximum SU gross sum of ratios (SOR_G) value and minimum background SOR_G value are used. If this check for automatic passage of the WRS Test is not productive, then the full test method is used.

- **Full WRS Test.**

Step 1. Add 1.0 to the SOR_G value for each background reference area sample to obtain adjusted reference area measurements (ARAMs).

Step 2. In a combined list, order the ARAMs (number of which is m) and SU SOR_N values (number of which is n) from high to low.

Step 3. Starting with the highest value ranked at 1, give each value a sequential integer rank until the lowest value is ranked at $n + m$. For any duplicate values in this list, assign all the duplicates the average of the ranks for the duplicates. For example, the values of 1.2, 0.9, 0.8, 0.8, and 0.2 would have ranks of 1, 2, 3.5, 3.5, and 5.

Step 4. Sum only the ranks for the ARAMs.

Step 5. While MARSSIM Table I.4 may be used to look up the critical value (W_{crit}), this process lends itself to spreadsheet calculations and the following equation for W_{crit} . The 1.645 value for $Z_{1-\alpha}$ is obtained from MARSSIM Table 5.2 based on the 0.05 value for the Type I (α) error.

$$W_{crit} = \frac{m(n + m + 1)}{2} + \frac{Z_{1-\alpha} \sqrt{nm(n + m + 1)}}{\sqrt{12}}$$

Step 6. If the sum of the ranks for the ARAMs exceeds W_{crit} then the null hypothesis (H_0) is rejected and the RG is met.

3.5.1.3 Sign Test Method

- Automatically Passing the Sign Test. Per MARSSIM Section 8.2.3, “if the largest measurement is below the $DCGL_w$, the Sign Test will always show that the survey unit meets the release criterion.” For this calculation, a value of 1.0 is used as the $DCGL_w$ and the maximum non-biased fixed-point measurement for the SU are used. If this check for automatic passage of the Sign Test is not productive, then the full test method is used.
- Full Sign Test.
 - Step 1. Subtract measurements from the applicable RG.
 - Step 2. Remove values of zero. Negatives values are allowed.
 - Step 3. Count the number of positive differences (S+).
 - Step 4. If S+ exceeds the critical value (S_{crit}) obtained from MARSSIM Table I.3, then the null hypothesis is rejected.

3.5.1.4 Non-Radiological Hazard Index and Risk Calculation

The receptor scenarios applicable to the SLDS are based on descriptions in the SLDS ROD (USACE 1998a) or documents referenced by the SLDS ROD, summarized as follows.

- Industrial Worker: The industrial worker is modeled as a typical site worker who spends most of the time indoors. The worker is at the property for 250 days per year for 25 years. During a standard year, the industrial worker is assumed to spend 1,600 hours working indoors and 400 hours working outdoors, plus 125 hours (0.5 hour per day) indoors to account for the possibility of eating lunch on site, early daily arrival, and late daily departure.
- Utility Worker: The utility worker may participate in utility work or other intrusive outdoor activities at the property. The utility worker is assumed to be exposed in a single event that takes place over an 80-hour period.
- Hypothetical Suburban Resident: The hypothetical suburban resident is assumed to live on site for 350 days per year for 30 years, including 6 years as a child. The hypothetical suburban resident is assumed to spend 16.4 hours indoors and 2 hours outdoors each day. Because of current governmental zoning restrictions, residential use is not allowed on properties within the SLDS.
- Hypothetical Residential Gardener: The hypothetical residential gardener receptor is the hypothetical suburban resident scenario where 0.2 hour of the 2 hours of outdoor activities involve gardening for the purpose of growing and consuming fruits and vegetables.
- Hypothetical Recreational User: The hypothetical recreational user is assumed to be an adolescent (ages 10 to 18 years old) who spends 75 hours per year (i.e., 1 hour per day for 75 days) for 9 years engaged in recreational activities on site.

The applicable exposure pathways for the receptor scenarios are dermal (soil on the skin), inhalation of dust, and soil ingestion for all scenarios, with the homegrown fruit and vegetable consumption pathway added for the hypothetical residential gardener scenario (USACE 1998a). The applicable HI equations and cancer risk equations for these pathways are provided in the following list with the subscript “o” for oral ingestion, “d” for dermal, “i” for inhalation, “p” for garden produce, “s” for soil, “c” for carcinogenic, and “nc” for non-carcinogenic. Cancer risk applies to arsenic but does not apply to cadmium or to the chemical properties of uranium (USACE 1998a).

The definitions of the terms in these equations are provided with the input parameters in Table 7. The Table 7 parameters are intended as a starting point for users and may be replaced by updated USEPA or other agency guidance.

$$HI_o = \sum_{organ, system} \frac{(EPC)(IR_s)(RBA)(EF)(ED)(CF)}{(RfD_o)(BW)(AT_{nc})}$$

$$HI_d = \sum_{organ, system} \frac{(EPC)(SA)(AF)(ABS)(EF)(ED)(CF)}{(RfD_o)(BW)(AT_{nc})(GIABS)}$$

$$HI_i = \sum_{organ, system} \frac{(EPC)(ET)(EF)(ED)}{(PEF)(RfC_i)(AT_{nc})}$$

$$HI_p = \sum_{organ, system} \frac{(EPC)(IR_{gp})(R_{up})(EF)(ED)(CF)}{(RfD_o)(BW)(AT_{nc})}$$

$$HI_{\text{hypothetical residential gardener}} = HI_o + HI_d + HI_i + HI_p$$

$$HI_{\text{other scenarios}} = HI_o + HI_d + HI_i$$

$$CR_o = \frac{(EPC)(IR_s)(CSF_o)(RBA)(EF)(ED)(CF)}{(BW)(AT_c)}$$

$$CR_d = \frac{(EPC)(SA)(AF)(CSF_o)(ABS)(EF)(ED)(CF)}{(BW)(AT_c)(GIABS)}$$

$$CR_i = \frac{(EPC)(IUR)(1,000 \mu\text{g}/\text{mg})(ET)(EF)(ED)}{(PEF)(AT_c)}$$

$$CR_p = \frac{(EPC)(IR_{gp})(R_{up})(CSF_o)(EF)(ED)(CF)}{(BW)(AT_c)}$$

$$CR_{\text{hypothetical residential gardener}} = CR_o + CR_d + CR_i + CR_p$$

$$CR_{\text{other scenarios}} = C_o + CR_d + CR_i$$

Table 7. Input Parameters for SLDS Non-Radiological Risk Assessment

Parameter	Arsenic	Cadmium	Uranium	Hypothetical Residential Gardener	Industrial Worker	Utility Worker	Hypothetical Recreational User
Absorption Factor Skin (ABS)	0.03	0.001	0.001	--	--	--	--
Soil to Skin Adherence Factor (AF _{HH}) (mg/cm ²)	--	--	--	0.10	0.12	0.3	0.07
Averaging Time for Cancer Effects (AT _c) (days)	--	--	--	25,550	25,550	25,550	25,550
Averaging Time for Non-Cancer Effects (AT _{nc}) (days)	--	--	--	10,950	9,125	365	3,285
Body Weight (BW) (kg)	--	--	--	72	80	80	80

Table 7. Input Parameters for SLDS Non-Radiological Risk Assessment (Continued)

Parameter	Arsenic	Cadmium	Uranium	Hypothetical Residential Gardener	Industrial Worker	Utility Worker	Hypothetical Recreational User
Conversion Factor (CF) (kg/mg)	--	--	--	0.000001	0.000001	0.000001	0.000001
Exposure Duration (ED) (year)	--	--	--	30	25	1	9
Exposure Frequency (EF) (days/year)	--	--	--	350	250	10	75
Exposure Time (ET)	--	--	--	0.767	0.354	0.333	0.0417
Gastrointestinal Absorption Fraction (GIABS)	1	0.025	0.02	--	--	--	--
Ingestion Rate Soil (IR _s) (mg/day)	--	--	--	120	100	330	100
Ingestion Rate of Garden Produce (IR _{gp}) (mg/day)	--	--	--	53,167	--	--	--
Inhalation Unit Risk (IUR) ([μg/m ³] ⁻¹)	0.0043	0.0018	--	--	--	--	--
Particulate Emission Factor (PEF) (m ³ /kg)	--	--	--	1.36 x 10 ⁹	1.36 x 10 ⁹	1 x 10 ⁷	1.36 x 10 ⁹
Root Uptake Multiplier (R _{up})	0.008	0.125	0.0024	--	--	--	--
Relative Bioavailability Factor (RBA) for Soil	0.6	1	1	--	--	--	--
Chronic Inhalation Reference Concentration (RfC _i) (mg/m ³)	0.000015	0.00001	0.0008	--	--	--	--
Reference Dose Oral Ingestion (RfD _o) (mg/kg-day)	0.0003	0.001	0.002	--	--	--	--
Skin Surface Area (SA) (cm ² /day)	--	--	--	5,625	3,608	3,608	5,044
Cancer Slope Factor Oral Ingestion (CSF _o) ([mg/kg-day] ⁻¹)	1.5	--	--	--	--	--	--

Notes:

The soil to skin adherence factor acronym “AF_{HI}” is commonly denoted as “AF” in USEPA risk assessment guidance documents. However, the acronym “AF” refers to radionuclide activity fractions in this FSSE. Therefore, in this FSSE, the soil to skin adherence factor acronym is denoted as “AF_{HI}” with a subscript “HI” to reference the hazard index.

For the hypothetical residential gardener, the AF_{HI}, BW, IR_s, IR_{gp}, and SA values are weighted averages of the adult and child values for these parameters; the reference sources for these values are discussed in subsequent notes.

The values for the hypothetical suburban resident are the same as the values for the hypothetical residential gardener, but HI_p and CR_p are not included for the hypothetical suburban resident.

ABS values for arsenic and cadmium are obtained from Exhibit 3-4 of the *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment)* (RAGS Part E) (USEPA 2004). The ABS value for uranium is obtained from *Gulf War and Health: Volume 1: Depleted Uranium, Sarin, Pyridostigmine Bromide, and Vaccines* (IOM 2000).

The AF_{HI}, AT_{nc}, IR_s, and RBA values are obtained from the “Regional Screening Levels (RLSs) – User’s Guide” (RSLUG) (USEPA 2020). AT_{nc} values are calculated from ED and 365 days per year.

The BW values for adults and for all child age groups are obtained from Table ES-1 of the *Exposure Factors Handbook: 2011 Edition* (EFH) (USEPA 2011). An age-weighted child value is calculated from all child age groups.

The CF value is the unit conversion between mg to kg.

ED, EF, and ET values are based on the scenario descriptions. The ET value is the fractional part of each 24-hour day spent on site.

GIABS values for arsenic and cadmium are obtained from the RSLUG (USEPA 2020). The GIABS value for uranium is obtained from International Commission on Radiological Protection (ICRP) Publication 69 “Age-Dependent Doses to Members of the Public from Intake of Radionuclides: Part 3 Ingestion Dose Coefficients” (ICRP 1995).

The IR_{gp} values for adults (i.e., 21 to less than 50 years old) and all child age groups are obtained from Table 13-70 of the EFH (USEPA 2011). An age-weighted child value is calculated from all child age groups.

IUR and RfD_o values for arsenic and cadmium are obtained from the Integrated Risk Information System (IRIS) (USEPA 1989b, 1995). The RfD_o value for uranium is obtained from Chapter 8 of the *Toxicological Profile for Uranium* (ATSDR 2013) with a modification of 10 to the soluble salts value because Agency for Toxic Substances and Disease Registry (ATSDR) documentation states, “These data suggest that the toxicity of soluble uranium compounds are at least an order of magnitude higher than for insoluble uranium compounds.”

The PEF values are obtained from the RSLUG (USEPA 2020), except for the utility worker scenario, which is based on the mass loading factor for inhalation of 0.0001 g/m³ that is used in the radiological risk calculations.

R_{up} values for arsenic and cadmium are obtained from the *Human Health Risk Assessment Protocol (HHRAP) for Hazardous Waste Combustion Facilities*, (HHRAP) (USEPA 2016). The maximum value for Br_{ag} or Br_{rootveg} was selected from the “HHRAP Companion Database” accessed in August 2020 (USEPA 2016). The R_{up} value for uranium is obtained from an average of the plant transfer factors for maize, herbs, and the following vegetables: leafy, non-leafy (includes fruits and berries), legume, root, and tuber in Table 17 of the *Handbook of Parameter Values for the Prediction of Radionuclide Transfer in Terrestrial and Freshwater Environments* (IAEA 2010) and corrected to wet weight using a 16 percent average dry weight of typical homegrown produce listed in Appendix I of same reference.

Table 7. Input Parameters for SLDS Non-Radiological Risk Assessment (Continued)

The RfC_i value for arsenic is obtained from a California Office of Environmental Health Hazard Assessment (OEHHA) database (OEHHA 2014). The RfC_i value for cadmium is obtained from Chapter 2 of the *Toxicological Profile for Cadmium* from the ATSDR (ATSDR 2012a). The RfC_i value for insoluble uranium is obtained from Chapter 2 of the *Toxicological Profile for Uranium* (ATSDR 2013).

SA values are obtained from Table 7-2 of the EFH (USEPA 2011), as follows, unless otherwise indicated.

- Hypothetical Adult Residential Gardener: Memorandum Office of Solid Waste and Emergency Response (OSWER) Directive 9200.1-120, *Human Health Evaluation Manual, Supplemental Guidance, Update of Standard Default Exposure Factors* (USEPA 2014).
- Hypothetical Child Residential Gardener: Calculate a weighted average of values across all age groups of the mean values for the head, arms (corrected to 50 percent for lower arms), hands, and legs (corrected to 50 percent for lower legs), and then sum the results.
- Industrial Worker and Utility Worker: Average the adult male and female mean values for the head, arms (corrected to 50 percent for lower arms), and hands, and then sum the results for those areas.
- Hypothetical Recreational User (i.e., ages 10 to 18 years old): Age-weighted average of the mean values for the head, lower arms (corrected to 50 percent for lower arms), hands, and lower legs (corrected to 50 percent for lower legs) for children across three age groups (i.e., 1 year in the 6 to less than 11 years old group, 5 years in the 11 to less than 16 years old group, and 3 years in the 16 to less than 21 years old group).
- The CSF_o value for arsenic is obtained from the IRIS (USEPA 1995).

-- indicates not applicable.

The EPC for each non-radiological COC is calculated by subtracting its 95 percent upper confidence limit (UCL_{95}) value from the background reference area dataset from the UCL_{95} value from the property dataset. The information used to calculate the UCL_{95} values for background reference samples for non-radiological COCs is from the *Background Soils Characterization Report for the St. Louis Downtown Site* (USACE 1999h).

3.5.2 North St. Louis County Sites

Table 8 contains the RGs and their evaluation criteria for the North St. Louis County Sites.

Table 8. North St. Louis County Sites Remediation Goals and Their Evaluation Criteria

Soil and Sediment Radionuclide $SOR_{N^{a,b}}$ Note: Area-weighted average in a 0.5-ft layer of soil over a 100-m ² area ^b	$SOR_N \leq 1.0$ when averaged over any 100 m ² for any 0.5-ft layer. The areas represented by each sample within the 100-m ² area are estimated, and a weighted-average SOR_N for the 100-m ² area is determined. $SOR_N \leq 1.0$ when non-biased soil sample analytical results are averaged over an SU. Equations for SOR_N calculations are provided in Section 3.5.2.1.		
Non-Radionuclide RG Comparison	Non-radionuclide RGs apply only at the North St. Louis County Sites properties IA-01, IA-02, IA-03, IA-04, IA-05, IA-06, IA-07, IA-08, IA-09, IA-10, IA-11, IA-12, IA-13, HISS, Futura, VP-02(L), and Parcel 10K530087. The RGs for chromium and uranium do not apply to HISS, Futura, VP-02(L), and Parcel 10K530087.		
	COC	Total Concentration (mg/kg)	
		Soil ≤ 0.5 ft bgs	Soil > 0.5 ft bgs
	Antimony	15	25
	Arsenic	36	40
	Barium	2,800	None
	Cadmium	12	None
	Chromium ^c	350	None
	Molybdenum	1,000	None
	Nickel	1,500	None
	Selenium	300	None
	Thallium	25	30
	Uranium ^c	150	150
	Vanadium	112	None

Table 8. North St. Louis County Sites Remediation Goals and Their Evaluation Criteria (Continued)

WRS Test (Soil and Sediment)	Each radiological SU passes the MARSSIM WRS Test using the SOR_G values from non-biased samples. Soil and sediment collected from the uppermost 0.5 ft of a sample station will be used for the WRS Test. For each non-radionuclide COC, the total COC non-biased dataset for the subject property passes the WRS Test. Methods and equations for WRS Test calculations are provided in Section 3.5.1.2. As described in MARSSIM Section 8.4.1, “some or all of the survey unit measurements may be larger than some reference area measurements, while still meeting the release criterion. Indeed, some survey unit measurements may exceed some reference area measurements by more than the $DCGL_W$” (DoD 2000).
Structures or Consolidated Material Surfaces	DCGL: 5,300 dpm/100 cm² total alpha radioactivity DCGL_{EMC}: 25,000 dpm/100 cm² total alpha radioactivity (50 m²) DCGL_{EMC}: 122,000 dpm/100 cm² total alpha radioactivity (10 m²) See Table A-5 for remediation goals and their evaluation criteria for structures and other consolidated materials left in place.
Sign Test (Consolidated Material Surfaces)	Because of the difficulty in establishing the background radioactivity of the consolidated materials themselves, the Sign Test is generally used instead of the WRS Test for the unbiased survey data from the surfaces of consolidated materials. When necessary, reference values (i.e., background activity) will be determined using MARSSIM and <i>Consolidated Decommissioning Guidance</i> (NRC 2022) values; net surface radioactivity will be calculated and the previously described WRS Test will be used. Pass the MARSSIM Sign Test using non-biased measurements. If the total surface area of consolidated material does not exceed 4 m², then a statistical test is not required because not enough data points can be collected for a statistical test. As described in MARSSIM Section 8.3.1, “some individual survey unit measurements may exceed the $DCGL_W$ even when the survey unit as a whole meets the release criterion. In fact, a survey unit average that is close to the $DCGL_W$ might have almost half of its individual measurements greater than the $DCGL_W$” (DoD 2000). The method for the Sign Test is provided in Section 3.5.1.3.
Health Risk ^d	Sum of radiological risk for soil and sediment, radiological risk for structure, and non-radiological risk for soil do not exceed 10^{-4}. Note that use of 3×10^{-4} was established for the North St. Louis County Sites in the NC FS (USACE 2003d) per USEPA guidance (USEPA 2014), but estimated risk not exceeding 3×10^{-4} is used only when necessary. Consolidated materials left in place within excavation areas with backfill covering at least 75 percent of the surveyed area that meet other consolidated material RGs in this table do not require a risk assessment. The risk from radiological COCs is calculated using RESRAD model software using the appropriate exposure scenario(s) (e.g., industrial, utility, residential, etc.), parameters, and methods consistent with the risk assessment approach described in Appendix D of the NC FS (USACE 2003d) for the North St. Louis County Sites. The risk from non-radiological risk is calculated consistent with the equations, parameters, and methods provided in Section 3.5.2.2.
Dose	Sum of the TEDE for soil and sediment and TEDE for structure(s) do not exceed 19 mrem/year. The risk from radiological COCs is calculated using RESRAD model software using the appropriate exposure scenarios (e.g., industrial, utility, residential, etc.), parameters, and methods consistent with the dose assessment approach described in Appendix D of the NC FS (USACE 2003d) for the North St. Louis County Sites.
HI	HI does not exceed 1. The HI from non-radiological risk is calculated consistent with the equations, parameters, and methods provided in Section 3.5.2.2.

Table 8. North St. Louis County Sites Remediation Goals and Their Evaluation Criteria (Continued)

RG Type	RG
Groundwater	The final remedy for ground water and surface water is monitoring. Monitoring activities for the selected remedy consist of monitoring during a response action and long-term monitoring of areas at which soil contamination remains exceeding RGs for UUUE.
Surface Water	

^a An individual SOR_N value of 1.0 or greater indicates further investigation and/or remediation could be necessary. Per a NC ROD RG provision (USACE 2005a), residual concentrations in soil averaged over any area of 100 m² shall be less than an SOR_N of 1.0 for a 0.5-ft layer of soil.

^b Based on 40 *CFR* 192, which is an ARAR.

^c Chromium and uranium non-radiological RGs are not applicable to the Latty Avenue Properties (i.e. HISS, Futura, VP-02[L], and Parcel 10K530087).

^d When estimating cancer risk, predictions indicate a lifetime risk level for an exposed individual and how many additional cancer cases might occur in a population of exposed people (i.e., 1×10^{-6} is equal to one additional case in a population of one million). These cancers may or may not occur, but should they occur, they would be in addition to cancers from other causes, such as smoking tobacco or obesity.

3.5.2.1 Net Sum of Ratios Equations for Soil and Sediment Samples

Per Section 2.8.2.1 of the NC ROD (USACE 2005a), the SOR_N RGs for surface soil, subsurface soil, and sediment at the North St. Louis County Sites are specified for Ra-226, Th-230, and U-238 to represent the other radionuclide COCs listed in the ROD. The background reference soil sample analytical data are provided in the *Evaluation of Background Concentrations in Soil at the North St. Louis County Sites* (USACE 2024); these background values for soil are applied to sediment as well.

- **Surface:** Soil not exceeding 0.5 ft bgs. Does not apply to excavation surfaces that will be backfilled by at least 0.5 ft of material. Unless cover material or gravel that is known to be clean and placed in recent times (see Section 3.3.8) are at least 0.5 ft thick, the surface equation is applied to the soil sample.

$$SOR_N^{depth \leq 0.5 \text{ ft bgs}} = \frac{Ra - 226_N}{5 \text{ pCi/g}} + \frac{Th - 230_N}{14 \text{ pCi/g}} + \frac{U - 238_N}{50 \text{ pCi/g}}$$

- **Subsurface:** Soil deeper than 0.5 ft bgs. Applies to excavation surfaces that will be backfilled by at least 0.5 ft of material.

$$SOR_N^{depth > 0.5 \text{ ft bgs}} = \frac{Ra - 226_N}{15 \text{ pCi/g}} + \frac{Th - 230_N}{15 \text{ pCi/g}} + \frac{U - 238_N}{50 \text{ pCi/g}}$$

- **Sediment:** Earth material to any depth that has the mean water gradient of CWC covering its surface; does not include tributaries.

$$\frac{Ra - 226}{15 \frac{\text{pCi}}{\text{g}}} + \frac{Th - 230}{43 \frac{\text{pCi}}{\text{g}}} + \frac{U - 238}{150 \frac{\text{pCi}}{\text{g}}} \leq 1.0?$$

3.5.2.2 Non-Radiological Hazard Index and Risk Calculation

The receptor scenarios applicable to the North St. Louis County Sites are based on descriptions in the NC ROD (USACE 1998a) or documents referenced by the NC ROD, summarized as follows.

- **Industrial Worker:** The industrial worker is modeled as a typical site worker who spends most of the time indoors. The worker is at the property for 250 days per year for 25 years. During a standard year, the industrial worker is assumed to spend 1,600 hours working indoors and 400 hours working outdoors, plus 125 hours (0.5 hour per day) indoors to account for the possibility of eating lunch on site, early daily arrival, and late daily departure.

- Utility Worker: The utility worker may participate in utility work or other intrusive outdoor activities at the property. The utility worker is assumed to be exposed in a single event that takes place over an 80-hour period.
- Construction Worker (Road/Rail): The road/rail construction worker receptor is assumed to be on site for a single event lasting 1 year. During the 1-year event, the worker is assumed to spend 90 days, or approximately 720 hours, on site and outdoors.
- Suburban Resident: The hypothetical suburban resident is assumed to live on site for 350 days per year for 30 years, including 6 years as a child. The hypothetical suburban resident is assumed to spend 16.4 hours indoors and 2 hours outdoors each day.

The applicable exposure pathways for the receptor scenarios are dermal (soil on the skin), inhalation of dust, and soil ingestion for all scenarios (USACE 2005a). The applicable HI equations and cancer risk equations for these pathways are provided in the following list with the subscript “o” for oral ingestion, “d” for dermal, “i” for inhalation, “s” for soil, “c” for carcinogenic, and “nc” for non-carcinogenic. Cancer risk applies to arsenic, cadmium, and chromium, but not to the other North St. Louis County Sites non-radiological COCs (USACE 2005a). Cancer risk for radiological properties of uranium is addressed in the radiological risk and dose assessment.

The definitions of the terms in these equations are provided with the input parameters in Table 9. The Table 9 parameters are intended as a starting point for users and may be replaced by updated USEPA or other agency guidance.

$$HI_o = \sum_{organ, system} \frac{(EPC)(IR_s)(RBA)(EF)(ED)(CF)}{(RfD_o)(BW)(AT_{nc})}$$

$$HI_d = \sum_{organ, system} \frac{(EPC)(SA)(AF)(ABS)(EF)(ED)(CF)}{(RfD_o)(BW)(AT_{nc})(GIABS)}$$

$$HI_i = \sum_{organ, system} \frac{(EPC)(ET)(EF)(ED)}{(PEF)(RfC_i)(AT_{nc})}$$

$$HI_{Total} = HI_o + HI_d + HI_i$$

Age-dependent adjustment factor (ADAF) applies only to chromium, which is assumed to be hexavalent chromium and may have mutagenic mode of action.

$$CR_o = \frac{(EPC)(IR_s)(CSF_o)(RBA)(EF)(ED)(CF)(ADAF)}{(BW)(AT_c)}$$

$$CR_d = \frac{(EPC)(SA)(AF_{HI})(CSF_o)(ABS)(EF)(ED)(CF)(ADAF)}{(BW)(AT_c)(GIABS)}$$

$$CR_i = \frac{(EPC)(IUR)(1,000 \mu\text{g/mg})(ET)(EF)(ED)}{(PEF)(AT_c)}$$

$$CR_{Total} = C_o + CR_d + CR_i$$

Table 9. Input Parameters for North St. Louis County Sites Non-Radiological Risk Assessment

Parameter	Antimony	Arsenic	Barium	Cadmium	Chromium	Molybdenum	Nickel	Selenium	Thallium	Uranium	Vanadium	Suburban Resident	Industrial Worker	Utility Worker	Construction Worker (Road/Rail)
ABS	0.03	0.03	0.03	0.001	0.02	0.01	0.04	0.03	0.03	0.001	0.03	--	--	--	--
AF _{HI} (mg/cm ²)	--	--	--	--	--	--	--	--	--	--	--	0.10	0.12	0.3	0.3
AT _c (days)	--	--	--	--	--	--	--	--	--	--	--	25,550	25,550	25,550	25,550
AT _{nc} (days)	--	--	--	--	--	--	--	--	--	--	--	10,950	9,125	365	365
BW (kg)	--	--	--	--	--	--	--	--	--	--	--	72	80	80	80
CF (kg/mg)	--	--	--	--	--	--	--	--	--	--	--	0.000001	0.000001	0.000001	0.000001
ED (year)	--	--	--	--	--	--	--	--	--	--	--	30	25	1	1
EF (days/year)	--	--	--	--	--	--	--	--	--	--	--	350	250	10	90
EPC (mg/kg)	Site Specific UCL ₉₅											--	--	--	--
ET	--	--	--	--	--	--	--	--	--	--	--	0.767	0.354	0.333	0.333
GIABS	0.15	1	0.07	0.025	0.025	1	0.04	0.55	1	0.02	0.026	--	--	--	--
IR _s (mg/day)	--	--	--	--	--	--	--	--	--	--	--	120	100	330	330
IUR ([μg/m ³] ⁻¹)	--	0.0043	--	0.0018	0.012	--	--	--	--	--	--	--	--	--	--
PEF (m ³ /kg)	--	--	--	--	--	--	--	--	--	--	--	1.36 x 10 ⁹	1.36 x 10 ⁹	1 x 10 ⁷	1 x 10 ⁷
RBA	1	0.6	1	1	1	1	1	1	1	1	1	--	--	--	--
RfC _i (mg/m ³)	0.0003	0.000015	0.0005	0.00001	0.0001	0.002	0.00009	0.02	0.016	0.0008	0.0001	--	--	--	--
RfD _o (mg/kg-day)	0.0004	0.0003	0.2	0.001	0.003	0.005	0.02	0.005	0.00002	0.002	0.005	--	--	--	--
SA (cm ² /day)	--	--	--	--	--	--	--	--	--	--	--	5,625	3,608	3,608	3,608
CSF _o ([mg/kg-day] ⁻¹)	--	1.5	--	--	0.5	--	--	--	--	--	--	--	--	--	--
ADAF	--	--	--	--	--	--	--	--	--	--	--	1.87	--	--	--

Notes:

The soil to skin adherence factor acronym “AF_{HI}” is commonly denoted as “AF” in USEPA risk assessment guidance documents. However, the acronym “AF” refers to radionuclide activity fractions in this FSSE. Therefore, in this FSSE, the soil to skin adherence factor acronym is denoted as “AF_{HI}” with a subscript “HI” to reference the hazard index.

For the suburban resident, the AF_{HI}, BW, IR_s, and SA values are weighted averages of the adult and child values for these parameters; the reference sources for these values are discussed in subsequent notes.

ABS values for arsenic and cadmium are obtained from Exhibit 3-4 of the RAGS Part E (USEPA 2004). The ABS value for uranium is obtained from *Gulf War and Health: Volume 1: Depleted Uranium, Sarin, Pyridostigmine Bromide, and Vaccines* (IOM 2000). The other ABS values are obtained from *Air Toxics Hot Spots Program Risk Assessment Guidelines: Technical Support Document for Exposure Assessment and Stochastic Analysis* (OEHA 2012).

The AF_{HI}, AT_c, IR_s, and RBA values are obtained from the RSLUG (USEPA 2020). AT_{nc} values are calculated from ED and 365 days per year.

The BW values for adults and for all child age groups are obtained from Table ES-1 of the EFH (USEPA 2011). An age-weighted child value is calculated from all child age groups.

The CF value is the unit conversion between mg to kg.

ED, EF, and ET values are based on the scenario descriptions. The ET value is the fractional part of each 24-hour day spent on site.

GIABS values for arsenic and cadmium are obtained from the RSLUG (USEPA 2020). The GIABS value for uranium is obtained from ICRP Publication 69 “Age-Dependent Doses to Members of the Public from Intake of Radionuclides: Part 3 Ingestion Dose Coefficients” (ICRP 1995). The remaining GIABS values are obtained from RAGS Part E (USEPA 2004).

Table 9. Input Parameters for North St. Louis County Sites Non-Radiological Risk Assessment (Continued)

IUR values are obtained from the IRIS (USEPA 1989b, 1998a, 1995).

The PEF values are obtained from the RSLUG (USEPA 2020), except for the utility worker and construction worker (road/rail) scenarios, which are based on the mass loading factor for inhalation of 0.0001 g/m³ that is used in the radiological risk calculations.

The RfC_i values for antimony, molybdenum, nickel, thallium, and vanadium are obtained from the corresponding ATSDR toxicological profile (ATSDR 1992, 2005, 2012b, 2019, 2020). The RfC_i values for arsenic and selenium are obtained from an OEHHHA database (OEHHHA 2014). The RfC_i value for barium is obtained from the *Health Effects Assessment Summary Tables: FY 1997 Update* (USEPA 1997). The RfC_i value for cadmium is obtained from Chapter 2 of the *Toxicological Profile for Cadmium* from the ATSDR (ATSDR 2012a). The RfC_i value for chromium is obtained from the IRIS (USEPA 1998a). The RfC_i value for insoluble uranium is obtained from Chapter 2 of the *Toxicological Profile for Uranium* (ATSDR 2013).

The RfD_o value for antimony is obtained from the “HHRAP Companion Database” accessed in August 2020 (USEPA 2016). RfD_o values for arsenic, barium, cadmium, chromium, molybdenum, nickel, and selenium are obtained from the IRIS (USEPA 1989b, 1998a, 1995). The RfD_o value for thallium is obtained from the *Provisional Peer-Reviewed Toxicity Values for Thallium and Compounds* (USEPA 2012) estimate for thallium sulfate. The RfD_o value for uranium is obtained from Chapter 8 of the *Toxicological Profile for Uranium* (ATSDR 2013) with a modification of 10 to the soluble salts value because ATSDR documentation states, “These data suggest that the toxicity of soluble uranium compounds are at least an order of magnitude higher than for insoluble uranium compounds.” The RfD_o value for vanadium is obtained from Section 5.4 of the RSLUG (USEPA 2020).

SA values are obtained from Table 7-2 of the EFH (USEPA 2011), as follows, unless otherwise indicated.

- Hypothetical Adult Residential Gardener: Memorandum OSWER Directive 9200.1-120, *Human Health Evaluation Manual, Supplemental Guidance, Update of Standard Default Exposure Factors* (USEPA 2014).
- Hypothetical Child Residential Gardener: Calculate a weighted average of values across all age groups of the mean values for the head, arms (corrected to 50 percent for lower arms), hands, and legs (corrected to 50 percent for lower legs), and then sum the results.
- Industrial Worker and Utility Worker: Average the adult male and female mean values for the head, arms (corrected to 50 percent for lower arms), and hands, and then sum the results for those areas.
- Hypothetical Recreational User (i.e., ages 10 to 18 years old): Age-weighted average of the mean values for the head, lower arms (corrected to 50 percent for lower arms), hands, and lower legs (corrected to 50 percent for lower legs) for children across three age groups (i.e., 1 year in the 6 to less than 11 years old group, 5 years in the 11 to less than 16 years old group, and 3 years in the 16 to less than 21 years old group).

The CSF_o value for arsenic is obtained from the IRIS (USEPA 1995).

The ADAF is a weighted average of the factors of 10 for ages 0 to 2, 3 for ages 2 to 16, and 1 for ages 16 or older from *Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens* (USEPA 2005). The ADAF applies to only chromium, which is assumed to be hexavalent chromium, which may have mutagenic mode of action. Although valence-specific data for chromium at the North St. Louis County Sites has not been gathered, hexavalent chromium is unlikely to be present for the following reasons: (1) hexavalent chromium is not associated with or produced as a by-product of past MED/AEC uranium-ore processes; and (2) based on environmental fate information presented in the *Toxicological Profile for Chromium* (ATSDR 2012b), organic matter in the soil is expected to convert any hexavalent form of chromium to the insoluble, less mobile, and less toxic trivalent form during the decades of residing in the soil.

-- indicates not applicable.

3.6 SPECIFY TOLERABLE LIMITS ON DECISION ERROR

Two types of decision errors exist: Type I (alpha) and Type II (beta) that are associated with hypothesis testing. The following is the null hypothesis (H_0) primarily used in MARSSIM guidance and this FSSP. Alternate hypotheses may be used with USACE authorization.

$$H_0 = \text{COC(s) exceeds the RGs.}$$

This null hypothesis means the subject area is assumed to be contaminated until proven otherwise. Type I decision error refers to the probability of rejecting the null hypothesis even though it is actually true (false negative). Therefore, for this null hypothesis, a Type I error is described as the probability of determining that the COC data for the subject area collectively do not exceed an RG when the data actually do (i.e., incorrectly releasing the SU). A Type II decision error occurs when the null hypothesis is accepted when the data actually are false (false positive). Therefore, for this null hypothesis, a Type II error is described as the probability of determining that the COC data collectively exceed RG criteria when it does not (i.e., incorrectly failing to release the SU).

- The Type I decision error shall be set at 0.05 for the SLS. A small Type I error reflects a small probability of falsely releasing a subject area.
- The Type II decision error may be selected from a range of 0.05 to 0.25, with the initial value set to 0.20 and adjusted as necessary. Type II errors do not adversely impact public safety and health but do affect project costs and schedules. A small Type II error reflects a small probability of falsely remediating an area that did not require remediation. However, a small Type II error also increases the required number of data points and associated sampling and analysis costs.

Because the decisions based on sample data rely on quality of that data, a minimum of 5 percent field duplicate and split laboratory samples will generally be collected of soil and sediment samples for QC purposes. The following documents establish the criteria against which the data are compared and from which a judgment is rendered regarding the acceptance and qualification of the data:

- *Department of Defense (DoD)/Department of Energy (DOE) Consolidated Quality Systems Manual (QSM) for Environmental Laboratories* (DoD and DOE 2017),
- *USACE Kansas City and St. Louis District Radionuclide Data Quality Evaluation Guidance for Alpha and Gamma Spectroscopy* (USACE 2002b), and
- *Data Verification and Validation* (Leidos 2015).

Data quality indicators for precision, accuracy, representativeness, completeness, and comparability have been established as follows.

- Field Duplicate precision must be less than the 50 percent criteria for relative percent difference (RPD); or, if the RPD is greater than 50 percent, the normalized absolute difference (NAD) must be less than or equal to 1.96 to meet the DQOs.
- Accuracy is the degree of agreement with the true or known, and accuracy is evaluated by measuring the agreement between an analytical result and its known or true value. This is generally determined using laboratory control samples, split sample comparisons, matrix spike analysis, and performance evaluation samples.
- Representativeness and comparability are assured through the selection and proper implementation of systematic sampling and measurement techniques.

- Completeness refers to the portion of the data that meets acceptance criteria and is therefore useable for statistical testing. The objective is 90 percent for this project.

A survey report will document data and processes used to assure compliance with the appropriate ROD criteria as described in Section 4.0.

3.7 OPTIMIZE THE DESIGN FOR OBTAINING DATA

Field screening techniques, surface and subsurface soil sampling, sediment sampling, sample analysis, collection of surface activity measurements, and the DQA process will be used, as appropriate, throughout the FSS to focus efforts and minimize survey/sampling efforts using a graded approach.

Existing survey data should be reviewed to determine if they are of sufficient quality to be included in an FSS dataset. In general, PDI planning should consider gathering data of sufficient quality and quantity to be used for an FSS.

THIS PAGE INTENTIONALLY LEFT BLANK

4.0 REPORT OF SURVEY FINDINGS

Survey procedures and results will be documented in a report following the general guidance in MARSSIM. Data packages and reports will typically contain the following information:

- Survey documentation of scan data, locations of elevated scan levels, and biased sample locations;
- Tables of radiological and non-radiological concentrations for each reference area, SU for radiological data, and subject area for non-radiological data;
- Summary statistics for sample data from the reference area, SU for radiological data, and subject area for non-radiological data;
- Results of the WRS Test or Sign Test;
- Results of any 100-m² averaging; and
- Radiological risk and dose estimates and non-radiological risk and HI estimates for the site.

Individual area/property reports will be used to develop a final report written in accordance with NPL closeout guidance.

THIS PAGE INTENTIONALLY LEFT BLANK

5.0 REFERENCES

- AEC 1974. U.S. Atomic Energy Commission, Directorate of Regulatory Standards. *Termination of Operating Licenses for Nuclear Reactions*. Regulatory Guide 1.86. June 1974.
- ANSI 1997. American National Standards Institute. *Radiation Protection Instrumentation Test and Calibration, Portable Survey Instruments*. N232A-1997. April 3, 1997.
- ANSI/HPS 2013. American National Standards Institute/Health Physics Society. *Surface and Volume Radioactivity Standards for Clearance*. ANSI/HPS N13.12-2013.
- ANSI/HPS 2022. American National Standards Institute/Health Physics Society. *Best Practices: Personal Property Clearance and Application of ANSI/HPS N13.12*. Radiation Safety Support Team Best Practices 385-2-22. June 2022.
- ATSDR 1992. Agency for Toxic Substances and Disease Registry, U.S. Department of Health and Human Services, Public Health Service. *Toxicological Profile for Thallium*. July 1992. <https://www.atsdr.cdc.gov/ToxProfiles/tp.asp?id=309&tid=49>. Accessed June 2023.
- ATSDR 2005. Agency for Toxic Substances and Disease Registry, U.S. Department of Health and Human Services, Public Health Service. *Toxicological Profile for Nickel*. August 2005. <https://www.atsdr.cdc.gov/ToxProfiles/tp.asp?id=245&tid=44>. Accessed June 2023.
- ATSDR 2012a. Agency for Toxic Substances and Disease Registry, U.S. Department of Health and Human Services, Public Health Service. *Toxicological Profile for Cadmium*. September 2012. <https://www.atsdr.cdc.gov/ToxProfiles/tp5.pdf>. Accessed June 2023.
- ATSDR 2012b. Agency for Toxic Substances and Disease Registry, U.S. Department of Health and Human Services, Public Health Service. *Toxicological Profile for Vanadium*. September 2012. <https://www.atsdr.cdc.gov/ToxProfiles/tp.asp?id=276&tid=50>. Accessed June 2023.
- ATSDR 2012c. Agency for Toxic Substances and Disease Registry, U.S. Department of Health and Human Services, Public Health Service. *Toxicological Profile for Chromium*. September 2012. <https://wwwn.cdc.gov/TSP/ToxProfiles/ToxProfiles.aspx?id=62&tid=17>. Page last reviewed September 28, 2016. Accessed June 2023.
- ATSDR 2013. Agency for Toxic Substances and Disease Registry, U.S. Department of Health and Human Services, Public Health Service. *Toxicological Profile for Uranium*. February 2013. <https://www.atsdr.cdc.gov/ToxProfiles/tp150.pdf>. Accessed June 2023.
- ATSDR 2019. Agency for Toxic Substances and Disease Registry, U.S. Department of Health and Human Services. *Toxicological Profile for Antimony and Compounds*. October 2019. <https://www.atsdr.cdc.gov/ToxProfiles/tp.asp?id=332&tid=58>. Accessed June 2023.
- ATSDR 2020. Agency for Toxic Substances and Disease Registry, U.S. Department of Health and Human Services. *Toxicological Profile for Molybdenum*. June 2023. <https://www.atsdr.cdc.gov/ToxProfiles/tp.asp?id=1482&tid=289>. Accessed September 2020.
- DoD 2000. U.S. Department of Defense, U.S. Department of Energy, U.S. Environmental Protection Agency, and U.S. Nuclear Regulatory Commission. *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)*. NUREG 1575, Revision 1. EPA 402-R-97-016, Rev. 1. DOE/EH-0624, Rev. 1. Revision 1. August 2000.

- DoD 2009. U.S. Department of Defense, U.S. Department of Energy, U.S. Environmental Protection Agency, and U.S. Nuclear Regulatory Commission. *Multi-Agency Radiation Survey and Assessment of Materials and Equipment Manual (MARSAME)*. NUREG-1575, Supp.1. EPA 402-R-09-001 DOE/HS-0004. Final. January 2009.
- DoD and DOE 2017. U.S. Department of Defense and U.S. Department of Energy. *Department of Defense (DoD)/Department of Energy (DOE) Consolidated Quality Systems Manual (QSM) for Environmental Laboratories*. DoD Quality Systems Manual Version 5.1 and DOE Quality Systems for Analytical Services Version 3.1. 2017.
- DOE 1987. U.S. Department of Energy, Oak Ridge Operations Office, Bechtel National, Inc. *Radiological and Limited Chemical Characterization Report for the St. Louis Airport Site*. DOE/OR/20722-163. August 1987.
- DOE 1993. U.S. Department of Energy, Oak Ridge National Laboratory. *Baseline Risk Assessment for Exposure to Contaminants at the St. Louis Site, St. Louis, Missouri*. DOE/OR/23701-41.1. November 1993.
- DOE 1994. U.S. Department of Energy, Oak Ridge National Laboratory. *Remedial Investigation Report for the St. Louis Site, St. Louis, Missouri*. DOE/OR/21949-280. January 1994.
- IAEA 2010. International Atomic Energy Agency. *Handbook of Parameter Values for the Prediction of Radionuclide Transfer in Terrestrial and Freshwater Environments*. Technical Report Series No. 472. 2010.
- ICRP 1995. International Commission on Radiological Protection. “Age-Dependent Doses to Members of the Public from Intake of Radionuclides: Part 3, Ingestion Dose Coefficients.” *Annals of the ICRP*. ICRP Publication 69. Volume 25, No. 1. 1995.
- IOM 2000. Institute of Medicine. *Gulf War and Health, Volume 1: Depleted Uranium, Sarin, Pyridostigmine Bromide, and Vaccines*. The National Academies Press. 2000. <https://doi.org/10.17226/9953>. Accessed June 2023.
- IT Corporation 1999a. IT Corporation. *Backfill Study for the St. Louis Downtown Site*. Preliminary Draft. March 1999.
- IT Corporation 1999b. IT Corporation. *Materials Handling and Transportation Plan*. Revision 1. July 1999.
- Leidos 2015. Leidos, Inc. *Data Verification and Validation*. Environmental Science & Engineering Operation. Standard Operating Procedure. ESE DM-05. Revision 0. January 31, 2015.
- MSDIS 2018. University of Missouri Department of Geography. *Missouri Spatial Data Information Service*. <https://data-msdis.opendata.arcgis.com/>. Access date unknown.
- NCRP 1996. National Council on Radiation Protection and Measurements. *Screening Models for Releases of Radionuclides to Atmosphere, Surface Water, and Ground*. Volume I and Volume II. NCRP Report No. 123I. January 22, 1996.
- NRC 1988. U.S. Nuclear Regulatory Commission. *Evaluation of Surface Contamination — Part I: Beta-Emitters (Maximum Beta Energy Greater than 0.15 MeV) and Alpha-Emitters*. ISO 7503-1:1988. August 1988.
- NRC 1992. U.S. Nuclear Regulatory Commission. *Manual for Conducting Radiological Surveys in Support of License Termination*. NUREG/CR-5849. Draft. June 1992.

- NRC 1998. U.S. Nuclear Regulatory Commission. *Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions*. NUREG-1507. June 1998.
- NRC 1999. U.S. Nuclear Regulatory Commission, Office of Nuclear Regulatory Research. *Residual Radioactive Contamination from Decommissioning: Parameter Analysis*. NUREG/CR-5512, Vol. 3, SAND99-2148. Draft Report for Comment. October 1999.
- NRC 2000. U.S. Nuclear Regulatory Commission. *Development of Probabilistic RESRAD 6.0 and RESRAD-BUILD 3.0 Computer Codes*. NUREG/CR-6697. PNL-7994. December 2000.
- NRC 2003. U.S. Nuclear Regulatory Commission, Office of Nuclear Regulatory Research. *Radiological Assessments for Clearance of Materials from Nuclear Facilities*. NUREG-1640. June 2003.
- NRC 2014. Nuclear Regulatory Commission. *Bioassay at Uranium Mills*. Regulatory Guide 8.22. Revision 2. May 2014.
- NRC 2020. U.S. Nuclear Regulatory Commission. *Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions*. NUREG-1507. Revision 1. August 2020.
- NRC 2022. U.S. Nuclear Regulatory Commission. *Consolidated Decommissioning Guidance*. NUREG-1757, Volume 2. Revision 2. July 2022.
- OEHHA 2012. Office of Environmental Health Hazard Assessment, California Environmental Protection Agency. *Air Toxics Hot Spots Program Risk Assessment Guidelines: Technical Support Document for Exposure Assessment and Stochastic Analysis*. Final. August 2012.
- OEHHA 2014. Office of Environmental Health Hazard Assessment, California Environmental Protection Agency. "Arsenic." Chemical Database. Last revised July 2014. <https://oehha.ca.gov/chemicals/arsenic>. Accessed June 2023.
- SAIC 2002. Science Applications International Corporation. *Methodology for Release of Railroad Ties from the St. Louis Downtown Site*. TWR-01- 010. Revision 0. August 2002.
- Shaw Corporation 2002. Shaw Corporation. *Work Assignment Plan for Crushate, Soil, and Concrete Sampling*. Revision 1. May 2002.
- Tidball 1984. Ronald R. Tidball. *Geochemical Survey of Missouri: Geography of Soil Geochemistry and Classification by Factor Analysis of Missouri Agricultural Soils*. Geological Survey Professional Paper 954-H,I. U.S. Department of the Interior. 1984.
- USACE 1997. U.S. Army Corps of Engineers. *Sampling and Analysis Plan for the 50 Series Building Crushate*. USACE Review Draft. November 1997.
- USACE 1998a. U.S. Army Corps of Engineers, St. Louis District. *Record of Decision for the St. Louis Downtown Site*. Final. October 1998.
- USACE 1998b. U.S. Army Corps of Engineers, St. Louis District. *Feasibility Study for the St. Louis Downtown Site*. Final. April 1998.
- USACE 1998c. U.S. Army Corps of Engineers. *Waste Management Plan for Unexpected Materials Found During Remediation at the FUSRAP St. Louis Sites*. November 1998.
- USACE 1999a. U.S. Army Corps of Engineers, St. Louis District. *Final Status Survey Walkover and Sample Collection Protocol*. FUSRAP Procedure. COE-ED-001. Revision 2. May 1999.

- USACE 1999b. U.S. Army Corps of Engineers, St. Louis District. *MARSSIM-Based Final Status Survey Plan for St. Louis Site Vicinity Property 56*. Final. May 1999.
- USACE 1999c. U.S. Army Corps of Engineers, St. Louis District. *Radiological Final Status Survey Plan for Accessible Soil within Plant 1, Plant 2 and the City Property at the St. Louis Downtown Site*. Final. May 1999.
- USACE 1999d. U.S. Army Corps of Engineers, St. Louis District. *MARSSIM-Based Final Status Survey Plan for the St. Denis Bridge Area*. Final. May 1999.
- USACE 1999e. U.S. Army Corps of Engineers, St. Louis District. *Radiological Final Status Survey Plan for the St. Louis Airport Site*. Final. August 1999.
- USACE 1999f. U.S. Army Corps of Engineers, St. Louis District. *Final Status Survey Plan for Accessible Soil Within Plants 3, 6, 6E, 7N, 7S, 7W, 8, 9, and the Vicinity Properties at the St. Louis Downtown Site*. Revision 0. September 1999.
- USACE 1999g. U.S. Army Corps of Engineers, St. Louis District. *FUSRAP Final Status Survey Plan for the St. Louis North County Vicinity Properties*. Final. November 1999.
- USACE 1999h. U.S. Army Corps of Engineers, St. Louis District. *Background Soils Characterization Report for the St. Louis Downtown Site*. St. Louis, Missouri. Final. March 1999.
- USACE 1999i. U.S. Army Corps of Engineers St. Louis District. *Data Management Process for the St. Louis FUSRAP Sites*. St. Louis, Missouri. Final. January 1999.
- USACE 2000. U.S. Army Corps of Engineers, St. Louis District. *Sampling and Analysis Guide for the St. Louis Sites*. Final. September 2000.
- USACE 2001. U.S. Army Corps of Engineers, St. Louis District. *Final Status Survey Plan for the VP-2(L) Building Roof*. Final. October 2001.
- USACE 2002a. U.S. Army Corps of Engineers, St. Louis District. *Radiological Final Status Survey Plan for Accessible Soil within the Mallinckrodt Property and the Vicinity Properties, Excluding Plants 1, 2 and the City Property at the St. Louis Downtown Site*. Revision 2. February 2002.
- USACE 2002b. U.S. Army Corps of Engineers. *USACE Kansas City and St. Louis District Radionuclide Data Quality Evaluation Guidance for Alpha and Gamma Spectroscopy*. Final. December 2002.
- USACE 2003a. U.S. Army Corps of Engineers, St. Louis District. *Final Status Survey Plan Addendum—Evaluation of Difficult to Access Soils*. Final. March 2003.
- USACE 2003b. U.S. Army Corps of Engineers, St. Louis District. *Final Status Survey Plan for Structures and Other Consolidated Material Left in Place at the St. Louis Sites*. Final. September 22, 2003.
- USACE 2003c. U.S. Army Corps of Engineers, St. Louis District. *Integrated Survey Plan for Consolidated Materials, Crushate, Overburden, Equipment and Materials*. Final. September 22, 2003.
- USACE 2003d. U.S. Army Corps of Engineers, St. Louis District. *Feasibility Study for the St. Louis North County Site*. Final. May 1, 2003.
- USACE 2004. U.S. Army Corps of Engineers, St. Louis District. *Derivation of Site-Specific DCGLs for North County Structures*. Final. October 18, 2004.

- USACE 2005a. U.S. Army Corps of Engineers, St. Louis District. *Record of Decision for the North St. Louis County Sites*. Final. September 2, 2005.
- USACE 2005b. U.S. Army Corps of Engineers, St. Louis District. Memorandum for Record. *Non-Significant Change to the Record of Decision for the St. Louis Downtown Site*. March 31, 2005.
- USACE 2009. U.S. Army Corps of Engineers, St. Louis District. *Remedial Investigation Work Plan for the Inaccessible Soil Operable Unit at the St. Louis Downtown Site*. Revision 0. November 30, 2009.
- USACE 2012. U.S. Army Corps of Engineers, St. Louis District. *Remedial Investigation and Baseline Risk Assessment Report for the Inaccessible Soil Operable Unit at the St. Louis Downtown Site*. Final. September 20, 2012.
- USACE 2014. U.S. Army Corps of Engineers St. Louis District. *Record of Decision for the Inaccessible Soil Operable Unit Associated with Group 1 Properties at the St. Louis Downtown Site*. Revision 0. September 29, 2014.
- USACE 2017. U.S. Army Corps of Engineers St. Louis District. *Post-Remedial Action Report and Final Status Survey Evaluation for the Accessible Soil within the St. Louis Downtown Site Plant 7 North and Plant 7 South Properties*. St. Louis, Missouri. Revision 0. September 27, 2017.
- USACE 2021a. U.S. Army Corps of Engineers St. Louis District. Memorandum for Record. *Non-significant change to the Record of Decision for the North St. Louis County Sites*. Phil Moser. December 2, 2021.
- USACE 2021b. U.S. Army Corps of Engineers St. Louis District. Memorandum for Record. *Non-significant change to the Record of Decision for the North St. Louis County Sites*. Phil Moser. December 3, 2021.
- USACE 2024. U.S. Army Corps of Engineers St. Louis District. *Evaluation of Background Concentrations in Soil at the North St. Louis County Sites*. St. Louis, Missouri. Revision 0. June 12, 2024.
- USEPA 1988. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response. *Test Methods for Evaluating Solid Wastes*. Volume II: Physical/Chemical Methods. Chapter 9, Sampling Plan. SW-846, Third Edition. November 1988.
- USEPA 1989a. U.S. Environmental Protection Agency, Office of Policy, Planning, and Evaluation. *Methods for Evaluating the Attainment of Cleanup Standards, Volume 1: Soils and Solid Media*. EPA 230/02-89-042. February 1989.
- USEPA 1989b. U.S. Environmental Protection Agency. “Cadmium; CASRN 7440-43-9.” Integrated Risk Information System (IRIS). Last revised October 1, 1989. https://cfpub.epa.gov/ncea/iris2/chemicalLanding.cfm?&substance_nmbr=141. Accessed June 2023.
- USEPA 1991. U.S. Environmental Protection Agency, Office of Emergency and Remedial Response, Toxics Integration Branch. *Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual, Supplemental Guidance, “Standard Default Exposure Factors.”* OSWER Directive 9285.6-03. Interim Final. March 25, 1991.
- USEPA 1992a. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response. *Method 6010A: Inductively Coupled Plasma - Atomic Emission Spectroscopy*. SW-6010A. Revision 1. July 1992.

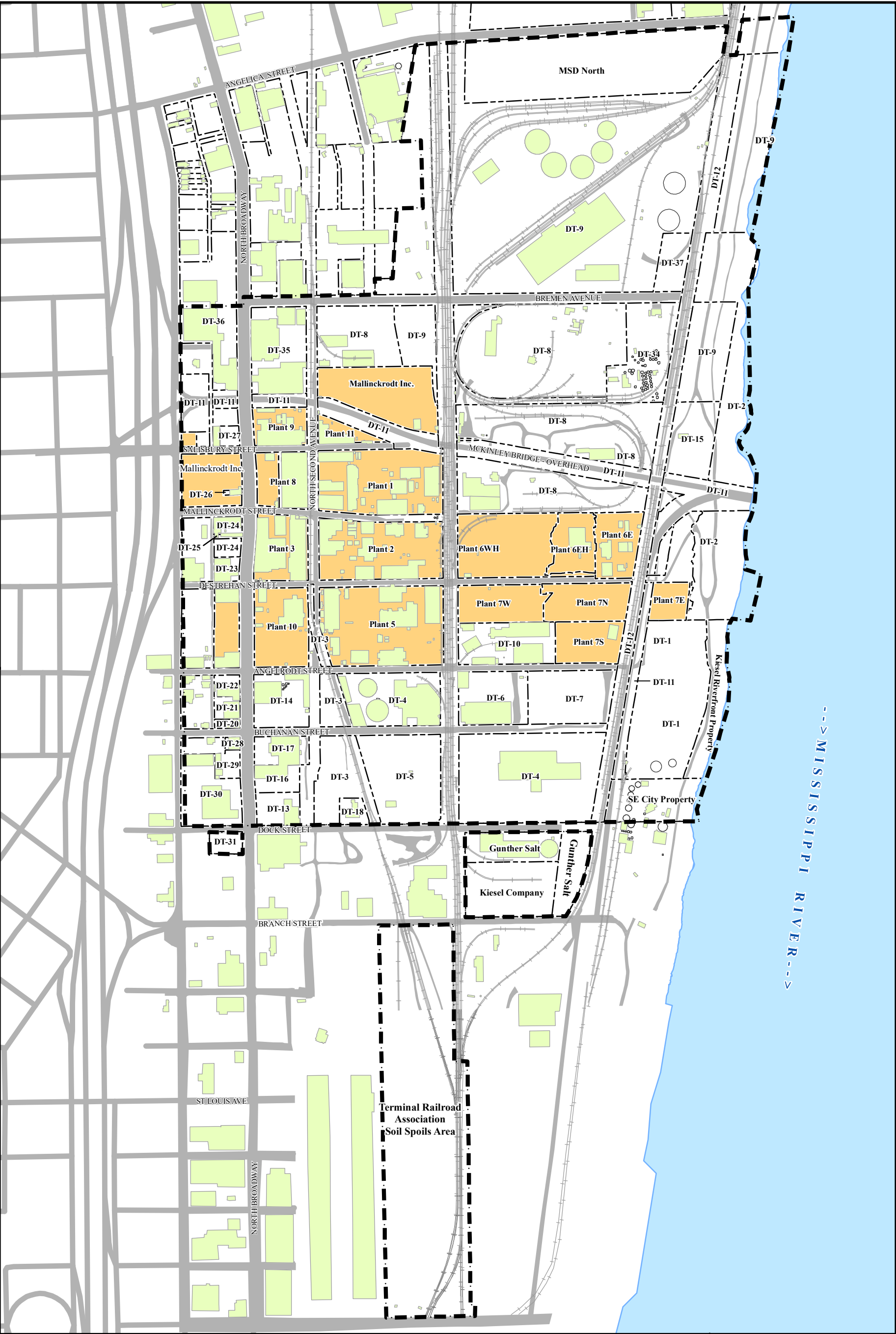
- USEPA 1992b. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response. *Method 7000A: Atomic Absorption Methods*. SW-7000A. Revision 1. July 1992.
- USEPA 1994. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response. *Method 6020: Inductively Coupled Plasma - Mass Spectroscopy*. SW-6010A. Revision 0. September 1994.
- USEPA 1995. U.S. Environmental Protection Agency. “Arsenic, Inorganic; CASRN 7440-38-2.” Integrated Risk Information System (IRIS). Last revised June 1, 1995. https://cfpub.epa.gov/ncea/iris2/chemicalLanding.cfm?&substance_nmbr=278. Accessed June 2023.
- USEPA 1996a. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response. *Method 8260B: Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)*. SW-8260B. Revision 2. December 1996.
- USEPA 1996b. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response. *Method 8270C: Semivolatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)*. SW-8270C. Revision 3. December 1996.
- USEPA 1996c. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response. *Method 8081A: Organochlorine Pesticides by Gas Chromatography*. SW-8081A. Revision 1. December 1996.
- USEPA 1996d. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response. *Method 8082: Polychlorinated Biphenyls (PCBs) by Gas Chromatography*. SW-8082. Revision 0. December 1996.
- USEPA 1997. HEAST U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response. *Health Effects Assessment Summary Tables: FY 1997 Update*. EPA-540/R-97-036, PB97-92119. July 31, 1997.
- USEPA 1998a. U.S. Environmental Protection Agency. “Chromium (VI); CASRN 18540-29-9.” Integrated Risk Information System (IRIS). Last revised September 3, 1998. https://cfpub.epa.gov/ncea/iris2/chemicalLanding.cfm?&substance_nmbr=144. Accessed June 2023.
- USEPA 1998b. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response. *Method 7000B: Flame Atomic Absorption Spectrophotometry*. SW-7000B. Revision 2. January 1998.
- USEPA 2000a. U. S. Environmental Protection Agency. *Guidance for the Data Quality Objectives Process*. EPA QA/G-4. Final. August.
- USEPA 2000b. U.S. Environmental Protection Agency. *Guidance for Data Quality Assessment*. EPA QA/G-9. Final. July 2020.
- USEPA 2004. U.S. Environmental Protection Agency, Office of Superfund Remediation and Technology Innovation. *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment)*. EPA/540/R/99/005. OSWER 9285.7-02EP. PB99-963312. Final. July 2004.
- USEPA 2005. U.S. Environmental Protection Agency. *Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens*. EPA/630/R-03/003F. March 2005.

- USEPA 2006. U.S. Environmental Protection Agency, Office of Environmental Information. *Guidance on Systematic Planning Using the Data Quality Objectives Process*. EPA QA/G-4. EPA /240/B-06/001. February 2006.
- USEPA 2011. U.S. Environmental Protection Agency. *Exposure Factors Handbook: 2011 Edition*. EPA/600/R-090/052F. September 2011.
- USEPA 2012. U.S. Environmental Protection Agency. *Provisional Peer-Reviewed Toxicity Values for Thallium and Compounds*. EPA/690/R-12/030F. Final. November 1, 2012.
- USEPA 2014. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response. *Human Health Evaluation Manual, Supplemental Guidance, Update of Standard Default Exposure Factors*. Memorandum OSWER Directive 9200.1-120. February 6, 2014.
- USEPA 2016. U.S. Environmental Protection Agency. *Human Health Risk Assessment Protocol (HHRAP) for Hazardous Waste Combustion Facilities*, EPA530-R-05-006, September 2005; and “HHRAP Companion Database.” Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities, Support Materials. Last updated February 22, 2016. <https://archive.epa.gov/epawaste/hazard/tsd/td/web/html/riskvol.html#volume2>. Accessed June 2023.
- USEPA 2020. U.S. Environmental Protection Agency. “Regional Screening Levels (RLSs) – User’s Guide.” Risk Assessment. May 2020. Last updated May 4, 2020. <https://www.epa.gov/risk/regional-screening-levels-rsls-users-guide>. Accessed June 2023.
- USEPA 2022. U.S. Environmental Protection Agency, Office of Research and Development. *ProUCL Version 5.2.0 Technical Guide: Statistical Software for Environmental Applications for Data Sets with and without Nondetect Observations*. Updated June 14, 2022. <https://www.epa.gov/land-researchreh/proucl-software>. Accessed June 2022.

THIS PAGE INTENTIONALLY LEFT BLANK

FIGURES

THIS PAGE INTENTIONALLY LEFT BLANK



LEGEND

- Railroad
- ROD Boundary
- Property Boundary
- Mallinckrodt Property
- River/Stream
- Road
- Building
- Tank

MO-East State Plane
(NAD 83, Feet)

0 250 500
Feet

Final Status Survey Plan for Soil,
Structures, and Sediment at the
St. Louis FUSRAP Sites

FUSRAP

DRAWN BY: Leidos	REV: 1	DATE: 6/10/2024

Figure 1. St. Louis Downtown Site

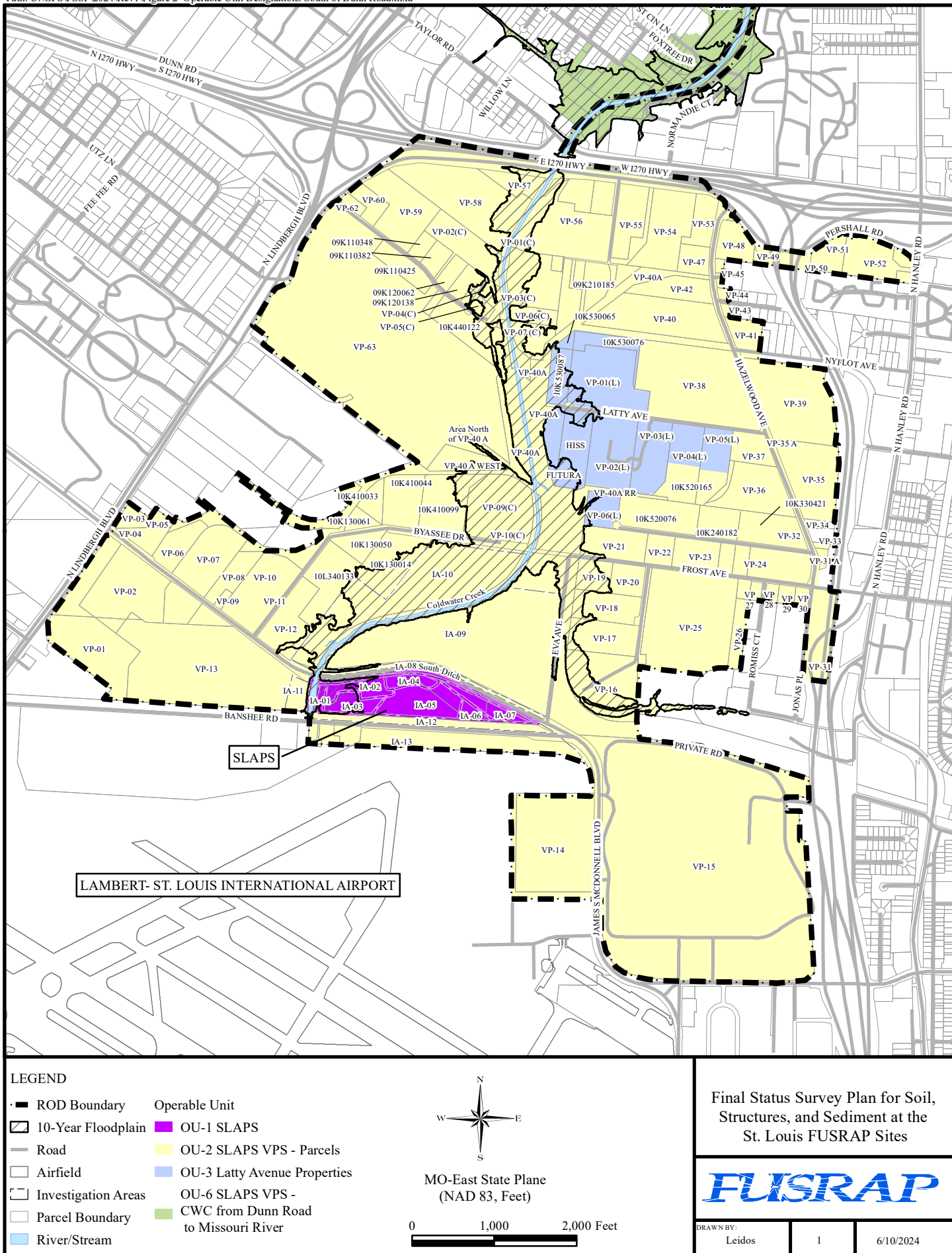


Figure 2. Operable Unit Designations South of Dunn Road

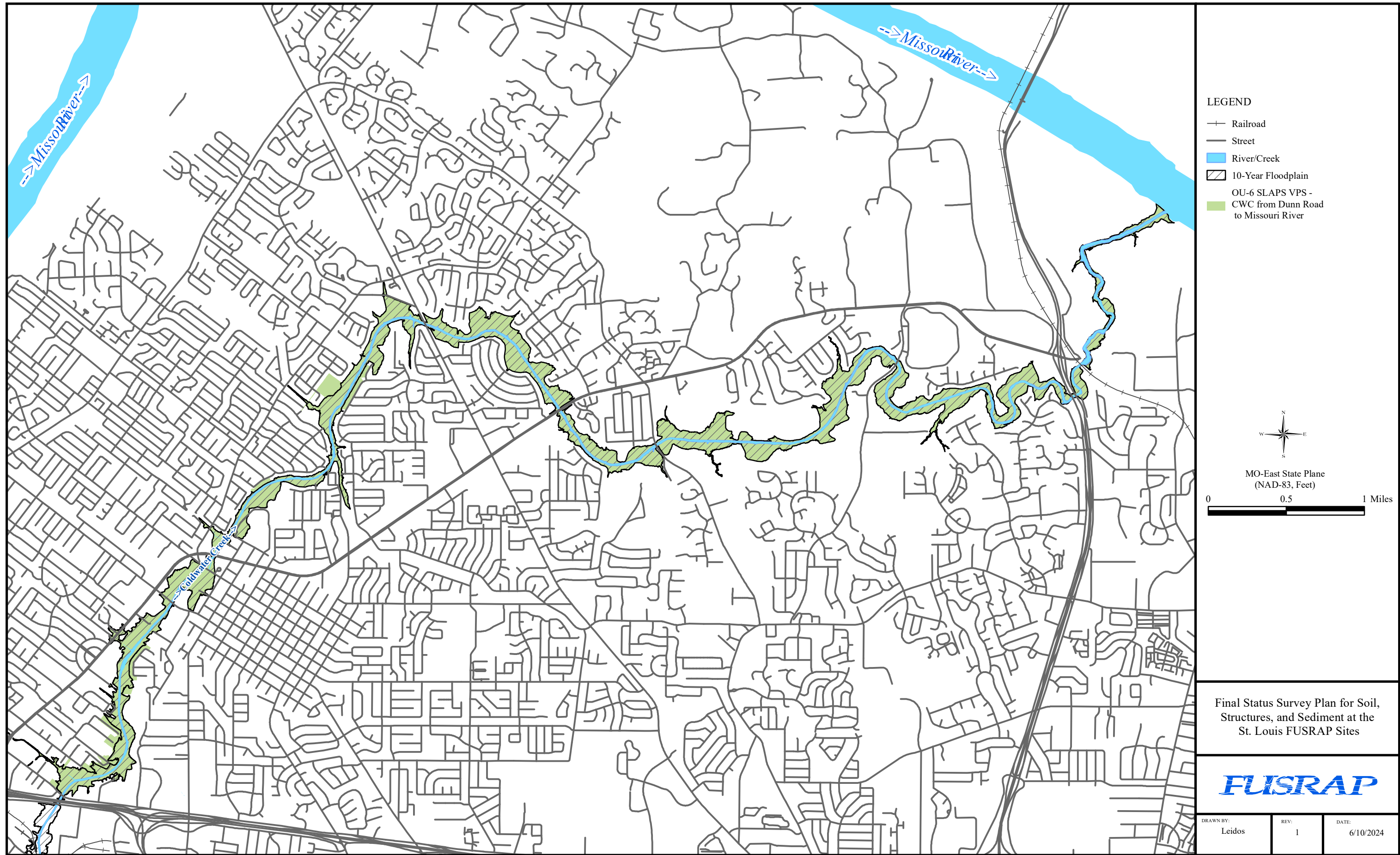
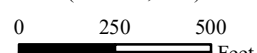


Figure 3. Operable Unit Designations North of Dunn Road

Does Not Apply

River
 Road



DATE:
6/10/2024

Figure 4. Deep-Soil Criterion Depth by Property for the St. Louis Downtown Site

APPENDIX A

FINAL STATUS SURVEY PLAN FOR STRUCTURES AND OTHER CONSOLIDATED MATERIAL LEFT IN PLACE AT THE ST. LOUIS SITES

THIS PAGE INTENTIONALLY LEFT BLANK

TABLE OF CONTENTS

<u>SECTION</u>	<u>PAGE</u>
LIST OF TABLES	A-iii
LIST OF FLOWCHARTS	A-iii
LIST OF ATTACHMENTS	A-iv
A-1.0 INTRODUCTION.....	A-1
A-1.1 PURPOSE.....	A-1
A-1.2 SCOPE	A-1
A-1.3 APPLICABILITY.....	A-1
A-1.4 BACKGROUND	A-2
A-1.5 OUTLINE OF PROCESS	A-2
A-2.0 ORGANIZATION AND RESPONSIBILITIES	A-3
A-3.0 DATA QUALITY OBJECTIVES.....	A-5
A-3.1 STATE THE PROBLEM.....	A-5
A-3.2 IDENTIFY THE DECISION	A-6
A-3.3 IDENTIFY THE INPUTS TO THE DECISION	A-7
A-3.3.1 Concerns Related to the Radiological Contaminants of Concern.....	A-7
A-3.3.2 Surface Contamination Scans	A-8
A-3.3.3 Fixed-Point Surficial Contamination Measurements.....	A-10
A-3.3.4 Other Issues.....	A-10
A-3.4 DEFINE THE BOUNDARIES OF THE STUDY AREA	A-10
A-3.5 DEVELOP A DECISION RULE	A-11
A-3.6 SPECIFY TOLERABLE LIMITS ON DECISION ERRORS	A-12
A-3.7 OPTIMIZE THE DESIGN FOR OBTAINING DATA	A-13
A-4.0 SURVEY PLANNING.....	A-15
A-4.1 IDENTIFY CONTAMINANTS	A-15
A-4.2 ESTABLISH DERIVED CONCENTRATION GUIDELINE LEVELS AND LIMITS.....	A-15
A-4.2.1 Surface Contamination Derived Concentration Guideline Level	A-15
A-4.2.2 Investigation Levels	A-15
A-4.2.3 Elevated Measurement Comparison.....	A-16
A-4.3 DETERMINE IF A STRUCTURE IS IMPACTED.....	A-16
A-4.3.1 General.....	A-16
A-4.3.2 Background and Basis for Decisions	A-17
A-4.3.3 Buildings	A-18
A-4.3.4 Non-Building Structures.....	A-21
A-4.4 CLASSIFY AREAS BY CONTAMINATION POTENTIAL	A-22
A-4.5 GROUP/SEPARATE AREAS INTO SURVEY UNITS	A-22

TABLE OF CONTENTS (Continued)

<u>SECTION</u>	<u>PAGE</u>
A-4.6 SELECT A BACKGROUND REFERENCE AREA DATASET	A-23
A-4.7 PREPARE SITE FOR SURVEY ACCESS.....	A-23
A-4.8 ESTABLISH SURVEY LOCATION REFERENCE SYSTEM	A-23
A-5.0 SURVEY DESIGN	A-25
A-5.1 DETERMINE NUMBER OF DATA POINTS NEEDED	A-25
A-5.1.1 Specify Decision Errors.....	A-25
A-5.1.2 Estimate the Dataset Standard Deviation	A-25
A-5.1.3 Calculate Relative Shift.....	A-25
A-5.1.4 Obtain Number of Data Points	A-25
A-5.2 DETERMINE SPACING FOR THE SURVEY UNIT	A-28
A-5.3 SMALL AREAS OF ELEVATED ACTIVITY.....	A-28
A-5.4 SCAN COVERAGE REQUIREMENTS	A-29
A-5.5 QUALITY ASSURANCE/QUALITY CONTROL MEASUREMENTS.....	A-29
A-5.5.1 Quality Control Duplicates	A-29
A-5.5.2 Instrument Performance Checks	A-29
A-5.5.3 In-Process Quality Control Checks	A-30
A-5.6 LABORATORY ANALYSIS.....	A-30
A-6.0 SURVEY INSTRUMENTATION.....	A-31
A-6.1 INSTRUMENT SELECTION	A-31
A-6.2 INSTRUMENT EFFICIENCY.....	A-31
A-6.3 SURFACE EFFICIENCY	A-31
A-6.4 STATIC MINIMUM DETECTABLE CONCENTRATIONS.....	A-31
A-6.5 BETA SCAN MINIMUM DETECTABLE CONCENTRATIONS	A-32
A-6.6 ALPHA SCAN PROBABILITY	A-33
A-7.0 INTERPRETATION OF SURVEY RESULTS.....	A-35
A-7.1 DATA QUALITY ASSESSMENT	A-35
A-7.2 REVIEW THE DATA QUALITY OBJECTIVES AND SAMPLING DESIGN 35	
A-7.3 CONDUCT A PRELIMINARY DATA REVIEW	A-35
A-7.4 EVALUATE SMALL AREAS OF ELEVATED ACTIVITY.....	A-36
A-7.4.1 Comparison to the Elevated Measurement Comparison.....	A-36
A-7.4.2 Use of an Exposure Pathway Model.....	A-37
A-7.5 REVIEW DATA QUALITY INDICATORS.....	A-37
A-7.6 VERIFY FINAL STATUS SURVEY DESIGN.....	A-38
A-7.7 SELECT THE STATISTICAL TEST	A-38

TABLE OF CONTENTS (Continued)

<u>SECTION</u>	<u>PAGE</u>
A-7.8 DRAW CONCLUSIONS FROM THE DATA	A-39
A-8.0 REPORT OF SURVEY FINDINGS	A-41

LIST OF TABLES

<u>NUMBER</u>	<u>PAGE</u>
Table A-1. Principal Decision and Alternative Actions	A-6
Table A-2. Criteria to Be Used for Survey Unit Classification	A-8
Table A-3. Surficial Contamination Scan Coverage Guidelines	A-9
Table A-4. Maximum Survey Unit Areas.....	A-11
Table A-5. Structure or Consolidated Material Surfaces Remediation Goals and Their Evaluation Criteria	A-12
Table A-6. SLS Decision Errors	A-13
Table A-7. Final Status Survey Investigation Levels	A-15
Table A-8. Modes of Potential Structure Contamination.....	A-17
Table A-9. Values of P_r When the WRS Test Is Used.....	A-26
Table A-10. Percentiles Represented by Selected Values of α and β Errors.....	A-26
Table A-11. Values of Sign p	A-27
Table A-12. Surface Efficiencies.....	A-31
Table A-13. Data Quality Indicator Summary	A-37

LIST OF FLOWCHARTS

Image A-1.	Final Status Survey Decision Tree
Image A-2.	Overview of the Impact Determination
Image A-3.	Determining the Impact on Buildings, Step 1 Consider the Foundation
Image A-4.	Determining the Impact on Buildings, Step 2 Consider the Exterior
Image A-5.	Determining the Impact on Buildings, Step 3 Consider the Interior
Image A-6.	Determining the Impact on Non-Building Structures

LIST OF ATTACHMENTS

ATTACHMENT A-1	DERIVED CONCENTRATION GUIDELINE LEVELS FOR ELEVATED MEASUREMENT COMPARISONS ON STRUCTURES
ATTACHMENT A-2	RESRAD-BUILD OUTPUT FILES FOR DERIVED CONCENTRATION GUIDELINE LEVELS FOR ELEVATED MEASUREMENT COMPARISON DERIVATIONS

The primary distribution format for this document is electronic files. If printed copies are distributed, the following portions will be included on a CD-ROM on the back cover of the report instead of being printed: Attachment A-2.

A-1.0 INTRODUCTION

A-1.1 PURPOSE

The purpose of this appendix is to provide the basis for conducting FSSs of the various structures and consolidated material left in place within the FUSRAP SLS.

The various structures and/or consolidated material left in place will simply be referred to as “structures” in the remainder of this appendix.

The ultimate objective of the FSS process is to validate that a structure does not present a current or potential threat to public health, welfare, or the environment. This objective is met for structures or portions of structures when the following conditions exist:

- They have been determined to have not been impacted by MED/AEC operations.
- They may have been impacted by MED/AEC operations, but an FSS has verified that any residual radioactive contamination meets RGs.
- They have been impacted by MED/AEC operations, have been remediated, and an FSS has verified that any residual radioactive contamination meets RGs.

A-1.2 SCOPE

This appendix contains guidance in the following areas:

- Determination of whether a structure is impacted per MARSSIM guidance (DoD 2000),
- MARSSIM classification of an impacted structure or impacted portions of a structure,
- Planning and execution of FSSs,
- Survey data analysis, and
- Survey reporting.

For the purposes of this appendix, structures include, but are not limited to, the following:

- Buildings and portions of buildings including interior and exterior surfaces, roof areas, and foundations;
- Footings, retaining walls, and stop logs;
- Piping and ducting;
- Utility poles;
- Bridges and supporting structures;
- Pavement;
- Consolidated material to be left in place; and
- Other similar items where surficial contamination is of concern.

A-1.3 APPLICABILITY

This appendix is applicable to all portions of the SLS.

This document supersedes any guidance relative to the evaluation of surficial contamination on structures or consolidated materials that may be contained within the *Radiological Final Status*

Survey Plan for Accessible Soil Within Mallinckrodt Property and the Vicinity Properties, Excluding Plants 1, 2, and the City Property at the St. Louis Downtown Site (USACE 2002a).

Consolidated materials that will not be left in place are to be evaluated by the processes provided in Appendix B.

Soil and items such as tools and equipment that are to be released for unrestricted use are beyond the scope of this document.

RGs involving volumetric contamination will be addressed by USACE on a case-by-case basis using concepts consistent with those defined herein.

A-1.4 BACKGROUND

The SLS is made up of the SLDS and the North St Louis County Site. Each of these contains properties that are subject to final status surveys. Relevant criteria for each site are defined in applicable decision documents with RODs defining the RGs that must be achieved within respective portions of the SLS.

Remediation goals are generally expressed in terms of a primary limit (annual dose or a residual risk level) to a stated target population under a stated limiting scenario. Modeling is used to derive secondary limits (in terms of surficial contamination) that must be met to achieve the primary limit. These secondary limits are called DCGLs. In MARSSIM statistical testing, the DCGLs are referred to as the “acceptance criterion.” Derivation of DCGLs is beyond the scope of this document.

The guidance described in MARSSIM (DoD 2000), the *Guidance for the Data Quality Objective Process* (USEPA 2000a), and the applicable decision document will be used to demonstrate compliance with RGs.

A-1.5 OUTLINE OF PROCESS

The process consists of the following general steps:

- Identify the DCGLs (generally expressed in units of residual surficial contamination),
- Determine whether the structure has been impacted by radiological operations,
- Characterize and classify impacted structures or impacted portions of structures based on contamination potential,
- Design the FSS,
- Execute the FSS,
- Evaluate the survey data, and
- Prepare the FSS report.

The details of the process are described in subsequent sections.

A-2.0 ORGANIZATION AND RESPONSIBILITIES

The verification contractor, under contract to the USACE, has developed this appendix.

The USACE is responsible for the implementation of the FSS as detailed in this appendix.

FSSs may be performed by the USACE, by the verification contractor, or by the RAC with direct oversight by USACE.

The USACE, verification contractor, or RAC may utilize scans and supplemental survey information to identify biased sampling locations. The USACE, verification contractor, or RAC will collect all biased measurements.

The RAC should generally have no prior knowledge of FSS fixed point measurement or survey locations.

THIS PAGE INTENTIONALLY LEFT BLANK

A-3.0 DATA QUALITY OBJECTIVES

The first step in designing effective surveys is planning. The DQO process provides systematic procedures for defining the criteria that the survey design should satisfy, including what type of measurements to perform, when and where to perform measurements, the level of decision errors for the survey, and how many measurements to perform.

The minimum outputs required for the DQO process to proceed with a MARSSIM-based FSS follow.

- Classify and specify boundaries of the SUs.
- State the null hypothesis (H_0).
- Specify a gray region where the consequences of decision errors are relatively minor.
- Define Type I (α) and Type II (β) decision errors and assign probability limits for the occurrence of these errors.
- Estimate the standard deviation (σ) of the measurements in the SU.
- Specify the relative shift (Δ/σ).
- Specify the detection limit for all measurement techniques.
- Calculate the estimated number of measurements (n) and specify measurement locations.
- Specify the documentation requirements for the survey, including survey planning documentation.

The DQOs are described following, as they apply to the surficial contamination FSSs of structures at the SLS.

A-3.1 STATE THE PROBLEM

Some structures at the SLS have a potential to contain residual radioactive surficial contamination as a consequence of MED/AEC activities. Depending on the history of the structure's use, its location, its date of construction, and the history of the surrounding soil, the potential for surficial contamination may exist on the exterior only, the interior only, on or under the foundation only, or any combination of these locations. The potential for such radioactive contamination must be assessed. If the structure is determined to be impacted by MED/AEC activities, then the levels of residual radioactive contamination must be determined by an FSS to confirm compliance with RGs.

The residual risk from exposure to surficial radioactive contamination at the SLS is generally dominated by thorium and/or uranium, both of which are alpha-emitting radionuclides. Alpha radionuclides pose additional challenges in the areas of fixed-point and scanning MDCs, application of surface efficiencies, surface cleanliness requirements, etc. when performing surficial contamination measurements.

The materials used in the construction of SLS structures contain naturally occurring radioactive material (NORM). The constituents of this NORM are similar to the radionuclide COC at the SLS. This means that any structure may contain detectable radioactive contamination regardless of MED/AEC historical activities. In some cases, "background" concentrations must be measured and subtracted from FSS surficial contamination measurements to accurately verify compliance with RGs.

A-3.2 IDENTIFY THE DECISION

This appendix will provide the process used to demonstrate that residual radionuclide concentrations on the surfaces of impacted structures at the SLS comply with the RGs as specified in the applicable decision document. Compliance will be verified as described in this appendix and MARSSIM guidance. Specifically, compliance will be demonstrated by the following activities:

- Performing surficial contamination scans to identify gross alpha contamination and any small areas of elevated activity;
- Collecting systematic surficial alpha contamination measurements in a manner consistent with the MARSSIM approach;
- Collecting biased alpha measurements in areas that exceed the IL;
- Performing statistical tests to verify RGs are met, and therefore that the structure does not present a current or potential threat to public health, welfare, or the environment; and
- Reviewing the data to verify it is of sufficient quality.

To demonstrate that an SU meets RGs, four evaluation questions must be answered.

1. Are radiological COCs limited to the surfaces of the SU being evaluated (i.e., no volume contamination is suspected)?
2. Do surficial contamination measurements pass the WRS Test or the Sign Test, as appropriate?
3. Do small areas of elevated activity, if present, pass the elevated measurement comparison (EMC) test such that application of the unity rule within the SU (Section A-7.4.1, Equation A-14) yields a fraction that is less than or equal to 1.0? Alternately, does an applicable and relevant exposure pathway model of the SU that contains small areas of elevated activity demonstrate that RGs are met for the SU?
4. Is data of sufficient quality to support the conclusions (i.e., have data quality indicators [DQIs] been met)?

If the answer to any one of these evaluation questions is “no” for any SU, then RGs are not satisfied. Table A-1 presents the principal study question of the decision-making process and offers alternative actions that may be taken if any of the evaluation questions result in a “no” answer.

Table A-1. Principal Decision and Alternative Actions

Study Question	Alternative Actions
Do residual levels of radioactive COCs within the SU exceed RGs?	Remediate the SU and re-survey.
	Collect additional survey information to better define the extent of the contamination. This may indicate that the SU achieves RGs.
	Remove the structure and dispose of it in an appropriate waste stream.
	Apply a situation-specific exposure pathway model to demonstrate compliance with RGs.
	Declare the SU or a portion of the SU inaccessible, if applicable. (The SU or portion of the SU would require some institutional controls.)
	Collect additional survey data or modify data collection techniques to meet DQIs.

A-3.3 IDENTIFY THE INPUTS TO THE DECISION

The DQA process described in MARSSIM guidance (DoD 2000) and in the *Guidance for Data Quality Assessment* (USEPA 2000b) will be used to determine if data obtained from environmental data operations are of the right type, quality, and quantity to support their intended use.

The “graded approach” concept will also be used to ensure that survey efforts are maximized in those areas where the highest probability for residual contamination or greatest potential for adverse impacts of residual contamination exist. Examples of integrating the graded approach into the MARSSIM process include the use of an HSA, site conditions, equipment capabilities, and results as the survey progresses to establish or adjust the degree of scanning coverage of a survey area, SU size, SU classification, sampling frequency, and criteria for the evaluation of elevated measurements.

Field activities for the FSS will include the following.

- Surface contamination scans to identify gross alpha contamination levels and small areas of elevated activity.
- Surface contamination fixed-point measurements to estimate the mean of the alpha contamination across the SU.
- Collection of surface samples and submittal to an analytical laboratory for the identification of specific radioactive contaminants and their relative ratios, if required. This will be done only at USACE direction and with specific USACE guidance.
- Collection of smears may be conducted to verify the removable fraction used in risk assessments.

Survey activities will be conducted in accordance with the approved standard operating procedures for the FUSRAP and FUSRAP contractors. Modifications, additions, or other changes needed to meet project-specific requirements as the survey progresses will be pre-approved by and documented according to USACE specifications.

A-3.3.1 Concerns Related to the Radiological Contaminants of Concern

The radioactive COCs at the SLS have been identified in decision documents as follows:

- Ra-226 (emits α radiation);
- Ra-228 (emits β radiation);
- Th-230 (emits α radiation);
- Th-232 (emits α radiation);
- Uranium, including U-238, U-235, and U-234 (emits α radiation); and
- Associated radioactive decay products.

Alpha (α) radiation is readily available for detection. Beta emissions from MED/AEC COC contamination are too low to be distinguishable within the variation of beta emissions due to natural background radioactivity. Natural background radioactivity varies by thousands of dpm/100 cm² because of varying material types and variations in plate-out of radon decay chain isotopes due to atmospheric pressure changes. A beta DCGL would also have to be decreased to account for the beta emissions from COCs that are not detected by the instrument because of insufficient energy to penetrate its mylar window. The AFs for MED/AEC COCs at the SLS result in too few beta-emitting contributions to the total activity for a total beta DCGL to be useful as a

surrogate DCGL for structures. Therefore, gross alpha DCGLs are used for both SLDS and North St. Louis County Sites properties.

Measurement of alpha radiation poses the following challenges because it has a very short range (travel distance) in air, and it is easily shielded (attenuated) by a thin layer of materials of moderate density, such as paper. The survey instrument detector must be in very close proximity to the surface being surveyed (usually approximately 1 cm or less). Surveying at a close distance can result in frequent accidental damage to the window of the survey instrument detector from rough and scabbled surfaces. Survey surfaces must be dry and relatively clean to ensure that moisture, dust, and dirt are not attenuating the alpha radiation (which would result in biased low readings).

In addition, personnel must be vigilant during the HSA and during survey execution for indications that surface contamination might have been purposely or inadvertently covered by a surface coating such as paint, glue, flashing, etc.

A-3.3.2 Surface Contamination Scans

Scanning surveys are typically performed before fixed-point measurements. This precludes fully evaluating an area that may quickly prove to be contaminated above the IL during the scanning process. ILs are discussed in Section A-4.2.2.

Selection of the survey instrument and detector and specifications for the operation of the pair should meet the following guidelines.

- The instrument efficiency (ϵ_i) should generally be greater than or equal to 0.15 to optimize counting statistics.
- Detectors with active probe areas of about 100 cm² should be used, where feasible, to compare measurements to the IL. If scanning with a large area probe identifies an area requiring further investigation, a follow up survey with an active probe area of about 100 cm² should be used.
- The beta scan MDC should be less than or equal to the DCGL if a beta DCGL is established. The scan MDC is dependent on several variables but is dominated by the selection of the scan speed. The beta scan MDC is determined in Section A-6.5.
- The alpha scan probability of observing a single count should generally be greater than or equal to 0.85 (85 percent) to provide more reliable alpha scan results.
- The detector should be checked for proper operation frequently during the conduct of the survey. Special consideration should be given to light and gas leaks.
- The alpha detector should generally be held at a distance of approximately 1 cm or less from the surface to be evaluated.

Impacted areas are areas that have some potential for containing contaminated material. These areas can be subdivided into three classes as shown in Table A-2.

Table A-2. Criteria to Be Used for Survey Unit Classification

Class	Criteria
Class 1 Area(s)	Areas that have, or had prior to remediation, a potential for radioactive contamination or known contamination exceeding the DCGL. <i>Examples include the following: site areas previously subjected to RAs, locations where leaks or spills are known to have occurred, former burial or disposal sites, waste storage sites, and areas with contaminants in discrete solid pieces of material with high specific activity.</i>

Table A-2. Criteria to Be Used for Survey Unit Classification (Continued)

Class	Criteria
Class 2 Area(s)	Areas that have, or had prior to remediation, a potential for radioactive contamination or known contamination, but are not expected to exceed the DCGL. <i>Examples include the following: locations where radioactive materials were present in an unsealed form, potentially contaminated transport routes, areas downwind from stack release points, upper walls and ceilings of some buildings or rooms subjected to airborne radioactivity, areas where low concentrations of radioactive materials were handled, and areas on the perimeter of former contamination control areas.</i>
Class 3 Area(s)	Any impacted areas that are not expected to contain any residual radioactivity, or are expected to contain levels of residual radioactivity at a small fraction of the DCGL, based on site operating history and previous radiation surveys. <i>Examples include the following: buffer zones around Class 1 or Class 2 areas, and areas with very low potential for residual contamination but insufficient information to justify a non-impacted classification.</i>

The amount of scan coverage will be based on the SU's classification, as outlined in MARSSIM guidance (DoD 2000). The scan coverage guidelines are provided in Table A-3.

Table A-3. Surficial Contamination Scan Coverage Guidelines

Area Classification	Amount of Coverage^a	Notes
Class 1	100%	Of accessible surfaces
Class 2	10% to 100%	Value based on the amount of concern for the presence of small areas of elevated activity
Class 3	Professional Judgment	Scans are biased toward areas that are most likely to have a contamination potential.

^a The coverage guidelines are applied to the entire SU and not to individual surfaces or grid cells.

The audible output of a survey instrument should be used during scanning to assist the surveyor in locating suspect areas. The audible instrument response is generally a factor of 10 times faster than the meter response, and this improves the surveyor efficiency.

The scanning IL should be converted to units of cpm using Equation A-1 prior to the start of the survey. This allows the surveyor to immediately determine if a scanning response is suspect and should be investigated.

Equation A-1 – Conversion of the IL to CPM¹

$$\text{CPM} = \left[(\text{Investigation Level})(\epsilon_i)(\epsilon_s) \left(\frac{\text{Probe Area}}{100} \right) \right] + (\text{Field Background})$$

where:

ϵ_i = the instrument efficiency (in cpm/dpm)

ϵ_s = the surface efficiency. Refer to Section A-6.3.

Probe Area (in cm²)

Field Background (in cpm)

If a measurement exceeding the IL is identified during scanning, the surveyor should revisit the area at a slower scan speed and pause for several seconds over the area in question. This is often referred to as a “pat” survey. The instrument reading in cpm is compared to the investigation level,

¹ When using a probe with an active area that is significantly larger than 100 cm² and areas exceeding the IL are identified, a detector with an active probe area of about 100 cm² shall be used to further investigate.

and the extent of any elevated area(s) are determined. The scanning of remaining areas may then continue.

If radon is suspected, steps such as wiping the surface, ventilating the area, or covering the surface with plastic to allow radon decay, can be taken to determine if activity is attributable to naturally occurring radon, and not to a FUSRAP COC. After the steps are completed, the fixed-point surveys will be retaken and compared to the initial measurements.

The areas that were scanned will be annotated on a survey record and retained for review and historical documentation. The area, general size and shape, and overall activity level (converted to units of dpm/100 cm²) of locations that exceed the IL will also be annotated on the survey record.

Locations where safety considerations or other restrictions prevent access for normal survey activities exist. Reasonable efforts to scan such locations will be made. Alternative and innovative approaches (e.g., use of extension poles, etc. will be used when appropriate).

A-3.3.3 Fixed-Point Surficial Contamination Measurements

The number of fixed-point surficial contamination measurements to be collected in each SU is calculated using MARSSIM guidance as described in Section A-5.1. The actual number of measurements will depend on SU-specific data and will be verified during survey data evaluation.

Selection of the survey instrument and detector and specifications for the operation of the pair should meet the following guidelines.

- The instrument efficiency (ϵ_i) should generally be greater than or equal to 0.15 to optimize counting statistics.
- Detectors with active probe areas of approximately 100 cm² should be used, where feasible, to compare measurements to the IL.
- The MDC must be less than or equal to the DCGL, with a target of 10 to 50 percent of the DCGL. The MDC is dependent on several variables but is dominated by the selection of the count time. The MDC is determined in Section A-6.4.
- The detector should be checked for light leaks, and gas leaks where applicable, frequently during the conduct of the survey.
- The detector should generally be held at a distance of approximately 1 cm or less from the surface to be evaluated.

A-3.3.4 Other Issues

Only properly qualified health physicists or senior health physics technicians will perform radiological surveys to include FSSs. Junior health physics technicians may perform survey duties under the instruction of a senior health physics technician.

The USACE will direct the selection of background reference areas and background reference material datasets, when required.

A-3.4 DEFINE THE BOUNDARIES OF THE STUDY AREA

Per MARSSIM guidance, an “area” is a general term that refers to any portion of a site, up to and including the entire site. All areas of the site may not have the same potential for residual contamination and, accordingly, may not need the same level of survey coverage to demonstrate compliance with RGs.

Classifying areas by contamination potential and then grouping areas into SUs is a critical step in the survey design process. Areas that have no reasonable potential for residual contamination do not need any level of survey coverage and are designated as non-impacted areas. These areas are typically identified during the HSA. Criteria for determining if a structure or portion of a structure is impacted are provided in Section A-4.3.

Structures and/or portions of structures will be classified during the survey design phase for that structure. Classified areas will then be segmented into SUs based upon the guidance in Table A-4. The area classification (i.e., Class 1, 2, or 3) shall not vary within an individual SU.

Table A-4. Maximum Survey Unit Areas

Class	Suggested Maximum SU Area
Class 1 Structure Survey Unit	100 m ²
Class 2 Structure Survey Unit	1,000 m ²
Class 3 Structure Survey Unit	No limit

The study boundary is therefore defined by the areal extent of the SU. Each study boundary (i.e., SU) will be evaluated for compliance with RGs on an individual basis. Vertical and horizontal surfaces may be combined into a single SU when appropriate.

A-3.5 DEVELOP A DECISION RULE

Image A-1 illustrates the sequence of events that are followed in the MARSSIM FSSE process. This is used to determine whether an SU meets RGs or if additional remediation or investigation and data gathering is required. Table A-5 contains the RGs and their evaluation criteria for structures and consolidated material surfaces for the SLDS and the North St. Louis County Sites.

Image A-1. Final Status Survey Decision Tree

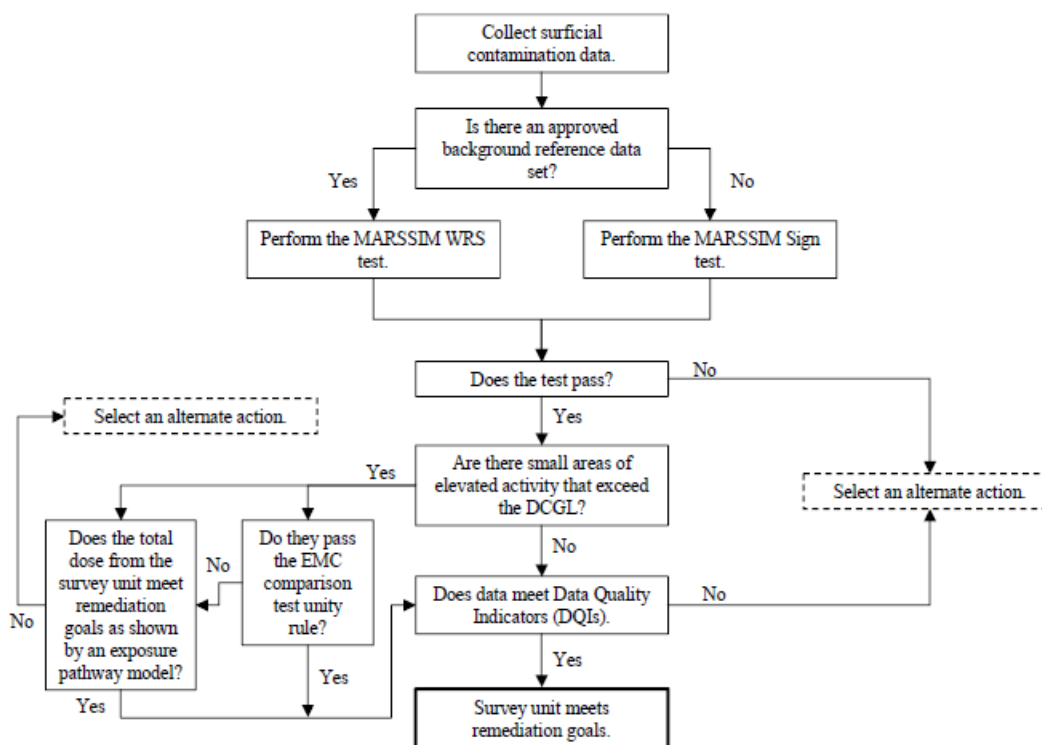


Table A-5. Structure or Consolidated Material Surfaces Remediation Goals and Their Evaluation Criteria

RG Type	RG
SLDS Structure or Consolidated Material Surfaces	Radiological scans and fixed-point measurements do not exceed 8,700 dpm/100 cm² total alpha radioactivity when averaged^a over 1 m². The calculation of this conservative (lowest) value is detailed in Appendix E. A total beta DCGL was not developed because the health-conservative total alpha surrogate DCGL ensures beta activity remains within the release criterion for the MED/AEC contaminant ratio at the SLDS and the wide variability in background beta activity of structural materials prevents an effective use of the beta DCGL. Structures and other consolidated materials left in place within excavation areas having surface activity levels that exceed this value may be released on a case-by-case basis only if an evaluation meets the DCGL_{EMC} (i.e., 23,000 or 69,000 dpm/100 cm² total alpha radioactivity when averaged over 50 m² or 10 m², respectively), a DCGL/ DCGL_{EMC} SOR is less than or equal to 1.0, a site-specific dose assessment documents that the SLDS ROD dose criteria are met and the appropriate statistical test passes. Structures outside of excavation areas will also be evaluated as described in this appendix. The average of the non-biased fixed-point measurements of external surfaces for a consolidated material survey unit (CMSU) does not exceed 8,700 dpm/100 cm² total alpha radioactivity. A release value for internal surfaces of occupied spaces has not been developed for use but could be developed if needed. Non-radiological COCs do not apply to surfaces of consolidated materials.
NC Structures or Consolidated Material Surfaces	Radiological scans and fixed-point measurements do not exceed 5,300 dpm/100 cm² of total alpha radioactivity when averaged^a over 1 m². The calculation of this conservative (lowest) value is detailed in Appendix D. The NC ROD provision for development of a property-specific value may be exercised as needed (USACE 2005a). The value for total beta radioactivity was too low to be distinguishable from background variations in beta measurements. Structures and other consolidated materials left in place within excavation areas having surface activity levels that exceed this value may be released on a case-by-case basis only if an evaluation meets the DCGL_{EMC} (i.e., 25,000 or 122,000 dpm/100 cm² total alpha radioactivity when averaged over 50 m² or 10 m², respectively), a DCGL/ DCGL_{EMC} SOR is less than or equal to 1.0, a site-specific dose assessment documents that the NC ROD dose criteria are met and the appropriate statistical test passes. Structures outside of excavation areas will also be evaluated as described in this appendix. The average of the non-biased fixed-point measurements for a CMSU does not exceed 5,300 dpm/100 cm² total alpha radioactivity. Non-radiological COCs do not apply to surfaces of consolidated materials.
Health Risk	See Tables 6 and 8 for health risk remediation goals and their evaluation criteria for SLDS and NC, respectively.
Dose	See Tables 6 and 8 for radiological dose remediation goals and their evaluation criteria for SLDS and NC, respectively.

^a Averaging over 1 m² and comparing to the DCGL is a simplified method of demonstrating compliance with a DCGL_{EMC}.

A-3.6 SPECIFY TOLERABLE LIMITS ON DECISION ERRORS

The null hypothesis states that residual radioactive surficial contamination exceeds the acceptance criterion.

In rejecting the null hypothesis, the alternative hypothesis must be accepted, and the finding would be that the SU meets the acceptance criterion.

The gray region represents a range of surficial contamination values where the consequences of decision errors are relatively minor. The upper bound of the gray region is defined as the DCGL,

and the LBGR is a site-specific variable that is initially selected to equal one half of the DCGL and is adjusted to provide an acceptable value for the relative shift.

The non-parametric WRS Test or the Sign Test will be used as appropriate in evaluating the residual contamination in the SU relative to the null hypothesis.

To enable testing of survey data relative to the acceptance criterion, the USACE has established acceptable decision errors for the SLS. These are shown in Table A-6.

The Type I decision error provides a 95 percent confidence level that the statistical tests will not incorrectly indicate that an SU satisfies acceptance criteria when, in fact, it does not. The Type II decision error provides a 75 to 95 percent confidence level that the statistical tests will not incorrectly indicate that an SU does not satisfy acceptance criteria when, in fact, it does. Type II errors are more a function of labor and survey costs and do not adversely impact public safety or health, and thus are subject to adjustment by the USACE as needed.

Table A-6. SLS Decision Errors

Error Type	Decision Error	Confidence Level
Type I Decision Error (α)	0.05	95%
Type II Decision Error (β)	0.25 to 0.05 (initially set to 0.20)	75% to 95%

A-3.7 OPTIMIZE THE DESIGN FOR OBTAINING DATA

Scoping surveys, field screening techniques, surface contamination scans, and the DQA process are used throughout the FSS process to focus efforts and to optimize costs.

Existing survey data should be reviewed in more detail if it appears that it could be used to support the survey design or if it might be of sufficient quality to be included in a FSS dataset. If existing data are going to be combined with new data to support a decision, then it should be determined if any gaps that can be filled or deficiencies that might be mitigated when designing the new data collection strategy exist.

THIS PAGE INTENTIONALLY LEFT BLANK

A-4.0 SURVEY PLANNING

This section provides the guidance to properly plan an FSS for surficial radioactive contamination at the SLS. The survey design, interpretation of survey results, assessment of the adequacy of the FSS design, and the assessment of data quality are described in subsequent sections.

A-4.1 IDENTIFY CONTAMINANTS

The SLS radiological COCs are described in Section A-3.3.1.

A-4.2 ESTABLISH DERIVED CONCENTRATION GUIDELINE LEVELS AND LIMITS

A-4.2.1 Surface Contamination Derived Concentration Guideline Level

The surface contamination DCGL is a derived, radionuclide-specific activity concentration within an SU corresponding to the release criterion (or RG). DCGLs may be expressed as a gross activity level or levels that reflect consideration of the radionuclide-specific mixtures that may be present. In general, the units for the surface contamination DCGL are the same as the units for measurements performed to demonstrate compliance (i.e., dpm/100 cm²). This allows direct comparisons between the survey results and the surface contamination DCGL.

The “surface contamination DCGL” may simply be referred to as the “DCGL” (and its variants, such as derived concentration guideline level for elevated measurement comparison [DCGL_{EMC}]) in the remainder of this appendix.

The DCGL is the average (or uniform) residual radioactivity concentration level within an SU that corresponds to the RG. Its use implies that consideration be given to the area of the SU that was considered during the dose modeling that was done to derive the DCGL. This is clarified in a later discussion of the elevated measurement comparison.

MARSSIM statistical tests refer to the DCGLs as the “acceptance criterion.” Statistical test results showing compliance with acceptance criterion indicate that residual risk levels are acceptable and the structure does not present a current or potential threat to human health and the environment.

A-4.2.2 Investigation Levels

ILs are based upon the DCGLs and are levels of radioactivity used to indicate when additional investigations may be necessary.

When an IL is exceeded, the first step is to confirm that the initial measurement actually exceeds the particular IL. This may involve taking further measurements. Depending on the results of the investigation, the SU may require reclassification, remediation, and/or resurvey.

ILs should generally be established as provided in Table A-7.

Table A-7. Final Status Survey Investigation Levels

SU Classification	Direct Measurement	Scanning Measurement
Class 1	> DCGL	> DCGL
Class 2	> DCGL	> 50% of the DCGL
Class 3	> 50% of the DCGL	> 25% of the DCGL

The USACE may direct that other ILs be used on a case-by-case basis.

A-4.2.3 Elevated Measurement Comparison

DCGLs are developed using exposure pathway models that assume a uniform distribution of contamination within the modeled SU area. While this represents an ideal situation, non-uniform conditions and small areas of elevated activity² exist in some instances. If a survey design were to rely solely on fixed-point surveying, a potential for small areas within an SU that are not detected and which may result in a residual dose exceeding the RGs exists. Scanning surveys are selected to detect such areas.

Small areas of elevated activity (i.e., exceeding the DCGL) may be acceptable in Class 1 SUs, provided that it can be shown that the RGs are still met. If an elevated spot is less than 1 m² in size, additional measurements may be collected within the 1 m² area to ensure the average over 1 m² meets the RG. The DCGL_{EMC} presents a simple method to evaluate areas 1 m² in size or greater.

The DCGL_{EMC} is simply the DCGL that has been modified to account for the smaller area of contamination. For example, the structure DCGLs for both the North St. Louis County Sites and the SLDS are developed to meet a primary limit (i.e., annual dose or a residual risk level) to a stated target population under a stated limiting scenario that assumed uniform contamination over a 180-m² area using dose and risk modeling software. That same model is then used to determine the DCGL for smaller areas (e.g., 50 m², 10 m²) that also meet RGs. Comparison of a small area of elevated activity directly to the DCGL_{EMC} allows rapid assessment of the acceptability of such an area.

The derivation of surrogate alpha DCGL_{EMC} values for the North St. Louis County Sites of 25,000 dpm/100 cm² for 50-m² areas and 122,000 dpm/100 cm² for 10-m² areas and for the SLDS of 23,000 dpm/100 cm² for 50-m² areas and 69,000 dpm/100 cm² for 10-m² areas is documented in Attachment A-1. The 50-m² surrogate alpha DCGL_{EMC} should be applied to small areas of elevated activity that are between 50 m² and 10 m² in size. The 10-m² surrogate alpha DCGL_{EMC} should be applied to small areas of elevated activity that are 10 m² or less in size.

If small areas of elevated activity are found in an isolated area, in addition to residual radioactivity distributed relatively uniformly across the SU, the unity rule (Section A-7.4, Equation A-14) is used to ensure the total dose or risk achieves RGs. If more than one of these areas exists, a separate term should be included in the calculation for each area of elevated radioactivity. As an alternative to the unity rule, the dose or risk from the actual residual radioactivity distribution can be calculated using an appropriate exposure pathway model.

The EMC is not applicable to Class 2 or 3 SUs because areas of elevated activity should not be present in such SUs. If small areas of elevated activity (exceeding the DCGL) are found, then the assumptions used to classify the SU may no longer be true, and the SU should be reclassified.

Refer to Section A-7.4 for the elevated measurement evaluation.

A-4.3 DETERMINE IF A STRUCTURE IS IMPACTED

A-4.3.1 General

This subsection contains guidelines for evaluating whether or not a structure has been impacted by MED/AEC activities. The evaluation is made based upon historical information and current site

² Commonly referred to as a scan-biased location.

data. Structures determined to be non-impacted are not subject to FSSs. The impact determination for a structure is subject to USACE review and concurrence.

Per MARSSIM guidance, an impacted area is an “area with a possibility of containing residual radioactivity in excess of natural background or fallout levels.” Non-impacted areas, by contrast, are those “areas where there is no reasonable possibility (extremely low probability) of residual contamination” (DoD 2000).

A-4.3.2 Background and Basis for Decisions

Some of the modes by which a structure might be contaminated are provided in Table A-8.

Table A-8. Modes of Potential Structure Contamination

Mode	Detected By
Used for processing MED/AEC materials	Structure history and site reconnaissance
Accidental or unauthorized dumping of contaminated soil nearby	Evaluation of the surrounding land area
Landscaping, regrading, or general soil movement	Evaluation of the surrounding land area
Surface water runoff	Evaluation of the surrounding land area
Flooding	Evaluation of the surrounding land area
Windborne contamination	Structure history and site reconnaissance
Underground preferential pathway(s)	Evaluation of the surrounding land area
Brought in by foot traffic	Evaluation of the surrounding land area
Built on or buried in contaminated soil	Evaluation of the surrounding land area

Inspection of Table A-8 reveals that seven of nine modes by which a structure might be contaminated at the SLS are closely related to soil contamination. As a result, the land area surrounding a structure will generally be investigated prior to focusing on the structure itself. This approach will yield the most valuable information about the potential for a structure to be impacted and is the basic premise of the remainder of this subsection.

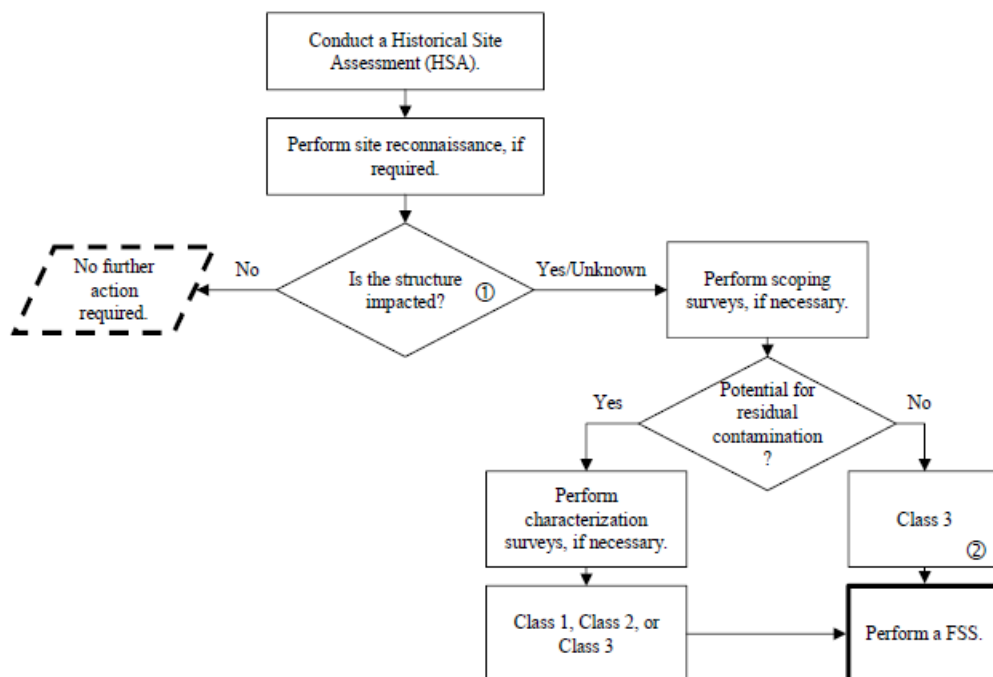
Note the following for the remaining two modes of structure contamination.

- A structure used for processing AEC/MED material is likely impacted.
- Under some circumstances, the exterior of structures, and especially the roof area of buildings, may have become contaminated from windborne contamination from contaminated soil or from dust along the soil haul routes. Experience shows that this mode requires that significant soil contamination levels be present to be a concern.

Reconnaissance surveys may be performed to confirm if the status of the structure as impacted or non-impacted.

Each impacted structure will generally be evaluated individually unless sufficient evidence to combine structures for the purpose of FSSs exists. Various parts (i.e., exterior, interior, foundation, separate rooms, etc.) of structures may be related with respect to potential contamination; thus, specific portions of a structure may be designated as impacted or non-impacted.

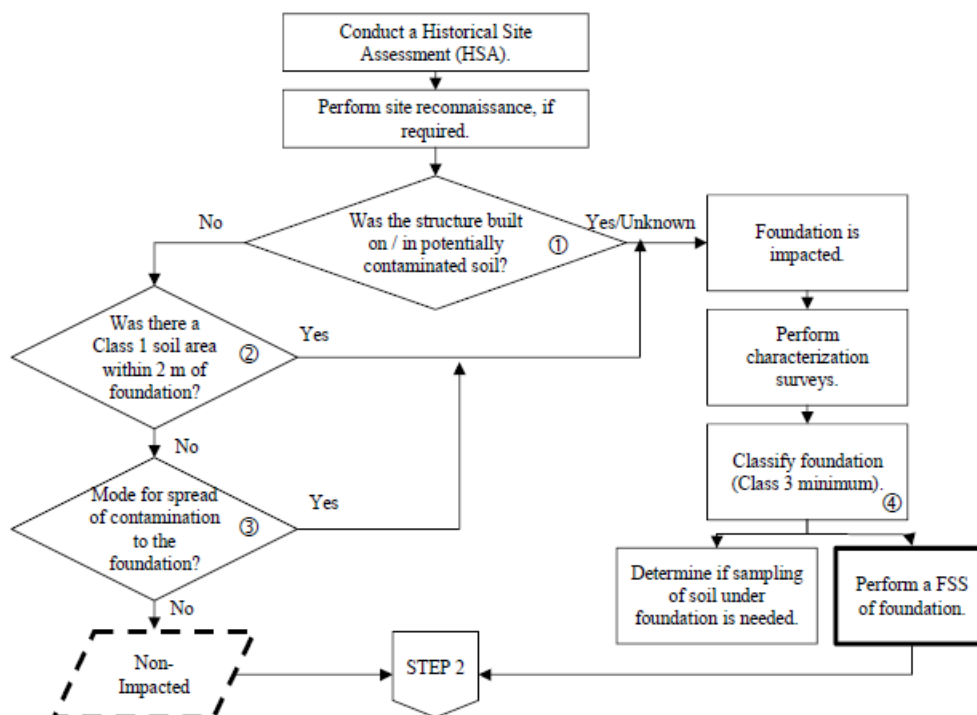
The general process for designating structures or portions of structures as impacted or non-impacted is illustrated in Image A-2. Buildings are evaluated using a three-part method. Non-building structures are evaluated separately. Specific guidance is provided in subsequent subsections of this document.

Image A-2. Overview of the Impact Determination**Comment**

- ① MARSSIM guidance suggests this decision might be based upon the results of an HSA alone.
- ② If the impacted status of a structure is unknown, the null hypothesis dictates that the assumption of impact be made. In this event, some amount of an FSS must be performed.

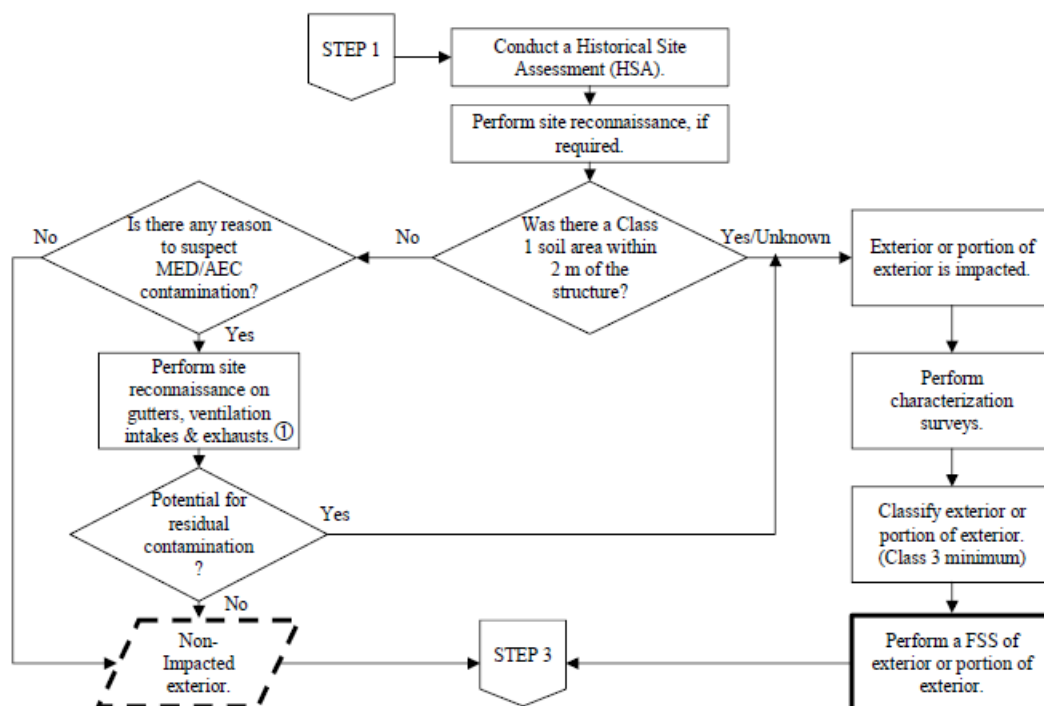
A-4.3.3 Buildings

Building structures are evaluated via a three-part review process. The building's foundation, exterior, and interior may all have varying potential for residual radioactive contamination and must be considered separately. The evaluation is performed by use of the flowcharts on Images A-3, A-4, and A-5 in sequential order.

Image A-3. Determining the Impact on Buildings, Step 1 Consider the Foundation**Comment**

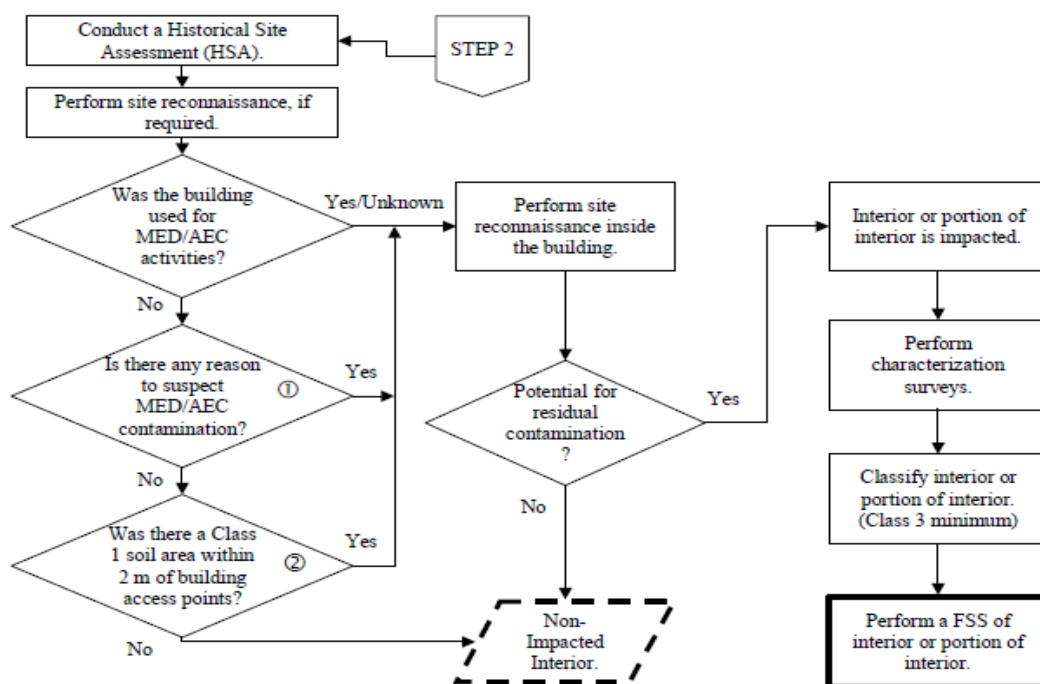
- ① The HSA is the primary data source for this question because the surrounding land area is assumed to have already been evaluated. For example, if the surrounding land area is Class 2 and no contamination exceeding the soil DCGL was found, then the answer to this question is no, unless history indicated the building was built over a burial ground or some other feature where contamination may be present.
- ② If soil exceeding the soil DCGL was located adjacent to the foundation, then contamination might have been spread to the foundation. A distance of 2 m represents a reasonable distance where this mechanism might occur.
- ③ Do indications that some process might have contributed to a spread of contamination to the foundation exist?
- ④ If a building is impacted, some amount of an FSS must be conducted.

Image A-4. Determining the Impact on Buildings, Step 2 Consider the Exterior



Comment

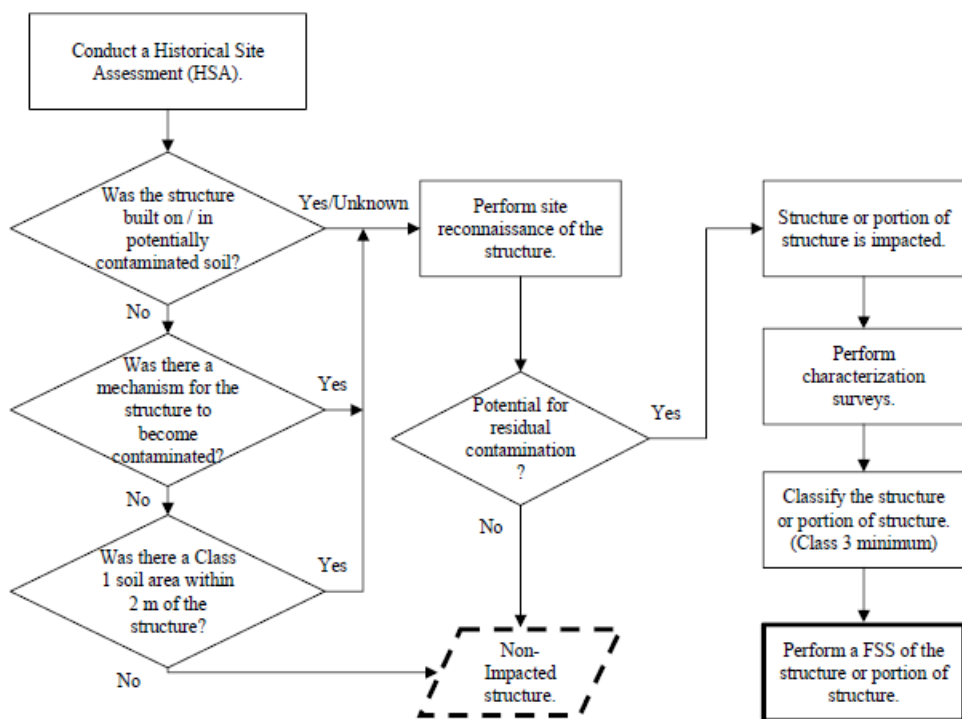
① Some buildings may be impacted by airborne contamination from soil handling or hauling. Experience at North St. Louis County Sites VPs indicate soil contamination levels must be relatively high for this to impact a structure's exterior.

Image A-5. Determining the Impact on Buildings, Step 3 Consider the Interior**Comment**

①&② Structure interiors, which were not used in the handling of radioactive material, may have been inadvertently contaminated because of physical transport of contamination. For example, foot traffic, vehicles, and equipment may have transported contamination from other areas of the site. This is especially a concern if the soil just outside of a building was contaminated and the distance to travel was short.

A-4.3.4 Non-Building Structures

Non-building structures are evaluated to determine the potential for the impact based on contamination within surrounding soil. The evaluation is performed by use of Image A-6.

Image A-6. Determining the Impact on Non-Building Structures

A-4.4 CLASSIFY AREAS BY CONTAMINATION POTENTIAL

Site areas are classified using the guidance provided in Section A-3.3.2 and using the classification guidance from Table A-2 in Section A-3.3.2.

As a survey progresses, re-evaluation of this classification may be necessary based on newly acquired survey data.

A-4.5 GROUP/SEPARATE AREAS INTO SURVEY UNITS

An SU is a physical area consisting of structures or portions of a structure of specified size and shape for which a separate decision will be made as to whether or not that area exceeds the criterion. The SU is the primary entity for demonstrating compliance with the release criterion.

An SU will not include areas that have different classifications. The SU's characteristics should be generally consistent with the exposure pathway modeling that was used to derive DCGLs.

Indoor areas may also be subdivided into several SUs of different classification, such as separating floors and lower walls from upper walls and ceilings (and other upper horizontal surfaces) or subdividing a large warehouse based on floor area.

Define SUs as outlined in Section A-3.4 and using the SU sizing guidelines from Table A-4 in Section A-3.4.

A-4.6 SELECT A BACKGROUND REFERENCE AREA DATASET

If the contribution of naturally occurring levels of the radiological COCs is to be subtracted from survey measurements (through application of the WRS Test), a background reference area dataset must be identified for use.

Development, review, and approval of background area reference datasets are beyond the scope of this appendix.

The USACE must pre-approve the use of any background reference area dataset in the FSSE process on an area-specific basis and must approve the final background reference area dataset to be used.

A-4.7 PREPARE SITE FOR SURVEY ACCESS

A right-of-entry must be obtained before entering the site and maintained throughout the survey process. All appropriate parties should be notified of the survey schedule.

The right-of-entry should include information relative to the following additional topics, where applicable (with much of this beyond the scope of a right-of-entry and informally coordinated with property owners):

- Security concerns, locking of the facility, and key control, where applicable;
- How grids, survey locations, and surface nomenclature may be marked (or not marked) on survey surfaces;
- What may and may not be moved, repositioned, or dismantled to gain access for survey, and the corresponding notification requirements;
- Cleanliness needs for survey execution and responsibilities for achieving this level of cleanliness; and
- Roof access requirements and special considerations for that access.

A-4.8 ESTABLISH SURVEY LOCATION REFERENCE SYSTEM

A reference coordinate system may be used to facilitate selection of measurement and survey locations, and to provide a mechanism for referencing a measurement to a specific location so that the same survey data point can be relocated.

The reference coordinate system might be established such that the grid spacing satisfies the survey design requirements of Section A-5.2 (and therefore the grid intersections correspond to the survey data point locations) for Class 1 and Class 2 SUs. For Class 3 SUs, where the survey data points are randomly selected, a base reference coordinate system might be established with grid spacing of some fixed value (e.g., as 1 m) or measured distance from a starting point (e.g., southwest corner of the room). Other survey data point locating strategies may be used as the situation and the available technology dictates.

A reference coordinate system consists of a grid of intersecting lines, referenced to a fixed site location or benchmark. The reference coordinate system used for a particular survey should provide a level of reproducibility consistent with the objectives of the survey.

Reference coordinate system patterns may be identified numerically on one axis and alphabetically on the other axis. The origin of such systems is generally started at the southwestern-most corner

of the room or area being investigated. Overhead measurement and survey locations (e.g., ceiling and overhead beams) are referenced to corresponding floor grids. Alternatively, distances in the northern and eastern direction from the southwest corner (or other designated location) may be used to provide a room or area northing and easting distance from the designated location (e.g., southwest corner) especially when using random points for a Class 3 SU.

Reference coordinate systems on structures may be marked by chalk line or paint along the entire grid line or at grid intersections or taped at grid intersections. Permission of the structure owner(s), where applicable, should be obtained prior to using any permanent marking system, and consideration should be given to weathering concerns.

The process used to develop the reference coordinate system should be recorded in the survey planning documentation.

The reference coordinate system does not dictate the spacing or location of survey measurements.

A-5.0 SURVEY DESIGN

A-5.1 DETERMINE NUMBER OF DATA POINTS NEEDED

A-5.1.1 Specify Decision Errors

Values for the decision errors are provided in Table A-6 of Section A-3.6.

A-5.1.2 Estimate the Dataset Standard Deviation

An estimate of the standard deviation (σ) of the gross contamination levels in the SU will likely be available from previous survey data (e.g., scoping or characterization survey data for un-remediated SUs or RA support surveys for remediated SUs). If such data are not available, the following steps may be necessary:

- Perform some limited preliminary measurements (approximately 5 to 20) to estimate the distributions;
- Make a reasonable estimate based on available site knowledge; and
- Estimate a value on the order of approximately 30 percent (0.30) based on experience.

In any case, overestimating the value for σ is preferable. If the value is grossly underestimated, the number of data points will be too few to obtain the desired power for the statistical test.

A-5.1.3 Calculate Relative Shift

The LBGR was established in Section A-3.6 and is initially set as one half of the DCGL or using the mean of existing data.

The shift (Δ) is defined as the width of the gray region, as shown in Equation A-2.

Equation A-2 – The Shift

$$\Delta = DCGL_W - LBGR$$

The relative shift (Δ/σ) is an expression of the resolution of the measurements in units of measurement uncertainty. The relative shift is calculated as shown in Equation A-3.

Equation A-3 – The Relative Shift

$$\text{Relative Shift} = \frac{\Delta}{\sigma}$$

The LBGR should be adjusted, as necessary, to achieve a value for the relative shift between 1.0 and 3.0.

A-5.1.4 Obtain Number of Data Points

The number of data points is calculated differently, depending on the statistical test to be applied. Select one method from the following two subsections.

A-5.1.4.1 Wilcoxon Rank Sum Test

The WRS Test is used when background measurements are available, and background measurements will be subtracted from FSS data point measurements.

The probability that a random measurement from an SU exceeds a random measurement from the background reference area by less than the DCGL when the SU median is equal to the LBGR exceeding background is defined as (P_r).

A value for P_r is selected from Table A-9 based on the relative shift.

Table A-9. Values of P_r When the WRS Test Is Used

Δ/σ	P_r	Δ/σ	P_r
0.1	0.528182	1.4	0.838864
0.2	0.556223	1.5	0.855541
0.3	0.583985	1.6	0.871014
0.4	0.611335	1.7	0.885299
0.5	0.638143	1.8	0.898420
0.6	0.664290	1.9	0.910413
0.7	0.689665	2.0	0.921319
0.8	0.714167	2.25	0.944167
0.9	0.737710	2.5	0.961428
1.0	0.760217	2.75	0.974067
1.1	0.781627	3.0	0.983039
1.2	0.801892	3.5	0.993329
1.3	0.820978	4.0	0.997658

The next step is to determine the decision error percentiles, $Z_{1-\alpha}$ and $Z_{1-\beta}$, represented by the selected decision error levels, α and β , for Type I and Type II errors, respectively. The decision error percentiles are selected from Table A-10.

Table A-10. Percentiles Represented by Selected Values of α and β Errors

α (or β)	$Z_{1-\alpha}$ (or $Z_{1-\beta}$)	α (or β)	$Z_{1-\alpha}$ (or $Z_{1-\beta}$)
0.005	2.576	0.10	1.282
0.01	2.326	0.15	1.036
0.015	2.241	0.20	0.842
0.025	1.960	0.25	0.674
0.05	1.645	0.30	0.524

Finally, calculate the number of data points (N) using Equation A-4.

Equation A-4 – Calculate N for the WRS Test

$$N = \frac{(Z_{1-\alpha} + Z_{1-\beta})^2}{3 (p_r - 0.5)^2}$$

where:

N = the number of data points

P_r = the probability that a random measurement from an SU exceeds a random measurement from the background reference area by less than the DCGL

$Z_{1-\alpha}$ = the decision error percentile for a Type I error

$Z_{1-\beta}$ = the decision error percentile for a Type II error

The number of data points (N) determined in Equation A-4 should be increased by 20 percent and rounded up to account for missing or unusable data.

N is the total number of data points for each SU/reference area combination. The N data points are divided between the SU (n) and the reference area (m). Generally, one half of the data points are

assigned to the SU and the remainder to the reference background area. Therefore, $n = N/2$, and (n) data points should be taken in the SU.

MARSSIM calculations can result in an unreasonably high or low data point density. In any case, a maximum of 100 data points³ and a minimum of 10 data points will be taken in each SU area.

A-5.1.4.2 Sign Test

The Sign Test is selected when background measurements will not be subtracted from the FSS data point measurements.

When a background reference area will not be subtracted from survey measurements, the contaminant levels may be compared directly with the DCGL value.

Sign p is the estimated probability that a random measurement from the SU will be less than the DCGL when the SU median is actually at the LBGR. The value of Sign p is based upon the relative shift and is taken from Table A-11.

Table A-11. Values of Sign p

Δ/σ	Sign p	Δ/σ	Sign p
0.1	0.539828	1.2	0.884930
0.2	0.579260	1.3	0.903199
0.3	0.617911	1.4	0.919243
0.4	0.655422	1.5	0.933193
0.5	0.691462	1.6	0.945201
0.6	0.725747	1.7	0.955435
0.7	0.758036	1.8	0.964070
0.8	0.788145	1.9	0.971284
0.9	0.815940	2.0	0.977250
1.0	0.841345	2.5	0.993790
1.1	0.864334	3.0	0.998650

Next, determine the decision error percentiles, $Z_{1-\alpha}$ and $Z_{1-\beta}$, represented by the selected decision error levels, α and β , respectively. The decision error percentiles are selected from Table A-10.

Finally, calculate the number of data points (n) using Equation A-5.

Equation A-5 – Calculate n for the Sign Test

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

where:

n = the number of data points

Sign p = the estimated probability that a random measurement from the SU will be less than the DCGL when the SU median is actually at the LBGR

$Z_{1-\alpha}$ = the decision error percentile for a Type I error

$Z_{1-\beta}$ = the decision error percentile for a Type II error

The number of anticipated data points should be increased by at least 20 percent to allow for missing or unusable data.

³ Roughly equivalent to 1 m grid spacing using a triangular grid in a Class 1 SU.

MARSSIM calculations can result in an unreasonably high or low data point density. In any case, a maximum of 100 data points⁴ and a minimum of 10 data points will be taken in each 100-m² SU area.

A-5.2 DETERMINE SPACING FOR THE SURVEY UNIT

The grid spacing for Class 1 or Class 2 SUs is estimated in one of two ways, depending on the intended shape of the grid.

If a triangular grid is used (preferred), the grid spacing (L) is estimated using Equation A-6.

Equation A-6 – Triangular Grid Spacing

$$L = \sqrt{\frac{(A)}{(0.866)(n)}}$$

where:

A = the surface area in the SU

n = the number of data point to be taken

If a square grid is used, the spacing (L) is estimated using Equation A-7.

Equation A-7 – Square Grid Spacing

$$L = \sqrt{\frac{(A)}{(n)}}$$

where:

A = the surface area in the SU

n = the number of data point to be taken

Areal units or measurement must be used consistently throughout either equation.

The nodes or center of the grid are used as the Class 1 or Class 2 data point locations. The grid lines may be lettered and numbered to form a reference coordinate grid, when a grid system is to be used.

A-5.3 SMALL AREAS OF ELEVATED ACTIVITY

This section is not applicable to Class 2 or Class 3 areas because small areas of elevated activity are not expected.

The WRS Test and the Sign Test evaluate whether or not the residual radioactivity in an area exceeds the DCGL for contamination conditions that are approximately uniform across the SU. These tests may not correctly assess compliance with RGs when small areas of elevated activity are present. Scanning is used to obtain adequate assurance that small areas of elevated activity are identified. If such areas are found, the DCGL_{EMC} may be used to evaluate their impact.

If a scanning technique's MDC is inadequate, then the systematic survey grid spacing may need to be reduced to increase the probability of detecting the small areas of elevated activity.

⁴ Roughly equivalent to 1 m grid spacing using a triangular grid in a Class 2 SU.

Within the SLS, the DCGLs will generally be such that the scan MDC will be approximately equal to or less than the DCGL; therefore, grid spacing corrections will not be required. The USACE will provide direction when such corrections are required.

A-5.4 SCAN COVERAGE REQUIREMENTS

Surface contamination scanning requirements are discussed in Section A-3.3.2. Table A-3 of that section provides guidance on the degree of scanning coverage to be provided based upon the SU classification.

A-5.5 QUALITY ASSURANCE/QUALITY CONTROL MEASUREMENTS

A-5.5.1 Quality Control Duplicates

MARSSIM Section 7.2.2.1 states, “Determining precision by replicating measurements with results at or near the detection limit of the measurement system is not recommended because the measurement uncertainty is usually greater than the desired level of precision” (DoD 2000). Based on experience, structure surveys by direct measurement and scan are typically near the detection limit and below half of the release criterion.

For direct measurement and scan surveys of structures, precision, or reproducibility, is best assessed by source response checks. As stated in American National Standards Institute (ANSI) N232A-1997, *Radiation Protection Instrumentation Test and Calibration, Portable Survey Instruments*, instruments “shall be checked with a source during operation at least daily or prior to each intermittent use, whichever is less frequent. If at any time the instrument response to the source differs from the reference reading by more than ± 20 percent (for any photon instrument the reading should be at least ten times background), the instrument shall be returned to the calibration facility for calibration or for maintenance, repair, and recalibration, as required” (ANSI 1997). MARSSIM Section 6.5.4 identifies that an instrument with a difference of more than ± 20 percent during source checks should not be used. MARSSIM Section 6.5.4 also identifies instrument source checks prior to daily use and states that a source check “following use may also provide valuable information” (DoD 2000). Daily pre-use and post-use source checks will be performed.

A-5.5.2 Instrument Performance Checks

Survey instruments shall be verified to be operable and to be performing within established tolerances on each day that they are used. The results of such checks will be documented.

The minimum checks required include the following.

- The background count rate.
- The count rate of a calibrated, National Institute of Standards and Technology (NIST)-traceable check source.

The instrument performance checks should be performed both prior to survey measurements and immediately following the completion of the survey measurements for that work shift or prior to use the following workday.

Survey personnel are responsible for verifying survey instrument compliance with established tolerances prior to use of the survey instrument. Additionally, compliance will be reviewed during the DQA of the survey data, as discussed in Section A-7.1.

A-5.5.3 In-Process Quality Control Checks

The performance of a survey instrument may degrade during use of the instrument. Proportional counters are particularly sensitive to changes in temperature, humidity, gas quality, and gas flow. Scintillation detectors may show large changes in the count rate with minute light-leaks in the mylar window of the detector. The surveyor should be alert for these conditions and should immediately halt the survey when any abnormal instrument response is suspected. Instrument operability may be quickly assessed in the field by performing a 1-minute field background count and comparing the result to the field background counts taken at the start of the survey. A difference exceeding 20 percent or 3 standard deviations, as applicable, is suspect; and additional investigation should be initiated; and the data collected since the last check should be evaluated to ensure its acceptability.

The results of any such in-process field background QC checks should be documented, whether acceptable or unacceptable, in FSS documentation and/or instrument response check paperwork.

A-5.6 LABORATORY ANALYSIS

The investigation of unusual conditions or circumstances may necessitate the collection of media samples to verify the presence or absence of the radiological COCs or to determine/verify their relative ratios. Sampling will be performed in accordance with the applicable existing sampling procedures approved for the SLS.

Samples will be transferred to a USACE-certified radio-analytical laboratory for analyses in accordance with documented laboratory-specific standard methods and the SAG.

USACE notification shall be made prior to the collection of media samples for laboratory analysis. Laboratory results and documentation of the sample location and reason for the sampling should be included in the FSS records.

A-6.0 SURVEY INSTRUMENTATION

A-6.1 INSTRUMENT SELECTION

A variety of radiological survey instruments and configurations are available for use in the conduct of FSS data collection. General performance requirements for instrumentation are provided in Sections A-3.3.2 and A-3.3.3.

The choice of detector type, instrument efficiency, probe size, and scanning speed must be carefully considered to ensure DQOs will be met.

A-6.2 INSTRUMENT EFFICIENCY

The instrument efficiency (ϵ_i) is used in calculations that convert the instrument response (in cpm) to units of the DCGL. The instrument efficiency is determined at the time of calibration and is verified regularly as part of instrument performance checks.

A-6.3 SURFACE EFFICIENCY

The surface efficiency (ϵ_s) provides a correction factor to account for the adverse impact that a survey surface may have on the ability to detect surface contamination. This factor is also used in calculations that convert the instrument response (in cpm) to units of the DCGL.

A more detailed discussion of surface efficiency can be found in NUREG-1507, *Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions* (NRC 1998).

Although several values for experimentally derived surface efficiencies are provided in NUREG-1507, many data gaps exist, and the experimental conditions may not be indicative of field conditions at the SLS. Based on these factors, NUREG-1507 guidance recommended International Organization for Standardization (ISO) 7503-1 values for surface efficiency will be used to the extent appropriate by both RACs and FSS personnel (NRC 1988). ISO 7503-1 values are provided in Table A-12.

Table A-12. Surface Efficiencies

Radiation Type	Maximum Energy	Surface Efficiency (ϵ_s)
Beta	> 0.4 MeV	0.5
Beta	0.15 to 0.4 MeV	0.25
Alpha	Not applicable	0.25

A-6.4 STATIC MINIMUM DETECTABLE CONCENTRATIONS

The FSS data point (i.e., “fixed-point”) survey measurements may also be referred to as “static” measurements.

Prior to performing field measurements, an investigator must evaluate the detection sensitivity of the equipment proposed for use to ensure that levels less than the DCGL can be reliably detected.

The minimum level of surficial contamination that may be reliably measured at a specified confidence level (95 percent), based upon characteristics of the detection system and the counting parameters, converted to units of the DCGL is known as the MDC. This is an a priori value⁵.

Guidance for the determination of the MDC may be found in the following documents:

- NUREG-1507, *Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions* (NRC 1998); and
- MARSSIM (DoD 2000).

Requirements for the static MDC are provided in Section A-3.3.3. The static MDC (in units of dpm/100 cm²) may be calculated using Equation A-8.

Equation A-8 – Static MDC

$$\text{Static MDC} = \frac{3 + 3.29 \sqrt{(R_b)(t_g) \left(1 + \frac{t_g}{t_b}\right)}}{(t_g)(\varepsilon_i)(\varepsilon_s) \left(\frac{\text{Probe Area}}{100}\right)}$$

where:

- R_b = the background count rate (cpm)
- t_b = the background count time (minutes)
- t_g = the survey count time (minutes)
- ε_i = the instrument efficiency (cpm/dpm)
- ε_s = the surface efficiency
- Probe Area = the open area of the detector face (cm²)

A-6.5 BETA SCAN MINIMUM DETECTABLE CONCENTRATIONS

The ability to identify a small area of elevated activity during scanning is dependent upon the surveyor's skill in recognizing an increase in the audible or display output of an instrument. The ability of a surveyor to detect a pre-determined level of contamination with a detector is called the "scanning sensitivity."

The scanning sensitivity for a given situation can be improved with the following approaches:

- Select an instrument with a higher instrument efficiency or a lower background,
- Decrease the scanning speed, or
- Increase the size of the effective probe area without increasing the background.

The probability of detecting residual contamination in the field depends not only on the sensitivity of the survey instrumentation but is also affected by the surveyor's ability (i.e., human factors).

The beta scan MDC (in units of dpm/100 cm²) may be calculated using Equations A-9, A-10, and A-11.

When calculating the beta scan MDC, the index of detectability (d') will be set at a value of 1.38, and the surveyor efficiency⁶ (p) will be assumed to be 0.50.

⁵ An a priori value is calculated before the parameters that are specific to a particular sample are known.

⁶ These values were pre-established in this FSSP and are repeated here for consistency.

Equation A-9 – The Observation Interval

$$i = \frac{w}{s}$$

where:

i = the time that the probe face is exposed to a point of contamination (second)

w = the probe face width, in the direction of scanning (cm)

s = the scan speed (cm/second)

Equation A-10 – The Minimum Detectable Count Rate (MDCR, in cpm)

$$MDCR = d' \sqrt{b \left(\frac{i}{60} \right)} \left(\frac{60}{i} \right)$$

where:

d' = the index of detectability (i.e., 1.38)

b = the background count rate (cpm)

i = taken from Equation 9 (second)

Equation A-11 – The MDC for Scans

$$\text{Scan MDC} = \frac{MDCR}{(\sqrt{p})(\varepsilon_i)(\varepsilon_s) \left(\frac{\text{Probe Area}}{100} \right)}$$

where:

$MDCR$ = the minimum increase exceeding background that can be seen reliably, taken from Equation A-10 (cpm)

p = the surveyor efficiency (i.e., 0.5)

ε_i = the detector efficiency (cpm/dpm)

ε_s = the surface efficiency

Probe Area = the open area of the detector face (cm²)

Requirements for the beta scan MDC are provided in Section A-3.3.2. Scan parameters should be adjusted such that the scan MDCs meet the guidelines provided.

A-6.6 ALPHA SCAN PROBABILITY

Scanning for alpha emitting radionuclides differs significantly from scanning for beta and gamma emitters in that the expected background response of most alpha detectors is very close to zero. Instead, determining the probability of detecting an area of contamination at a predetermined DCGL for given scan rates is more useful.

Given a known scanning rate and a surface contamination IL, the probability of detecting a single count while passing over the contaminated area is provided in Equation A-12.

Equation A-12 – Alpha Scan Probability

$$P(n \geq 1) = 1 - e^{\frac{(-G)(\varepsilon_i)(d)}{(60)(v)}}$$

where:

P = the probability of observing a single count

G = the IL (dpm/100 cm²)

ε_i = the detector efficiency (cpm/dpm)

d = the width of the detector face in the direction of scan (cm)

v = the scan speed (cm/second)

When a single count is detected, the surveyor should pause over the suspect area for approximately 10 seconds (or a sufficient time to determine if a measurement would exceed the IL) while continuing to monitor the instrument's audible and visual response. If additional counts are seen, this situation may warrant a static measurement in the area to determine the true contamination level.

Requirements for the alpha scan probability are provided in Section A-3.3.2. Scan parameters should be adjusted such that the alpha scan probability meets the guidelines provided.

A-7.0 INTERPRETATION OF SURVEY RESULTS

This section discusses the interpretation of surficial contamination FSS results.

A-7.1 DATA QUALITY ASSESSMENT

A DQA is a scientific and statistical evaluation that determines if the data are of the right type, quality, and quantity to support their intended use. Detailed guidance for the DQA process is provided in *Guidance for Data Quality Assessment* (USEPA 2000b).

The effort expended during the DQA evaluation should be consistent with the graded approach used in designing the survey.

A-7.2 REVIEW THE DATA QUALITY OBJECTIVES AND SAMPLING DESIGN

The survey design and data collection documentation should be reviewed for consistency with DQOs. For example, the review should check that the appropriate number of samples were taken in the correct locations, and that they were measured with instruments of the appropriate sensitivity.

A-7.3 CONDUCT A PRELIMINARY DATA REVIEW

The survey results should be converted to units of the DCGL using Equation A-13. Automated software applications are frequently employed to speed the process and eliminate simple math errors.

Equation A-13 – Calculate Results in Units of the DCGL

$$\text{Result} \left(\frac{\text{dpm}}{100\text{cm}^2} \right) = \frac{(R_g) - (R_b)}{(\varepsilon_i)(\varepsilon_s) \left(\frac{\text{Probe Area}}{100} \right)}$$

where:

R_g = the static data point gross count rate (cpm)

R_b = the average field background count rate (cpm)

ε_i = the instrument efficiency (cpm/dpm)

ε_s = the surface efficiency

Probe Area = the open area of the detector face (cm²)

The survey results should then be inspected for obvious outliers, trends, values that clearly exceed the DCGL, and indicators of inconsistent results. Basic statistical quantities such as the mean, median, and sample standard deviation may be calculated to develop an overall picture of the SU.

The value of the sample standard deviation is especially important. If it is too large compared to that assumed during the survey design, this may indicate an insufficient number of samples were collected to achieve the desired power for statistical testing. Inadequate power can lead to unnecessary remediation.

Unusual or unexpected results should be investigated. Results that exceed the DCGL should be investigated and additional field measurements performed to accurately estimate the magnitude and areal extent of area(s) of elevated activity. This will facilitate comparison to the EMC.

A-7.4 EVALUATE SMALL AREAS OF ELEVATED ACTIVITY

Survey measurements that exceed the DCGL may not necessarily indicate that RGs have not been met for the SU. If one or more measurements exceed the DCGL, three options are available to assess compliance.

- If the area is less than 1 m² in size, additional measurements can be made within the 1-m² area to verify the average result over 1 m² is less than the RG.
- Small areas of elevated activity 1 m² in size and greater can be compared to the DCGL_{EMC}.
- An exposure pathway model can be run to determine the total dose from residual radioactive contamination in the SU.

A-7.4.1 Comparison to the Elevated Measurement Comparison

The EMC is performed for survey measurements that exceed the DCGL. The EMC is performed for both measurements obtained on the systematic-sampling grid and for locations flagged by scanning measurements. If a measurement passes the EMC, then the small area(s) of elevated activity are acceptable and the SU may pass the FSS evaluation, pending acceptable completion of other tests.

Values for the DCGL_{EMC} are based on the area of the elevated activity and are provided in Section A-4.2.3.

If a single small area of elevated activity within the SU exists, the process for the EMC is as follows.

- Determine the area of the elevated activity.
- Determine the average concentration of residual radioactive contamination in the area of elevated activity, in units of the DCGL.
- Find the value of the DCGL_{EMC} that corresponds to the area of the elevated activity. If no DCGL_{EMC} corresponds to the area of the elevated activity, then select the DCGL_{EMC} that corresponds to the next larger area of the elevated activity (e.g., for EMC areas less than 10 m², use the DCGL_{EMC} for 10 m²).
- Compare the average concentration in the small area of elevated activity directly to the selected DCGL_{EMC}. If the DCGL_{EMC} is greater than the average activity, then the small area passes the EMC.

If the DCGL_{EMC} is used for small areas of elevated activity within the SU, the unity rule must be applied. The process for applying the unity rule is as follows (refer to Equation A-14).

- Determine the area for each location of elevated activity.
- Determine the average concentration of residual radioactive contamination in each area of elevated activity, in units of the DCGL.
- Find the value of the DCGL_{EMC} that corresponds to each area of elevated activity.
- Determine the remaining area of the SU (i.e., subtract the total of all areas of elevated activity from the SU area).

- Calculate the mean ($\bar{x}$) of the residual radioactive contamination in that remaining area of the SU.
- Apply Equation A-14. If the result is less than or equal to 1.0, then the SU passes the EMC.

Equation A-14 – The Unity Rule

$$\frac{C_1}{DCGL_{EMC1}} + \frac{C_2}{DCGL_{EMC2}} + \dots + \frac{C_n}{DCGL_{EMCn}} + \frac{C_x}{DCGL} \leq 1.0$$

where:

C_n = the concentration in the small area (dpm/100 cm²)

$DCGL_{EMCn}$ = the $DCGL_{EMC}$ value based upon the area of the small area of elevated activity (dpm/100 cm²)

C_x = the mean of the concentration in the remainder of the SU (dpm/100 cm²)

$DCGL$ = the site-specific $DCGL$

A-7.4.2 Use of an Exposure Pathway Model

Survey data can be entered into an exposure pathway model to calculate the annual dose to the target population. In general, the same model and assumptions are used as were used to derive the $DCGL$ s initially. This option should be used only with prior USACE approval.

A-7.5 REVIEW DATA QUALITY INDICATORS

DQIs are established to quantify the amount of error in the data collection process and the analytical measurement system.

The following DQIs have been established for surficial contamination FSSs:

- Calibration checks to assess precision, accuracy, and instrument bias;
- Background measurement to estimate bias caused by instrument contamination;
- Other – minimum acceptable instrument efficiency;
- Other – static MDC;
- Other – beta scan MDC; and
- Other – alpha scan probability.

Acceptance criteria for the DQIs are provided in Table A-13.

Table A-13. Data Quality Indicator Summary

DQI Parameter	Purpose	Criteria
Precision, Accuracy, and Bias (Instrument, calibration check)	Check to ensure that the instrument is responding properly.	Value is no more than +20 percent of the counts on a known source (that were determined after calibration).
Bias (Contamination, background check)	Check of the instrument counting rate in office conditions to verify that the detector has not become contaminated.	±3 standard deviations or within 20 percent (whichever is applicable) from the background value determined during instrument setup after calibration.
Instrument Efficiency (ε)	Check to ensure that the instrument will provide adequate field response to radiation.	Generally ≥ 0.15

Table A-13. Data Quality Indicator Summary (Continued)

DQI Parameter	Purpose	Criteria
Static MDC	Verify that instrument has adequate resolution.	$\leq$ DCGL. Target of 10 to 50 percent of the DCGL.
Beta Scan MDC	Verify that scans can detect small areas of elevated activity.	$\leq$ DCGL, where feasible.
Alpha Scan MDC	Verify that scans can detect small areas of elevated activity.	Probability of detecting a single count ≥ 0.85 .

Survey data and instrument check-in sheets should be reviewed to verify that DQIs were met. Out-of-tolerance values should be investigated and evaluated. If a DQI is found to have not been met, then the USACE should be contacted for a determination of the adequacy of related FSS data.

A-7.6 VERIFY FINAL STATUS SURVEY DESIGN

An evaluation is performed to determine that the data are consistent with the underlying assumptions of the survey design. Specifically, the procedures described in Section A-5.0 are re-performed with actual survey data to verify that an adequate number of survey points were taken to support the desired power of the statistical test to be applied.

The process is fully described in Section A-5.0 but is modified as follows:

- Calculate the sample standard deviation of the contaminant in the SU from actual survey data;
- Determine the relative shift;
- Obtain the number of data points needed (based on the desired statistical test to be applied); and
- Compare the number of data points actually obtained to the new estimate to ensure that sufficient information is available to support the statistical testing.

Information demonstrating the validity of the initial survey design is included in the FSS report.

A-7.7 SELECT THE STATISTICAL TEST

Statistical results are applied only to measurements made at random or systematic locations. Biased survey measurements are not included in statistical tests, because they alter the underlying assumptions of the tests.

The one-sample statistical test (i.e., Sign Test) described in MARSSIM Section 5.5.2.3 should be used in cases where a background reference dataset is not available or will not be used. In this situation, any natural radioactivity in the surveyed materials will have contributed to the results of the survey measurements, and the mean of the residual radioactivity in the SU may be overestimated to some degree. In many cases, the natural background radioactivity is small when compared to the DCGL, and application of the Sign Test is reasonable and may be the most beneficial test overall.

The two-sample statistical test (i.e., WRS Test) discussed in MARSSIM Section 5.5.2.2 should be used in cases where a background reference dataset for the material type being surveyed is available and has been approved for use at the site and area being evaluated by the USACE.

The selected statistical test is applied to the survey data in accordance with MARSSIM guidance and examples, and conclusions about the SU are drawn.

Results of such tests are included in the FSS report.

A-7.8 DRAW CONCLUSIONS FROM THE DATA

The DQOs identified a decision (Section A-3.2) and a decision rule (Section A-3.5, Image A-1). The decision rule is used to compare the FSS results to the decision.

If the SU is determined to meet RGs, then the survey effort is essentially complete. If not, then an alternate action is taken. Options for alternate actions are provided in Table A-1 of Section A-3.2. Alternate actions may lead to remediation, followed by additional FSS efforts.

Conclusions are documented in the FSSE report.

THIS PAGE INTENTIONALLY LEFT BLANK

A-8.0 REPORT OF SURVEY FINDINGS

Survey procedures and results are documented in an FSSE report, following the general MARSSIM (DoD 2000) and draft NUREG/CR-5849 (NRC 1992) guidance for FSSE reports. Information from the FSSE report is an integral part of an applicable post-remedial action report (PRAR) or other similar document.

Documentation of the FSS should provide a complete and unambiguous record of the radiological status of the SU, relative to the established DCGLs. In addition, sufficient data and information should be provided to enable an independent re-creation and evaluation at some future time. To the extent practicable, the report will be a stand-alone document with minimum information incorporated by reference.

The FSS report will, at a minimum, contain the following information:

- A facility or area map;
- Survey figures that document scan locations and coverage, locations of elevated biased measurements, and sample/fixed-point measurement locations from each SU;
- Tables of surficial contamination survey results for each static measurement in the SU, in dpm/100 cm²;
- Tables of surficial contamination survey results for each static measurement from the reference area, in dpm/100 cm²;
- Summary statistics for the static measurements from each SU,
- Results of the statistical test(s);
- Results of any EMC comparisons or exposure pathway modeling;
- Documentation of the overall scan and static MDCs for the FSS;
- Evidence that DQOs and the associated DQIs were met for the FSS;
- Indication that the survey design was appropriate when reviewed retrospectively; and
- Conclusions of the FSS (i.e., that the SU meets or does not meet remediation criteria).

THIS PAGE INTENTIONALLY LEFT BLANK

ATTACHMENT A-1

**DERIVED CONCENTRATION GUIDELINE LEVELS FOR ELEVATED
MEASUREMENT COMPARISONS ON STRUCTURES**

THIS PAGE INTENTIONALLY LEFT BLANK

DERIVED CONCENTRATION GUIDELINE LEVELS FOR ELEVATED MEASUREMENT COMPARISONS ON STRUCTURES

INTRODUCTION

The purpose of this attachment is to document the process used for developing health conservative surrogate gross total alpha $DCGL_{EMC}$ values for structures and consolidated material present on North St. Louis County Sites and the SLDS to use in evaluating small areas of elevated activity.

DCGLs for structure surfaces are documented in Appendix D for North St. Louis County Sites and Appendix E for the SLDS. The North St. Louis County Sites surrogate alpha DCGL of 5,300 dpm/100 cm² and the SLDS surrogate alpha DCGL of 8,700 dpm/100 cm² are the limiting DCGLs used as the basis for the surrogate alpha $DCGL_{EMC}$ values developed here.

DERIVED CONCENTRATION GUIDELINE LEVELS FOR ELEVATED MEASUREMENT COMPARISONS DERIVATION PROCESS

North St. Louis County Sites

The method for deriving the RGs originally included in the *Derivation of Site-Specific DCGLs for North County Structures* (USACE 2004) is discussed in Appendix D. The same methods and parameters established in the *Derivation of Site-Specific DCGLs for North County Structures* are applied for all 11 radionuclide COCs using RESRAD-BUILD Version 4.0 for the limiting scenario with the exception of reducing the area of the contaminated source to obtain surrogate alpha $DCGL_{EMC}$ values related to smaller areas of contamination of 50 m² and 10 m². The original 180-m² contaminated source area in the *Derivation of Site-Specific DCGLs for North County Structures* consists of a 100-m² floor surrounded by four 20-m² walls contaminated on the lower 2 m. For this $DCGL_{EMC}$ derivation, the contaminated area has been reduced to a single contaminated area on the floor directly below the receptor. Contamination areas of 50 m² and 10 m² are evaluated. The resulting dose-to-source ratio (DSR) and risk-to-source ratio (RSR) are used to calculate nuclide-specific $DCGL_{EMC}$ values equivalent to 15 mrem/year and 3E-04 risk, respectively. The limiting nuclide-specific $DCGL_{EMC}$ and the limiting site-specific activity fractions (AF) (i.e., Hazelwood Properties) are then used to calculate the effective total alpha surrogate $DCGL_{EMC}$ using the following MARSSIM equation and multiplying by the alpha portion of the AF, which is approximately 95 percent of the AF as documented in Appendix D. The Hazelwood Properties AFs are documented in Appendix D and listed in Table A-1-1. The dose and risk equivalent nuclide-specific $DCGL_{EMC}$ values and the total activity alpha surrogate $DCGL_{EMC}$ values for each evaluated area (i.e., 50 m² and 10 m²) are presented in Table A-1-1. The RESRAD-BUILD output reports are documented in Attachment A-2.

The MARSSIM equation for calculating a surrogate DCGL is based on total radioactivity, as shown in the following equation:

$$Activity\ DCGL_{EMC(Alpha)} = \left(\frac{1}{\frac{AF_1}{DCGL_{EMC1}} + \frac{AF_2}{DCGL_{EMC2}} + \dots + \frac{AF_n}{DCGL_{EMCn}}} \right) * 0.949$$

where:

AF_i = the site-specific AF for each radionuclide of interest

$DCGL_{EMCi}$ = the limiting $DCGL_{EMC}$ (risk or dose) for each radionuclide of interest

0.949 = the alpha portion of the AF (e.g., 94.9 percent)

For the 50-m² area, the alpha surrogate DCGL_{EMC} follows.

$$\text{Activity } DCGL_{EMC(Alpha)} = \frac{1}{\frac{0.0145}{1,730} + \frac{0.0165}{6,909} + \frac{0.0451}{272,727} + \frac{0.0188}{24,116} + \frac{0}{19,531} + \frac{0}{18,844} + \frac{0.8781}{34,375} + \frac{0}{6,537} + \frac{0.0131}{84,743} + \frac{0.0007}{70,073} + \frac{0.0131}{89,820}} * 0.949$$

$$= 25,260 \text{ dpm}/100 \text{ cm}^2$$

For the 10-m² area, the alpha surrogate DCGL_{EMC} follows.

$$\text{Activity } DCGL_{EMC(Alpha)} = \frac{1}{\frac{0.0145}{8,475} + \frac{0.0165}{34,021} + \frac{0.0451}{1,339,286} + \frac{0.0188}{55,057} + \frac{0}{54,152} + \frac{0}{63,830} + \frac{0.8781}{171,473} + \frac{0}{31,322} + \frac{0.0131}{421,334} + \frac{0.0007}{258,563} + \frac{0.0131}{412,086}} * 0.949$$

$$= 122,331 \text{ dpm}/100 \text{ cm}^2$$

Table A-1-1. North St Louis County Nuclide-Specific DCGL_{EMC} and Surrogate Alpha DCGL_{EMC} Values

Radionuclide	AF	Nuclide-Specific DCGL _{EMC} (dpm/100 cm ²)			
		Dose	Risk	Dose	Risk
		50 m ²		10 m ²	
Ac-227	0.0145	1,730	38,860	8,475	154,639
Pa-231	0.0165	6,909	39,474	34,021	168,067
Pb-210	0.0451	343,249	272,727	1,632,209	1,339,286
Ra-226	0.0188	26,403	24,116	55,057	57,582
Ra-228	0	19,531	25,929	54,152	86,455
Th-228	0	18,844	122,449	63,830	443,787
Th-230	0.8781	34,375	184,064	171,473	873,510
Th-232	0	6,537	11,641	31,322	39,432
U-234	0.0131	84,743	234,339	421,334	1,162,606
U-235	0.0007	70,073	154,493	258,563	472,126
U-238	0.0131	89,820	241,926	412,086	1,013,479
Alpha Surrogate DCGL_{EMC}		25,260		122,331	

Note:

Green shading indicates the limiting DCGL_{EMC} (risk or dose) for each radionuclide of interest.

St. Louis Downtown Site

The method for deriving the SLDS RGs is discussed in Appendix E. The same methods and parameters established in Appendix E are applied for all 11 radionuclide COCs using RESRAD-BUILD Version 4.0 for the limiting scenario with the exception of reducing the area of the contaminated source to obtain surrogate alpha DCGL_{EMC} values related to smaller areas of contamination of 50 m² and 10 m². The original 180-m² contaminated source area associated with the Appendix E DCGL consists of a 100-m² floor surrounded by four 20-m² walls contaminated on the lower 2 m. For the DCGL_{EMC} derivation, the contaminated area has been reduced to a single contaminated area on the floor directly below the receptor. Contamination areas of 50 m² and 10 m² are evaluated. The resulting DSR and RSR ratio are used to calculate nuclide-specific DCGL_{EMC} values equivalent to 25 mrem/year and 3E-04 risk, respectively. The limiting nuclide-specific DCGL_{EMC} and the site-specific AFs are then used to calculate the effective total alpha surrogate DCGL_{EMC} using the following MARSSIM equation and multiplying by the alpha portion of the AF, which is approximately 70 percent of the AF as documented in Appendix E. The SLDS AFs are documented in Appendix E and listed in Table A-1-2.

The dose and risk equivalent nuclide-specific $DCGL_{EMC}$ values and the total activity alpha surrogate $DCGL_{EMC}$ values for each evaluated area (i.e., 50 m² and 10 m²) are presented in Table A-1-2. The RESRAD-BUILD output reports are documented in Attachment A-2.

The MARSSIM equation for calculating a surrogate DCGL is based on total radioactivity, as shown in the following equation:

$$Activity\ DCGL_{EMC(Alpha)} = \left(\frac{1}{\frac{AF_1}{DCGL_{EMC1}} + \frac{AF_2}{DCGL_{EMC2}} + \dots + \frac{AF_n}{DCGL_{EMCn}}} \right) * 0.697$$

where:

AF_i = the site-specific AF for each radionuclide of interest

$DCGL_{EMCi}$ = the limiting $DCGL_{EMC}$ (risk or dose) for each radionuclide of interest

0.697 = the alpha portion of the AF (e.g., 69.7 percent)

For the 50-m² area, the alpha surrogate $DCGL_{EMC}$ follows.

$$Activity\ DCGL_{EMC(Alpha)} = \frac{1}{\frac{0.0173}{19,841} + \frac{0.0171}{21,918} + \frac{0.1009}{242,718} + \frac{0.0776}{7,549} + \frac{0.0086}{6,484} + \frac{0.0089}{1,701} + \frac{0.1926}{54,900} + \frac{0.0085}{2,711} + \frac{0.2763}{331,799} + \frac{0.0157}{65,612} + \frac{0.2763}{98,360}} * 0.697 = 23,682\ dpm/100\ cm^2$$

For the 10-m² area, the alpha surrogate $DCGL_{EMC}$ follows.

$$Activity\ DCGL_{EMC(Alpha)} = \frac{1}{\frac{0.0173}{62,035} + \frac{0.0171}{83,565} + \frac{0.1009}{764,526} + \frac{0.0776}{16,598} + \frac{0.0086}{23,130} + \frac{0.0089}{7,692} + \frac{0.1926}{271,825} + \frac{0.0085}{9,603} + \frac{0.2763}{1,507,230} + \frac{0.0157}{131,527} + \frac{0.2763}{222,221}} * 0.697 = 69,985\ dpm/100\ cm^2$$

Table A-1-2. SLDS Nuclide-Specific $DCGL_{EMC}$ and Surrogate Alpha $DCGL_{EMC}$ Values

Radionuclide	AF	Nuclide-Specific $DCGL_{EMC}$ (dpm/100 cm ²)			
		Dose	Risk	Dose	Risk
		50 m ²		10 m ²	
Ac-227	0.0173	19,841	27,027	62,035	67,873
Pa-231	0.0171	21,918	31,881	98,604	83,565
Pb-210	0.1009	242,718	280,374	764,526	874,636
Ra-226	0.0776	14,521	7,549	31,705	16,598
Ra-228	0.0086	7,135	6,484	25,667	23,130
Th-228	0.0089	1,701	20,548	7,692	80,429
Th-230	0.1926	54,900	221,836	271,825	852,813
Th-232	0.0085	35,643	2,711	159,134	9,603
U-234	0.2763	493,076	331,799	2,272,637	1,507,230
U-235	0.0157	116,272	65,612	240,378	131,527
U-238	0.2763	162,338	98,360	375,375	222,221
Alpha Surrogate $DCGL_{EMC}$		23,682		69,985	

Note:

Green shading indicates the limiting $DCGL_{EMC}$ (risk or dose) for each radionuclide of interest.

CONCLUSION

The total alpha surrogate $DCGL_{EMC}$ calculations resulted in total alpha surrogate $DCGL_{EMC}$ values of 25,260 and 122,331 dpm/100 cm² for the 50-m² and 10-m² areas, respectively for North St. Louis County Sites. For the purposes of implementation and as a health-conservative measure, those values are rounded down to 25,000 and 122,000 dpm/100 cm² for use as the alpha surrogate $DCGL_{EMC}$ values used for elevated measurement comparisons for structures on all North St. Louis County Sites properties.

The total alpha surrogate $DCGL_{EMC}$ calculations resulted in total alpha surrogate $DCGL_{EMC}$ values of 23,682 and 69,985 dpm/100 cm² for the 50-m² and 10-m² areas, respectively for the SLDS. For the purposes of implementation and as a health-conservative measure, those values are rounded down to 23,000 and 69,000 dpm/100 cm² for use as the alpha surrogate $DCGL_{EMC}$ values used for elevated measurement comparisons for structures on all SLDS properties.

ATTACHMENT A-2

**RESRAD-BUILD OUTPUT FILES FOR DERIVED CONCENTRATION GUIDELINE
LEVELS FOR ELEVATED MEASUREMENT COMPARISON DERIVATIONS**

THIS PAGE INTENTIONALLY LEFT BLANK

** RESRAD-BUILD Dose Program Output, Version 4.0 06/01/23 12:25:00 Page: 1 **
Title : Default Case for RESRAD-BUILD
Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\NC DCGL EMC 50m2.bld

=====	
=====	
=====	=====
=====	=====
RESRAD-BUILD Table of Contents	
=====	=====
=====	
=====	

RESRAD-BUILD Input Parameters.....	2
Building Information.....	3
Source Information.....	4
Temporal Dose Summary.....	5
For time = 0.00E+00 yr	
Receptor-Source Dose Summary.....	6
Dose by Pathway Detail.....	7
Dose by Nuclide Detail.....	8
For time = 1.00E+00 yr	
Receptor-Source Dose Summary.....	9
Dose by Pathway Detail.....	10
Dose by Nuclide Detail.....	11

** RESRAD-BUILD Dose Program Output, Version 4.0 06/01/23 12:25:00 Page: 2 **
 Title : Default Case for RESRAD-BUILD
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\NC DCGL EMC 50m2.bld

```

=====
=====
=====
RESRAD-BUILD Input Parameters
=====
=====
=====
  
```

```

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

```

Transformations data from: ICRP38
Cut off half life : 180.000000 days
Library information in the Dose Coefficients and Slope Factors report
  
```

```

===== Receptor Information =====
  
```

Receptor	Room	x [m]	y [m]	z [m]	FracTime	Inhalation [m3/day]	Ingestion(Dust) [m2/hr]
1	1	5.000	5.000	1.000	1.000	3.36E+01	1.00E-04

```

===== Receptor-Source Shielding Relationship =====
  
```

Receptor	Source	Density [g/cm3]	Thickness [cm]	Material
1	1	2.40E+00	0.00E+00	Concrete

** RESRAD-BUILD Dose Program Output, Version 4.0 06/01/23 12:25:00 Page: 3 **
Title : Default Case for RESRAD-BUILD
Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\NC DCGL EMC 50m2.bld

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

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

Height[m]	Air Exchanges [m3/hr]	
Area [m2]	*****	
	*	*
	*	*
	*	<=Q01: 0.00E+00
H1: 2.500	* Room 1	* Q10 : 0.00E+00
	* LAMBDA: 0.00E+00	*
Area 100.000	*	*
	*	*

Deposition velocity: 1.00E-02 [m/s] Resuspension Rate: 0.00E+00 [1/s]
Deposition velocity: 5.00E-07 [m/s] Resuspension Rate:

** RESRAD-BUILD Dose Program Output, Version 4.0 06/01/23 12:25:00 Page: 4 **
Title : Default Case for RESRAD-BUILD
Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\NC DCGL EMC 50m2.bld

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

Source: 1

Location:: Room : 1 x: 5.00 y: 5.00 z: 0.00[m]
Geometry:: Type: Area Area:5.00E+01 [m2] Direction: z
Pathway ::
Direct Ingestion Rate: 0.000E+00 [1/hr]
Fraction released to air: 7.000E-02
Removable fraction: 2.000E-01
Time to Remove: 1.000E+04 [day]

Radon Release Fraction: 1.000E-01

Contamination::

Nuclide Concentration

	[dpm/m2]
Ac-227	1.000E+00
Pa-231	1.000E+00
Pb-210	1.000E+00
Ra-226	1.000E+00
Ra-228	1.000E+00
Th-228	1.000E+00
Th-230	1.000E+00
Th-232	1.000E+00
U-234	1.000E+00
U-235	1.000E+00
U-238	1.000E+00

** RESRAD-BUILD Dose Program Output, Version 4.0 06/01/23 12:25:00 Page: 5 **
 Title : Default Case for RESRAD-BUILD
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\NC DCGL EMC 50m2.bld
 Temporal Summary

RESRAD-BUILD Temporal Dose Tables

Dose to Receptor over the Exposure Duration

(mrem)

Evaluation Time years	Receptor 1	Total
0.000000000	9.07E-05	9.07E-05
1.000000000	1.63E-04	1.63E-04

** RESRAD-BUILD Dose Program Output, Version 4.0 06/01/23 12:25:00 Page: 6 **
 Title : Default Case for RESRAD-BUILD
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\NC DCGL EMC 50m2.bld
 Evaluation Time: 0.00000000E+00 years

RESRAD-BUILD Dose Tables

Source Contributions to Receptor Doses

[mrem]

	Source	Total
	1	
Receptor 1	9.07E-05	9.07E-05
Total	9.07E-05	9.07E-05

** RESRAD-BUILD Dose Program Output, Version 4.0 06/01/23 12:25:00 Page: 7 **
 Title : Default Case for RESRAD-BUILD
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\NC DCGL EMC 50m2.bld
 Evaluation Time: 0.00000000E+00 years

Pathway Detail of Doses

[mrem]

Source: 1

	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	1.44E-05	7.08E-05	1.66E-09	1.55E-11	3.42E-07	5.18E-06	0.00E+00	9.07E-05
Total	1.44E-05	7.08E-05	1.66E-09	1.55E-11	3.42E-07	5.18E-06	0.00E+00	9.07E-05

** RESRAD-BUILD Dose Program Output, Version 4.0 06/01/23 12:25:00 Page: 8 **
 Title : Default Case for RESRAD-BUILD
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\NC DCGL EMC 50m2.bld
 Evaluation Time: 0.00000000E+00 years

Nuclide Detail of Doses

[mrem]

Source: 1

Nuclide	Receptor 1	Total
Ac-227	4.48E-05	4.48E-05
Pa-231	8.68E-06	8.68E-06
Ac-227	8.91E-07	8.91E-07
Pb-210	2.24E-07	2.24E-07
Ra-226	5.63E-06	5.63E-06
Pb-210	4.37E-09	4.37E-09
Ra-228	2.82E-06	2.82E-06
Th-228	1.84E-06	1.84E-06
Th-228	9.47E-06	9.47E-06
Th-230	2.16E-06	2.16E-06
Ra-226	1.22E-09	1.22E-09
Pb-210	6.89E-13	6.89E-13
Th-232	1.09E-05	1.09E-05
Ra-228	1.74E-07	1.74E-07
Th-228	7.87E-08	7.87E-08
U-234	8.79E-07	8.79E-07
Th-230	1.21E-11	1.21E-11
Ra-226	3.67E-15	3.67E-15
Pb-210	1.63E-18	1.63E-18
U-235	1.31E-06	1.31E-06
Pa-231	1.14E-10	1.14E-10
Ac-227	6.86E-12	6.86E-12
U-238	8.77E-07	8.77E-07
U-234	1.55E-12	1.55E-12
Th-230	1.25E-17	1.25E-17
Ra-226	2.38E-21	2.38E-21
Pb-210	0.00E+00	0.00E+00

RESRAD-BUILD Dose Tables

```
[mrem]
```

		Source	Total
		1	
Receptor	1	1.63E-04	1.63E-04
Total		1.63E-04	1.63E-04

** RESRAD-BUILD Dose Program Output, Version 4.0 06/01/23 12:25:00 Page: 10 **
 Title : Default Case for RESRAD-BUILD
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\NC DCGL EMC 50m2.bld
 Evaluation Time: 1.00000000 years

Pathway Detail of Doses

[mrem]

Source: 1

	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	1.43E-05	1.43E-04	3.65E-09	3.13E-11	7.52E-07	5.15E-06	0.00E+00	1.63E-04
Total	1.43E-05	1.43E-04	3.65E-09	3.13E-11	7.52E-07	5.15E-06	0.00E+00	1.63E-04

** RESRAD-BUILD Dose Program Output, Version 4.0 06/01/23 12:25:00 Page: 11 **
 Title : Default Case for RESRAD-BUILD
 Input File : C:\RESRAD Family\BUILD\4.0\UserFiles\NC DCGL EMC 50m2.bld
 Evaluation Time: 1.00000000 years

Nuclide Detail of Doses

[mrem]

Source: 1

Nuclide	Receptor	Total
	1	
Ac-227	8.67E-05	8.67E-05
Pa-231	1.74E-05	1.74E-05
Ac-227	4.31E-06	4.31E-06
Pb-210	4.37E-07	4.37E-07
Ra-226	5.66E-06	5.66E-06
Pb-210	2.12E-08	2.12E-08
Ra-228	2.52E-06	2.52E-06
Th-228	5.16E-06	5.16E-06
Th-228	7.96E-06	7.96E-06
Th-230	4.36E-06	4.36E-06
Ra-226	3.68E-09	3.68E-09
Pb-210	7.32E-12	7.32E-12
Th-232	2.19E-05	2.19E-05
Ra-228	4.98E-07	4.98E-07
Th-228	5.47E-07	5.47E-07
U-234	1.77E-06	1.77E-06
Th-230	5.99E-11	5.99E-11
Ra-226	2.58E-14	2.58E-14
Pb-210	3.59E-17	3.59E-17
U-235	2.14E-06	2.14E-06
Pa-231	5.62E-10	5.62E-10
Ac-227	7.27E-11	7.27E-11
U-238	1.67E-06	1.67E-06
U-234	7.66E-12	7.66E-12
Th-230	1.34E-16	1.34E-16
Ra-226	3.91E-20	3.91E-20
Pb-210	1.12E-23	1.12E-23

** RESRAD-BUILD Risk Program Output, Version 4.0 06/01/23 12:23:47 Page: 1 **

Title : Default Case for RESRAD-BUILD

Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\NC DCGL EMC 50m2.bld

RESRAD-BUILD Table of Contents

RESRAD-BUILD Input Parameters.....	2
Building Information.....	3
Source Information.....	4
Temporal Risk Summary.....	5
For time = 0.00E+00 yr	
Receptor-Source Risk Summary.....	6
Risk by Pathway Detail.....	7
Risk by Nuclide Detail.....	8
For time = 1.00E+00 yr	
Receptor-Source Risk Summary.....	9
Risk by Pathway Detail.....	10
Risk by Nuclide Detail.....	11

** RESRAD-BUILD Risk Program Output, Version 4.0 06/01/23 12:23:47 Page: 2 **
 Title : Default Case for RESRAD-BUILD
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\NC DCGL EMC 50m2.bld

```

=====
=====
=====
RESRAD-BUILD Input Parameters
=====
=====
=====
  
```

```

Number of Sources : 1
Number of Receptors: 1
Total Time : 9.125000E+03 days
Fraction Inside : 2.300000E-01
  
```

```

Transformations data from: ICRP38
Cut off half life : 180.000000 days
Library information in the Dose Coefficients and Slope Factors report
  
```

```

===== Receptor Information =====
  
```

Receptor	Room	x [m]	y [m]	z [m]	FracTime	Inhalation [m3/day]	Ingestion(Dust) [m2/hr]
1	1	5.000	5.000	1.000	1.000	3.36E+01	1.00E-04

```

===== Receptor-Source Shielding Relationship =====
  
```

Receptor	Source	Density [g/cm3]	Thickness [cm]	Material
1	1	2.40E+00	0.00E+00	Concrete

** RESRAD-BUILD Risk Program Output, Version 4.0 06/01/23 12:23:47 Page: 3 **
Title : Default Case for RESRAD-BUILD
Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\NC DCGL EMC 50m2.bld

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

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

Height[m]	Air Exchanges [m3/hr]	
Area [m2]	*****	
	*	*
	*	*
	*	<=Q01: 0.00E+00
H1: 2.500	* Room 1	* Q10 : 0.00E+00
	* LAMBDA: 0.00E+00	*
Area 100.000	*	*
	*	*

Deposition velocity: 1.00E-02 [m/s] Resuspension Rate: 0.00E+00 [1/s]
Deposition velocity: 5.00E-07 [m/s] Resuspension Rate:

** RESRAD-BUILD Risk Program Output, Version 4.0 06/01/23 12:23:47 Page: 4 **
Title : Default Case for RESRAD-BUILD
Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\NC DCGL EMC 50m2.bld

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

Source: 1

Location:: Room : 1 x: 5.00 y: 5.00 z: 0.00[m]
Geometry:: Type: Area Area:5.00E+01 [m2] Direction: z
Pathway ::
Direct Ingestion Rate: 0.000E+00 [1/hr]
Fraction released to air: 7.000E-02
Removable fraction: 2.000E-01
Time to Remove: 1.000E+04 [day]

Radon Release Fraction: 1.000E-01

Contamination::

Nuclide Concentration

	[dpm/m2]
Ac-227	1.000E+00
Pa-231	1.000E+00
Pb-210	1.000E+00
Ra-226	1.000E+00
Ra-228	1.000E+00
Th-228	1.000E+00
Th-230	1.000E+00
Th-232	1.000E+00
U-234	1.000E+00
U-235	1.000E+00
U-238	1.000E+00

** RESRAD-BUILD Risk Program Output, Version 4.0 06/01/23 12:23:47 Page: 5 **
 Title : Default Case for RESRAD-BUILD
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\NC DCGL EMC 50m2.bld
 Temporal Summary

RESRAD-BUILD Temporal Risk Tables

Risk to Receptor over the Exposure Duration

(Risk)

Evaluation Time years	Receptor 1	Total
0.000000000	7.42E-10	7.42E-10
1.000000000	7.47E-10	7.47E-10

** RESRAD-BUILD Risk Program Output, Version 4.0 06/01/23 12:23:47 Page: 6 **
 Title : Default Case for RESRAD-BUILD
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\NC DCGL EMC 50m2.bld
 Evaluation Time: 0.00000000E+00 years

RESRAD-BUILD Risk Tables

Source Contributions to Receptor Risks

	[Risk]	
	Source	Total
	1	
Receptor 1	7.42E-10	7.42E-10
Total	7.42E-10	7.42E-10

** RESRAD-BUILD Risk Program Output, Version 4.0 06/01/23 12:23:47 Page: 7 **
 Title : Default Case for RESRAD-BUILD
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\NC DCGL EMC 50m2.bld
 Evaluation Time: 0.00000000E+00 years

Pathway Detail of Risks

[Risk]

Source: 1

	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	2.47E-10	3.05E-10	9.31E-14	7.85E-16	4.57E-12	1.85E-10	0.00E+00	7.42E-10
Total	2.47E-10	3.05E-10	9.31E-14	7.85E-16	4.57E-12	1.85E-10	0.00E+00	7.42E-10

** RESRAD-BUILD Risk Program Output, Version 4.0 06/01/23 12:23:47 Page: 8 **
 Title : Default Case for RESRAD-BUILD
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\NC DCGL EMC 50m2.bld
 Evaluation Time: 0.00000000E+00 years

Nuclide Detail of Risks

[Risk]

Source: 1

Nuclide	Receptor	Total
	1	
Ac-227	7.74E-11	7.74E-11
Pa-231	3.62E-11	3.62E-11
Ac-227	3.63E-11	3.63E-11
Pb-210	1.09E-11	1.09E-11
Ra-226	1.19E-10	1.19E-10
Pb-210	5.05E-12	5.05E-12
Ra-228	2.26E-11	2.26E-11
Th-228	9.64E-11	9.64E-11
Th-228	3.41E-11	3.41E-11
Th-230	1.52E-11	1.52E-11
Ra-226	6.30E-13	6.30E-13
Pb-210	1.94E-14	1.94E-14
Th-232	1.93E-11	1.93E-11
Ra-228	4.85E-11	4.85E-11
Th-228	1.76E-10	1.76E-10
U-234	1.24E-11	1.24E-11
Th-230	1.78E-15	1.78E-15
Ra-226	4.66E-17	4.66E-17
Pb-210	1.13E-18	1.13E-18
U-235	1.92E-11	1.92E-11
Pa-231	9.95E-15	9.95E-15
Ac-227	6.81E-15	6.81E-15
U-238	1.21E-11	1.21E-11
U-234	4.59E-16	4.59E-16
Th-230	4.21E-20	4.21E-20
Ra-226	8.17E-22	8.17E-22
Pb-210	1.64E-23	1.64E-23

		Source	Total
		1	
Receptor	1	7.47E-10	7.47E-10
Total		7.47E-10	7.47E-10

** RESRAD-BUILD Risk Program Output, Version 4.0 06/01/23 12:23:47 Page: 10 **
 Title : Default Case for RESRAD-BUILD
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\NC DCGL EMC 50m2.bld
 Evaluation Time: 1.00000000 years

Pathway Detail of Risks

[Risk]

Source: 1

	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	2.45E-10	3.13E-10	9.57E-14	8.06E-16	4.70E-12	1.84E-10	0.00E+00	7.47E-10
Total	2.45E-10	3.13E-10	9.57E-14	8.06E-16	4.70E-12	1.84E-10	0.00E+00	7.47E-10

** RESRAD-BUILD Risk Program Output, Version 4.0 06/01/23 12:23:47 Page: 11 **
 Title : Default Case for RESRAD-BUILD
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\NC DCGL EMC 50m2.bld
 Evaluation Time: 1.00000000 years

Nuclide Detail of Risks

[Risk]

Source: 1

Nuclide	Receptor	Total
	1	
Ac-227	7.72E-11	7.72E-11
Pa-231	3.71E-11	3.71E-11
Ac-227	3.89E-11	3.89E-11
Pb-210	1.10E-11	1.10E-11
Ra-226	1.19E-10	1.19E-10
Pb-210	5.40E-12	5.40E-12
Ra-228	2.04E-11	2.04E-11
Th-228	9.53E-11	9.53E-11
Th-228	2.45E-11	2.45E-11
Th-230	1.56E-11	1.56E-11
Ra-226	6.77E-13	6.77E-13
Pb-210	2.17E-14	2.17E-14
Th-232	1.98E-11	1.98E-11
Ra-228	5.09E-11	5.09E-11
Th-228	1.87E-10	1.87E-10
U-234	1.28E-11	1.28E-11
Th-230	1.92E-15	1.92E-15
Ra-226	5.21E-17	5.21E-17
Pb-210	1.32E-18	1.32E-18
U-235	1.94E-11	1.94E-11
Pa-231	1.07E-14	1.07E-14
Ac-227	7.60E-15	7.60E-15
U-238	1.24E-11	1.24E-11
U-234	4.96E-16	4.96E-16
Th-230	4.74E-20	4.74E-20
Ra-226	9.50E-22	9.50E-22
Pb-210	1.99E-23	1.99E-23

** RESRAD-BUILD Dose Program Output, Version 4.0 06/01/23 12:32:43 Page: 1 **

Title : Default Case for RESRAD-BUILD

Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\NC DCGL EMC 10m2.bld

RESRAD-BUILD Table of Contents

RESRAD-BUILD Input Parameters.....	2
Building Information.....	3
Source Information.....	4
Temporal Dose Summary.....	5
For time = 0.00E+00 yr	
Receptor-Source Dose Summary.....	6
Dose by Pathway Detail.....	7
Dose by Nuclide Detail.....	8
For time = 1.00E+00 yr	
Receptor-Source Dose Summary.....	9
Dose by Pathway Detail.....	10
Dose by Nuclide Detail.....	11

** RESRAD-BUILD Dose Program Output, Version 4.0 06/01/23 12:32:43 Page: 2 **
 Title : Default Case for RESRAD-BUILD
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\NC DCGL EMC 10m2.bld

```

=====
=====
=====
RESRAD-BUILD Input Parameters
=====
=====
=====
  
```

```

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

```

Transformations data from: ICRP38
Cut off half life : 180.000000 days
Library information in the Dose Coefficients and Slope Factors report
  
```

```

===== Receptor Information =====
  
```

Receptor	Room	x [m]	y [m]	z [m]	FracTime	Inhalation [m3/day]	Ingestion(Dust) [m2/hr]
1	1	5.000	5.000	1.000	1.000	3.36E+01	1.00E-04

```

===== Receptor-Source Shielding Relationship =====
  
```

Receptor	Source	Density [g/cm3]	Thickness [cm]	Material
1	1	2.40E+00	0.00E+00	Concrete

** RESRAD-BUILD Dose Program Output, Version 4.0 06/01/23 12:32:43 Page: 3 **
Title : Default Case for RESRAD-BUILD
Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\NC DCGL EMC 10m2.bld

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

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

Height[m]	Air Exchanges [m3/hr]	
Area [m2]	*****	
	*	*
	*	*
	*	<=Q01: 0.00E+00
H1: 2.500	* Room 1	* Q10 : 0.00E+00
	* LAMBDA: 0.00E+00	*
Area 100.000	*	*
	*	*

Deposition velocity: 1.00E-02 [m/s] Resuspension Rate: 0.00E+00 [1/s]
Deposition velocity: 5.00E-07 [m/s] Resuspension Rate:

** RESRAD-BUILD Dose Program Output, Version 4.0 06/01/23 12:32:43 Page: 4 **
Title : Default Case for RESRAD-BUILD
Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\NC DCGL EMC 10m2.bld

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

Source: 1

Location:: Room : 1 x: 5.00 y: 5.00 z: 0.00[m]
Geometry:: Type: Area Area:1.00E+01 [m2] Direction: z
Pathway ::
Direct Ingestion Rate: 0.000E+00 [1/hr]
Fraction released to air: 7.000E-02
Removable fraction: 2.000E-01
Time to Remove: 1.000E+04 [day]

Radon Release Fraction: 1.000E-01

Contamination::

Nuclide Concentration

	[dpm/m2]
Ac-227	1.000E+00
Pa-231	1.000E+00
Pb-210	1.000E+00
Ra-226	1.000E+00
Ra-228	1.000E+00
Th-228	1.000E+00
Th-230	1.000E+00
Th-232	1.000E+00
U-234	1.000E+00
U-235	1.000E+00
U-238	1.000E+00

** RESRAD-BUILD Dose Program Output, Version 4.0 06/01/23 12:32:43 Page: 5 **
 Title : Default Case for RESRAD-BUILD
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\NC DCGL EMC 10m2.bld
 Temporal Summary

RESRAD-BUILD Temporal Dose Tables	

Dose to Receptor over the Exposure Duration

(mrem)

Evaluation Time years	Receptor 1	Total
0.000000000	2.25E-05	2.25E-05
1.000000000	3.70E-05	3.70E-05

** RESRAD-BUILD Dose Program Output, Version 4.0 06/01/23 12:32:43 Page: 7 **
 Title : Default Case for RESRAD-BUILD
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\NC DCGL EMC 10m2.bld
 Evaluation Time: 0.00000000E+00 years

Pathway Detail of Doses

[mrem]

Source: 1

	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	7.28E-06	1.42E-05	3.32E-10	3.10E-12	6.85E-08	1.04E-06	0.00E+00	2.25E-05
Total	7.28E-06	1.42E-05	3.32E-10	3.10E-12	6.85E-08	1.04E-06	0.00E+00	2.25E-05

** RESRAD-BUILD Dose Program Output, Version 4.0 06/01/23 12:32:43 Page: 8 **
 Title : Default Case for RESRAD-BUILD
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\NC DCGL EMC 10m2.bld
 Evaluation Time: 0.00000000E+00 years

Nuclide Detail of Doses

[mrem]

Source: 1

Nuclide	Receptor 1	Total
Ac-227	9.30E-06	9.30E-06
Pa-231	1.78E-06	1.78E-06
Ac-227	1.84E-07	1.84E-07
Pb-210	4.95E-08	4.95E-08
Ra-226	2.72E-06	2.72E-06
Pb-210	9.45E-10	9.45E-10
Ra-228	1.42E-06	1.42E-06
Th-228	5.71E-07	5.71E-07
Th-228	3.00E-06	3.00E-06
Th-230	4.34E-07	4.34E-07
Ra-226	5.90E-10	5.90E-10
Pb-210	1.48E-13	1.48E-13
Th-232	2.17E-06	2.17E-06
Ra-228	8.70E-08	8.70E-08
Th-228	2.42E-08	2.42E-08
U-234	1.78E-07	1.78E-07
Th-230	2.43E-12	2.43E-12
Ra-226	1.77E-15	1.77E-15
Pb-210	3.48E-19	3.48E-19
U-235	4.16E-07	4.16E-07
Pa-231	2.33E-11	2.33E-11
Ac-227	1.41E-12	1.41E-12
U-238	2.05E-07	2.05E-07
U-234	3.13E-13	3.13E-13
Th-230	2.50E-18	2.50E-18
Ra-226	1.31E-21	1.31E-21
Pb-210	0.00E+00	0.00E+00

RESRAD-BUILD Dose Tables

```
[mrem]
```

		Source	Total
		1	
Receptor	1	3.70E-05	3.70E-05
Total		3.70E-05	3.70E-05

** RESRAD-BUILD Dose Program Output, Version 4.0 06/01/23 12:32:43 Page: 10 **
 Title : Default Case for RESRAD-BUILD
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\NC DCGL EMC 10m2.bld
 Evaluation Time: 1.00000000 years

Pathway Detail of Doses

[mrem]

Source: 1

	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	7.23E-06	2.86E-05	7.30E-10	6.25E-12	1.50E-07	1.03E-06	0.00E+00	3.70E-05
Total	7.23E-06	2.86E-05	7.30E-10	6.25E-12	1.50E-07	1.03E-06	0.00E+00	3.70E-05

** RESRAD-BUILD Dose Program Output, Version 4.0 06/01/23 12:32:43 Page: 11 **
 Title : Default Case for RESRAD-BUILD
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\NC DCGL EMC 10m2.bld
 Evaluation Time: 1.00000000 years

Nuclide Detail of Doses

[mrem]

Source: 1

Nuclide	Receptor	Total
	1	
Ac-227	1.77E-05	1.77E-05
Pa-231	3.53E-06	3.53E-06
Ac-227	8.79E-07	8.79E-07
Pb-210	9.19E-08	9.19E-08
Ra-226	2.72E-06	2.72E-06
Pb-210	4.46E-09	4.46E-09
Ra-228	1.25E-06	1.25E-06
Th-228	1.52E-06	1.52E-06
Th-228	2.35E-06	2.35E-06
Th-230	8.73E-07	8.73E-07
Ra-226	1.77E-09	1.77E-09
Pb-210	1.54E-12	1.54E-12
Th-232	4.38E-06	4.38E-06
Ra-228	2.48E-07	2.48E-07
Th-228	1.61E-07	1.61E-07
U-234	3.56E-07	3.56E-07
Th-230	1.20E-11	1.20E-11
Ra-226	1.24E-14	1.24E-14
Pb-210	7.53E-18	7.53E-18
U-235	5.80E-07	5.80E-07
Pa-231	1.14E-10	1.14E-10
Ac-227	1.48E-11	1.48E-11
U-238	3.64E-07	3.64E-07
U-234	1.54E-12	1.54E-12
Th-230	2.69E-17	2.69E-17
Ra-226	1.89E-20	1.89E-20
Pb-210	1.09E-23	1.09E-23

** RESRAD-BUILD Risk Program Output, Version 4.0 06/01/23 12:32:14 Page: 1 **

Title : Default Case for RESRAD-BUILD

Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\NC DCGL EMC 10m2.bld

RESRAD-BUILD Table of Contents

RESRAD-BUILD Input Parameters.....	2
Building Information.....	3
Source Information.....	4
Temporal Risk Summary.....	5
For time = 0.00E+00 yr	
Receptor-Source Risk Summary.....	6
Risk by Pathway Detail.....	7
Risk by Nuclide Detail.....	8
For time = 1.00E+00 yr	
Receptor-Source Risk Summary.....	9
Risk by Pathway Detail.....	10
Risk by Nuclide Detail.....	11

** RESRAD-BUILD Risk Program Output, Version 4.0 06/01/23 12:32:14 Page: 2 **
 Title : Default Case for RESRAD-BUILD
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\NC DCGL EMC 10m2.bld

```

=====
=====
=====
RESRAD-BUILD Input Parameters
=====
=====
    
```

```

Number of Sources : 1
Number of Receptors: 1
Total Time : 9.125000E+03 days
Fraction Inside : 2.300000E-01
    
```

```

Transformations data from: ICRP38
Cut off half life : 180.000000 days
Library information in the Dose Coefficients and Slope Factors report
    
```

```

===== Receptor Information =====
    
```

Receptor	Room	x [m]	y [m]	z [m]	FracTime	Inhalation [m3/day]	Ingestion(Dust) [m2/hr]
1	1	5.000	5.000	1.000	1.000	3.36E+01	1.00E-04

```

===== Receptor-Source Shielding Relationship =====
    
```

Receptor	Source	Density [g/cm3]	Thickness [cm]	Material
1	1	2.40E+00	0.00E+00	Concrete

** RESRAD-BUILD Risk Program Output, Version 4.0 06/01/23 12:32:14 Page: 3 **
 Title : Default Case for RESRAD-BUILD
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\NC DCGL EMC 10m2.bld

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

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

Height[m]	Air Exchanges [m3/hr]	
Area [m2]		

	*	*
	*	*
	*	<=Q01: 0.00E+00
H1: 2.500	* Room 1	* Q10 : 0.00E+00
	* LAMBDA: 0.00E+00	*
Area 100.000	*	*
	*	*

Deposition velocity: 1.00E-02 [m/s] Resuspension Rate: 0.00E+00 [1/s]
 Deposition velocity: 5.00E-07 [m/s] Resuspension Rate:

** RESRAD-BUILD Risk Program Output, Version 4.0 06/01/23 12:32:14 Page: 4 **
Title : Default Case for RESRAD-BUILD
Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\NC DCGL EMC 10m2.bld

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

Source: 1

Location:: Room : 1 x: 5.00 y: 5.00 z: 0.00[m]
Geometry:: Type: Area Area:1.00E+01 [m2] Direction: z
Pathway ::
Direct Ingestion Rate: 0.000E+00 [1/hr]
Fraction released to air: 7.000E-02
Removable fraction: 2.000E-01
Time to Remove: 1.000E+04 [day]

Radon Release Fraction: 1.000E-01

Contamination::

Nuclide Concentration

	[dpm/m2]
Ac-227	1.000E+00
Pa-231	1.000E+00
Pb-210	1.000E+00
Ra-226	1.000E+00
Ra-228	1.000E+00
Th-228	1.000E+00
Th-230	1.000E+00
Th-232	1.000E+00
U-234	1.000E+00
U-235	1.000E+00
U-238	1.000E+00

Evaluation Time years	Receptor 1	Total
0.0000000000	2.24E-10	2.24E-10
1.0000000000	2.24E-10	2.24E-10

** RESRAD-BUILD Risk Program Output, Version 4.0 06/01/23 12:32:14 Page: 6 **
 Title : Default Case for RESRAD-BUILD
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\NC DCGL EMC 10m2.bld
 Evaluation Time: 0.00000000E+00 years

RESRAD-BUILD Risk Tables

Source Contributions to Receptor Risks

	[Risk]	
	Source	Total
	1	
Receptor 1	2.24E-10	2.24E-10
Total	2.24E-10	2.24E-10

** RESRAD-BUILD Risk Program Output, Version 4.0 06/01/23 12:32:14 Page: 7 **
 Title : Default Case for RESRAD-BUILD
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\NC DCGL EMC 10m2.bld
 Evaluation Time: 0.00000000E+00 years

Pathway Detail of Risks

[Risk]

Source: 1

	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	1.25E-10	6.10E-11	1.86E-14	1.57E-16	9.14E-13	3.71E-11	0.00E+00	2.24E-10
Total	1.25E-10	6.10E-11	1.86E-14	1.57E-16	9.14E-13	3.71E-11	0.00E+00	2.24E-10

** RESRAD-BUILD Risk Program Output, Version 4.0 06/01/23 12:32:14 Page: 8 **
 Title : Default Case for RESRAD-BUILD
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\NC DCGL EMC 10m2.bld
 Evaluation Time: 0.00000000E+00 years

Nuclide Detail of Risks

[Risk]

Source: 1

Nuclide	Receptor	Total
	1	
Ac-227	1.96E-11	1.96E-11
Pa-231	8.02E-12	8.02E-12
Ac-227	9.04E-12	9.04E-12
Pb-210	2.23E-12	2.23E-12
Ra-226	5.13E-11	5.13E-11
Pb-210	1.03E-12	1.03E-12
Ra-228	9.68E-12	9.68E-12
Th-228	2.64E-11	2.64E-11
Th-228	9.54E-12	9.54E-12
Th-230	3.06E-12	3.06E-12
Ra-226	2.70E-13	2.70E-13
Pb-210	3.96E-15	3.96E-15
Th-232	3.88E-12	3.88E-12
Ra-228	2.02E-11	2.02E-11
Th-228	4.81E-11	4.81E-11
U-234	2.51E-12	2.51E-12
Th-230	3.58E-16	3.58E-16
Ra-226	1.99E-17	1.99E-17
Pb-210	2.31E-19	2.31E-19
U-235	6.32E-12	6.32E-12
Pa-231	2.19E-15	2.19E-15
Ac-227	1.69E-15	1.69E-15
U-238	2.91E-12	2.91E-12
U-234	9.28E-17	9.28E-17
Th-230	8.49E-21	8.49E-21
Ra-226	3.49E-22	3.49E-22
Pb-210	3.35E-24	3.35E-24

		Source	Total
		1	
Receptor	1	2.24E-10	2.24E-10
Total		2.24E-10	2.24E-10

** RESRAD-BUILD Risk Program Output, Version 4.0 06/01/23 12:32:14 Page: 10 **
 Title : Default Case for RESRAD-BUILD
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\NC DCGL EMC 10m2.bld
 Evaluation Time: 1.00000000 years

Pathway Detail of Risks

[Risk]

Source: 1

	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	1.24E-10	6.26E-11	1.91E-14	1.61E-16	9.40E-13	3.68E-11	0.00E+00	2.24E-10
Total	1.24E-10	6.26E-11	1.91E-14	1.61E-16	9.40E-13	3.68E-11	0.00E+00	2.24E-10

** RESRAD-BUILD Risk Program Output, Version 4.0 06/01/23 12:32:14 Page: 11 **
 Title : Default Case for RESRAD-BUILD
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\NC DCGL EMC 10m2.bld
 Evaluation Time: 1.00000000 years

Nuclide Detail of Risks

[Risk]

Source: 1

Nuclide	Receptor	Total
	1	
Ac-227	1.94E-11	1.94E-11
Pa-231	8.19E-12	8.19E-12
Ac-227	9.66E-12	9.66E-12
Pb-210	2.24E-12	2.24E-12
Ra-226	5.10E-11	5.10E-11
Pb-210	1.10E-12	1.10E-12
Ra-228	8.60E-12	8.60E-12
Th-228	2.61E-11	2.61E-11
Th-228	6.76E-12	6.76E-12
Th-230	3.14E-12	3.14E-12
Ra-226	2.90E-13	2.90E-13
Pb-210	4.42E-15	4.42E-15
Th-232	3.98E-12	3.98E-12
Ra-228	2.12E-11	2.12E-11
Th-228	5.09E-11	5.09E-11
U-234	2.58E-12	2.58E-12
Th-230	3.87E-16	3.87E-16
Ra-226	2.23E-17	2.23E-17
Pb-210	2.68E-19	2.68E-19
U-235	6.35E-12	6.35E-12
Pa-231	2.36E-15	2.36E-15
Ac-227	1.88E-15	1.88E-15
U-238	2.96E-12	2.96E-12
U-234	1.00E-16	1.00E-16
Th-230	9.55E-21	9.55E-21
Ra-226	4.06E-22	4.06E-22
Pb-210	4.05E-24	4.05E-24

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 07:56:28 Page: 1 **
 Title : SLDS DCGL Resident EMC 50 m2
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res EMC 50m2.bld

RESRAD-BUILD Table of Contents

RESRAD-BUILD Input Parameters.....	2
Building Information.....	3
Source Information.....	4
Temporal Dose Summary.....	5
For time = 0.00E+00 yr	
Receptor-Source Dose Summary.....	6
Dose by Pathway Detail.....	7
Dose by Nuclide Detail.....	8
For time = 1.00E+00 yr	
Receptor-Source Dose Summary.....	9
Dose by Pathway Detail.....	10
Dose by Nuclide Detail.....	11
For time = 3.00E+00 yr	
Receptor-Source Dose Summary.....	12
Dose by Pathway Detail.....	13
Dose by Nuclide Detail.....	14
For time = 1.00E+01 yr	
Receptor-Source Dose Summary.....	15
Dose by Pathway Detail.....	16
Dose by Nuclide Detail.....	17
For time = 2.00E+01 yr	
Receptor-Source Dose Summary.....	18
Dose by Pathway Detail.....	19
Dose by Nuclide Detail.....	20
For time = 3.00E+01 yr	
Receptor-Source Dose Summary.....	21
Dose by Pathway Detail.....	22
Dose by Nuclide Detail.....	23
For time = 1.00E+02 yr	
Receptor-Source Dose Summary.....	24
Dose by Pathway Detail.....	25
Dose by Nuclide Detail.....	26
For time = 3.00E+02 yr	
Receptor-Source Dose Summary.....	27
Dose by Pathway Detail.....	28
Dose by Nuclide Detail.....	29
For time = 1.00E+03 yr	
Receptor-Source Dose Summary.....	30
Dose by Pathway Detail.....	31
Dose by Nuclide Detail.....	32

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 07:56:28 Page: 2 **
 Title : SLDS DCGL Resident EMC 50 m2
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res EMC 50m2.bld

```

=====
=====
=====
RESRAD-BUILD Input Parameters
=====
=====
=====
  
```

```

Number of Sources : 1
Number of Receptors: 1
Total Time : 3.650000E+02 days
Fraction Inside : 6.390000E-01
  
```

```

Transformations data from: ICRP107
Cut off half life : 180.000000 days
Library information in the Dose Coefficients and Slope Factors report
  
```

```

===== Receptor Information =====
  
```

Receptor	Room	x [m]	y [m]	z [m]	FracTime	Inhalation [m3/day]	Ingestion(Dust) [m2/hr]
1	1	5.000	5.000	1.000	1.000	1.48E+01	6.90E-04

```

===== Receptor-Source Shielding Relationship =====
  
```

Receptor	Source	Density [g/cm3]	Thickness [cm]	Material
1	1	2.40E+00	0.00E+00	Concrete

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 07:56:28 Page: 3 **
Title : SLDS DCGL Resident EMC 50 m2
Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res EMC 50m2.blc

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

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

Height[m]	Air Exchanges [m3/hr]	
Area [m2]	*****	
	*	*
	*	*
	*	<=Q01: 0.00E+00
H1: 2.500	* Room 1	* Q10 : 0.00E+00
	* LAMBDA: 0.00E+00	*
Area 100.000	*	*
	*	*

Deposition velocity: 3.90E-04 [m/s] Resuspension Rate: 0.00E+00 [1/s]
Deposition velocity: 5.00E-07 [m/s] Resuspension Rate:

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 07:56:28 Page: 4 **
Title : SLDS DCGL Resident EMC 50 m2
Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res EMC 50m2.bld

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

Source: 1

Location:: Room : 1 x: 5.00 y: 5.00 z: 0.00[m]
Geometry:: Type: Area Area:5.00E+01 [m2] Direction: z
Pathway ::
Direct Ingestion Rate: 0.000E+00 [1/hr]
Fraction released to air: 7.000E-02
Removable fraction: 1.000E-01
Time to Remove: 1.000E+04 [day]

Radon Release Fraction: 1.000E-01

Contamination::
Nuclide Concentration

	[dpm/m2]
Ac-227	1.000E+00
Pa-231	1.000E+00
Pb-210	1.000E+00
Ra-226	1.000E+00
Ra-228	1.000E+00
Th-228	1.000E+00
Th-230	1.000E+00
Th-232	1.000E+00
U-234	1.000E+00
U-235	1.000E+00
U-238	1.000E+00

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 07:56:28 Page: 5 **
 Title : SLDS DCGL Resident EMC 50 m2
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res EMC 50m2.bld
 Temporal Summary

RESRAD-BUILD Temporal Dose Tables

Dose to Receptor over the Exposure Duration

(mrem)

Evaluation Time years	Receptor 1	Total
0.000000000	2.40E-04	2.40E-04
1.000000000	2.41E-04	2.41E-04
3.000000000	2.40E-04	2.40E-04
10.00000000	2.34E-04	2.34E-04
20.00000000	2.27E-04	2.27E-04
30.00000000	1.85E-04	1.85E-04
100.0000080	1.85E-04	1.85E-04
300.0000310	1.85E-04	1.85E-04
1000.000000	1.85E-04	1.85E-04

		Source	Total
		1	
Receptor	1	2.40E-04	2.40E-04
Total		2.40E-04	2.40E-04

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 07:56:28 Page: 7 **
 Title : SLDS DCGL Resident EMC 50 m2
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res EMC 50m2.bld
 Evaluation Time: 0.00000000E+00 years

Pathway Detail of Doses

[mrem]

Source: 1

	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	4.19E-05	3.42E-05	2.61E-10	5.28E-11	3.87E-07	1.64E-04	0.00E+00	2.40E-04
Total	4.19E-05	3.42E-05	2.61E-10	5.28E-11	3.87E-07	1.64E-04	0.00E+00	2.40E-04

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 07:56:28 Page: 8 **
 Title : SLDS DCGL Resident EMC 50 m2
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res EMC 50m2.bld
 Evaluation Time: 0.00000000E+00 years

Nuclide Detail of Doses

[mrem]

Source: 1

Nuclide	Receptor	Total
	1	
Ac-227	1.26E-05	1.26E-05
Pa-231	1.12E-05	1.12E-05
Ac-227	2.06E-07	2.06E-07
Pb-210	1.03E-06	1.03E-06
Ra-226	1.72E-05	1.72E-05
Pb-210	1.66E-08	1.66E-08
Ra-228	7.84E-06	7.84E-06
Th-228	2.72E-05	2.72E-05
Th-228	1.47E-04	1.47E-04
Th-230	4.55E-06	4.55E-06
Ra-226	3.73E-09	3.73E-09
Pb-210	2.42E-12	2.42E-12
Th-232	5.40E-06	5.40E-06
Ra-228	4.84E-07	4.84E-07
Th-228	1.13E-06	1.13E-06
U-234	5.07E-07	5.07E-07
Th-230	2.17E-11	2.17E-11
Ra-226	1.14E-14	1.14E-14
Pb-210	5.58E-18	5.58E-18
U-235	2.15E-06	2.15E-06
Pa-231	1.22E-10	1.22E-10
Ac-227	1.46E-12	1.46E-12
U-238	1.54E-06	1.54E-06
U-234	7.41E-13	7.41E-13
Th-230	2.05E-17	2.05E-17
Ra-226	9.85E-21	9.85E-21
Pb-210	7.54E-23	7.54E-23

RESRAD-BUILD Dose Tables

```
[mrem]
```

		Source	Total
		1	
Receptor	1	2.41E-04	2.41E-04
Total		2.41E-04	2.41E-04

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 07:56:28 Page: 10 **
 Title : SLDS DCGL Resident EMC 50 m2
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res EMC 50m2.bld
 Evaluation Time: 1.00000000 years

Pathway Detail of Doses

[mrem]

Source: 1

	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	4.18E-05	3.58E-05	2.92E-10	5.52E-11	4.34E-07	1.63E-04	0.00E+00	2.41E-04
Total	4.18E-05	3.58E-05	2.92E-10	5.52E-11	4.34E-07	1.63E-04	0.00E+00	2.41E-04

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 07:56:28 Page: 11 **
 Title : SLDS DCGL Resident EMC 50 m2
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res EMC 50m2.bld
 Evaluation Time: 1.00000000 years

Nuclide Detail of Doses

[mrem]

Source: 1

Nuclide	Receptor 1	Total
Ac-227	1.25E-05	1.25E-05
Pa-231	1.17E-05	1.17E-05
Ac-227	6.12E-07	6.12E-07
Pb-210	1.04E-06	1.04E-06
Ra-226	1.72E-05	1.72E-05
Pb-210	4.96E-08	4.96E-08
Ra-228	6.97E-06	6.97E-06
Th-228	6.59E-05	6.59E-05
Th-228	1.02E-04	1.02E-04
Th-230	4.76E-06	4.76E-06
Ra-226	1.11E-08	1.11E-08
Pb-210	1.68E-11	1.68E-11
Th-232	5.65E-06	5.65E-06
Ra-228	1.38E-06	1.38E-06
Th-228	6.94E-06	6.94E-06
U-234	5.30E-07	5.30E-07
Th-230	6.57E-11	6.57E-11
Ra-226	7.97E-14	7.97E-14
Pb-210	8.33E-17	8.33E-17
U-235	2.16E-06	2.16E-06
Pa-231	3.70E-10	3.70E-10
Ac-227	1.01E-11	1.01E-11
U-238	1.55E-06	1.55E-06
U-234	2.25E-12	2.25E-12
Th-230	1.44E-16	1.44E-16
Ra-226	1.22E-19	1.22E-19
Pb-210	1.45E-22	1.45E-22

RESRAD-BUILD Dose Tables

```
[mrem]
```

		Source	Total
		1	
Receptor	1	2.40E-04	2.40E-04
Total		2.40E-04	2.40E-04

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 07:56:28 Page: 13 **
 Title : SLDS DCGL Resident EMC 50 m2
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res EMC 50m2.bld
 Evaluation Time: 3.00000000 years

Pathway Detail of Doses

[mrem]

Source: 1

	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	4.15E-05	3.58E-05	2.92E-10	5.52E-11	4.34E-07	1.62E-04	0.00E+00	2.40E-04
Total	4.15E-05	3.58E-05	2.92E-10	5.52E-11	4.34E-07	1.62E-04	0.00E+00	2.40E-04

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 07:56:28 Page: 14 **
 Title : SLDS DCGL Resident EMC 50 m2
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res EMC 50m2.bld
 Evaluation Time: 3.00000000 years

Nuclide Detail of Doses

[mrem]

Source: 1

Nuclide	Receptor	Total
	1	
Ac-227	1.17E-05	1.17E-05
Pa-231	1.17E-05	1.17E-05
Ac-227	1.38E-06	1.38E-06
Pb-210	9.72E-07	9.72E-07
Ra-226	1.70E-05	1.70E-05
Pb-210	1.12E-07	1.12E-07
Ra-228	5.45E-06	5.45E-06
Th-228	9.73E-05	9.73E-05
Th-228	4.91E-05	4.91E-05
Th-230	4.76E-06	4.76E-06
Ra-226	2.58E-08	2.58E-08
Pb-210	8.71E-11	8.71E-11
Th-232	5.65E-06	5.65E-06
Ra-228	2.85E-06	2.85E-06
Th-228	2.74E-05	2.74E-05
U-234	5.30E-07	5.30E-07
Th-230	1.53E-10	1.53E-10
Ra-226	4.18E-13	4.18E-13
Pb-210	9.55E-16	9.55E-16
U-235	2.15E-06	2.15E-06
Pa-231	8.63E-10	8.63E-10
Ac-227	5.25E-11	5.25E-11
U-238	1.55E-06	1.55E-06
U-234	5.24E-12	5.24E-12
Th-230	7.62E-16	7.62E-16
Ra-226	1.40E-18	1.40E-18
Pb-210	2.49E-21	2.49E-21

RESRAD-BUILD Dose Tables

```
[mrem]
```

		Source	Total
		1	
Receptor	1	2.34E-04	2.34E-04
Total		2.34E-04	2.34E-04

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 07:56:28 Page: 16 **
 Title : SLDS DCGL Resident EMC 50 m2
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res EMC 50m2.bld
 Evaluation Time: 10.0000000 years

Pathway Detail of Doses

[mrem]

Source: 1

	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	4.04E-05	3.58E-05	2.92E-10	5.52E-11	4.34E-07	1.58E-04	0.00E+00	2.34E-04
Total	4.04E-05	3.58E-05	2.92E-10	5.52E-11	4.34E-07	1.58E-04	0.00E+00	2.34E-04

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 07:56:28 Page: 17 **
 Title : SLDS DCGL Resident EMC 50 m2
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res EMC 50m2.bld
 Evaluation Time: 10.0000000 years

Nuclide Detail of Doses

[mrem]

Source: 1

Nuclide	Receptor 1	Total
Ac-227	9.30E-06	9.30E-06
Pa-231	1.16E-05	1.16E-05
Ac-227	3.69E-06	3.69E-06
Pb-210	7.74E-07	7.74E-07
Ra-226	1.65E-05	1.65E-05
Pb-210	3.00E-07	3.00E-07
Ra-228	2.29E-06	2.29E-06
Th-228	6.59E-05	6.59E-05
Th-228	3.78E-06	3.78E-06
Th-230	4.76E-06	4.76E-06
Ra-226	7.54E-08	7.54E-08
Pb-210	7.20E-10	7.20E-10
Th-232	5.65E-06	5.65E-06
Ra-228	5.82E-06	5.82E-06
Th-228	9.96E-05	9.96E-05
U-234	5.30E-07	5.30E-07
Th-230	4.60E-10	4.60E-10
Ra-226	3.65E-12	3.65E-12
Pb-210	2.38E-14	2.38E-14
U-235	2.10E-06	2.10E-06
Pa-231	2.59E-09	2.59E-09
Ac-227	4.33E-10	4.33E-10
U-238	1.52E-06	1.52E-06
U-234	1.57E-11	1.57E-11
Th-230	6.82E-15	6.82E-15
Ra-226	3.61E-17	3.61E-17
Pb-210	1.80E-19	1.80E-19

		Source Contributions to Receptor Doses	
		[mrem]	
		Source 1	Total
Receptor	1	2.27E-04	2.27E-04
Total		2.27E-04	2.27E-04

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 07:56:28 Page: 19 **
 Title : SLDS DCGL Resident EMC 50 m2
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res EMC 50m2.bld
 Evaluation Time: 20.0000000 years

Pathway Detail of Doses

[mrem]

Source: 1

	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	3.89E-05	3.58E-05	2.92E-10	5.52E-11	4.34E-07	1.52E-04	0.00E+00	2.27E-04
Total	3.89E-05	3.58E-05	2.92E-10	5.52E-11	4.34E-07	1.52E-04	0.00E+00	2.27E-04

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 07:56:28 Page: 20 **
 Title : SLDS DCGL Resident EMC 50 m2
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res EMC 50m2.bld
 Evaluation Time: 20.0000000 years

Nuclide Detail of Doses

[mrem]

Source: 1

Nuclide	Receptor 1	Total
Ac-227	6.68E-06	6.68E-06
Pa-231	1.16E-05	1.16E-05
Ac-227	6.14E-06	6.14E-06
Pb-210	5.60E-07	5.60E-07
Ra-226	1.59E-05	1.59E-05
Pb-210	4.99E-07	4.99E-07
Ra-228	6.62E-07	6.62E-07
Th-228	2.05E-05	2.05E-05
Th-228	9.69E-08	9.69E-08
Th-230	4.76E-06	4.76E-06
Ra-226	1.42E-07	1.42E-07
Pb-210	2.46E-09	2.46E-09
Th-232	5.65E-06	5.65E-06
Ra-228	7.17E-06	7.17E-06
Th-228	1.42E-04	1.42E-04
U-234	5.29E-07	5.29E-07
Th-230	8.97E-10	8.97E-10
Ra-226	1.34E-11	1.34E-11
Pb-210	1.62E-13	1.62E-13
U-235	2.04E-06	2.04E-06
Pa-231	5.04E-09	5.04E-09
Ac-227	1.48E-09	1.48E-09
U-238	1.48E-06	1.48E-06
U-234	3.06E-11	3.06E-11
Th-230	2.60E-14	2.60E-14
Ra-226	2.58E-16	2.58E-16
Pb-210	2.42E-18	2.42E-18

		Source Contributions to Receptor Doses	
		[mrem]	
		Source 1	Total
Receptor	1	1.85E-04	1.85E-04
Total		1.85E-04	1.85E-04

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 07:56:28 Page: 22 **
 Title : SLDS DCGL Resident EMC 50 m2
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res EMC 50m2.bld
 Evaluation Time: 30.0000000 years

Pathway Detail of Doses

[mrem]

Source: 1

	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	3.78E-05	4.51E-17	8.92E-22	6.96E-23	1.32E-18	1.48E-04	0.00E+00	1.85E-04
Total	3.78E-05	4.51E-17	8.92E-22	6.96E-23	1.32E-18	1.48E-04	0.00E+00	1.85E-04

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 07:56:28 Page: 23 **
 Title : SLDS DCGL Resident EMC 50 m2
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res EMC 50m2.bld
 Evaluation Time: 30.0000000 years

Nuclide Detail of Doses

[mrem]

Source: 1

Nuclide	Receptor	Total
	1	
Ac-227	1.58E-06	1.58E-06
Pa-231	5.01E-07	5.01E-07
Ac-227	2.59E-06	2.59E-06
Pb-210	1.27E-07	1.27E-07
Ra-226	1.48E-05	1.48E-05
Pb-210	2.01E-07	2.01E-07
Ra-228	1.69E-07	1.69E-07
Th-228	5.92E-06	5.92E-06
Th-228	2.47E-09	2.47E-09
Th-230	1.53E-08	1.53E-08
Ra-226	1.97E-07	1.97E-07
Pb-210	1.54E-09	1.54E-09
Th-232	1.21E-08	1.21E-08
Ra-228	6.51E-06	6.51E-06
Th-228	1.50E-04	1.50E-04
U-234	1.59E-08	1.59E-08
Th-230	4.28E-12	4.28E-12
Ra-226	2.77E-11	2.77E-11
Pb-210	1.55E-13	1.55E-13
U-235	1.54E-06	1.54E-06
Pa-231	3.24E-10	3.24E-10
Ac-227	9.70E-10	9.70E-10
U-238	1.01E-06	1.01E-06
U-234	1.37E-12	1.37E-12
Th-230	1.84E-16	1.84E-16
Ra-226	7.98E-16	7.98E-16
Pb-210	3.49E-18	3.49E-18

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 07:56:28 Page: 24 **
 Title : SLDS DCGL Resident EMC 50 m2
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res EMC 50m2.bld
 Evaluation Time: 100.000008 years

RESRAD-BUILD Dose Tables

Source Contributions to Receptor Doses

[mrem]

	Source	Total
	1	
Receptor 1	1.85E-04	1.85E-04
Total	1.85E-04	1.85E-04

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 07:56:28 Page: 25 **
 Title : SLDS DCGL Resident EMC 50 m2
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res EMC 50m2.bld
 Evaluation Time: 100.000008 years

Pathway Detail of Doses

[mrem]

Source: 1

	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	3.78E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.48E-04	0.00E+00	1.85E-04
Total	3.78E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.48E-04	0.00E+00	1.85E-04

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 07:56:28 Page: 26 **
 Title : SLDS DCGL Resident EMC 50 m2
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res EMC 50m2.bld
 Evaluation Time: 100.000008 years

Nuclide Detail of Doses

[mrem]

Source: 1

Nuclide	Receptor	Total
	1	
Ac-227	1.70E-07	1.70E-07
Pa-231	5.01E-07	5.01E-07
Ac-227	4.00E-06	4.00E-06
Pb-210	1.43E-08	1.43E-08
Ra-226	1.44E-05	1.44E-05
Pb-210	3.06E-07	3.06E-07
Ra-228	3.66E-11	3.66E-11
Th-228	1.28E-09	1.28E-09
Th-228	2.34E-20	2.34E-20
Th-230	1.53E-08	1.53E-08
Ra-226	6.41E-07	6.41E-07
Pb-210	9.82E-09	9.82E-09
Th-232	1.21E-08	1.21E-08
Ra-228	6.68E-06	6.68E-06
Th-228	1.56E-04	1.56E-04
U-234	1.59E-08	1.59E-08
Th-230	1.41E-11	1.41E-11
Ra-226	2.98E-10	2.98E-10
Pb-210	3.65E-12	3.65E-12
U-235	1.54E-06	1.54E-06
Pa-231	1.07E-09	1.07E-09
Ac-227	6.21E-09	6.21E-09
U-238	1.01E-06	1.01E-06
U-234	4.52E-12	4.52E-12
Th-230	2.00E-15	2.00E-15
Ra-226	2.83E-14	2.83E-14
Pb-210	2.91E-16	2.91E-16

		Source Contributions to Receptor Doses	
		[mrem]	
		Source 1	Total
Receptor	1	1.85E-04	1.85E-04
Total		1.85E-04	1.85E-04

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 07:56:28 Page: 28 **
 Title : SLDS DCGL Resident EMC 50 m2
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res EMC 50m2.bld
 Evaluation Time: 300.000031 years

Pathway Detail of Doses

[mrem]

Source: 1

	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	3.78E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.48E-04	0.00E+00	1.85E-04
Total	3.78E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.48E-04	0.00E+00	1.85E-04

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 07:56:28 Page: 29 **
 Title : SLDS DCGL Resident EMC 50 m2
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res EMC 50m2.bld
 Evaluation Time: 300.000031 years

Nuclide Detail of Doses

[mrem]

Source: 1

Nuclide	Receptor 1	Total
Ac-227	2.92E-10	2.92E-10
Pa-231	4.99E-07	4.99E-07
Ac-227	4.15E-06	4.15E-06
Pb-210	2.78E-11	2.78E-11
Ra-226	1.32E-05	1.32E-05
Pb-210	2.94E-07	2.94E-07
Ra-228	1.24E-21	1.24E-21
Th-228	4.34E-20	4.34E-20
Th-228	0.00E+00	0.00E+00
Th-230	1.52E-08	1.52E-08
Ra-226	1.83E-06	1.83E-06
Pb-210	3.62E-08	3.62E-08
Th-232	1.21E-08	1.21E-08
Ra-228	6.68E-06	6.68E-06
Th-228	1.56E-04	1.56E-04
U-234	1.59E-08	1.59E-08
Th-230	4.21E-11	4.21E-11
Ra-226	2.59E-09	2.59E-09
Pb-210	4.62E-11	4.62E-11
U-235	1.54E-06	1.54E-06
Pa-231	3.18E-09	3.18E-09
Ac-227	2.37E-08	2.37E-08
U-238	1.01E-06	1.01E-06
U-234	1.35E-11	1.35E-11
Th-230	1.79E-14	1.79E-14
Ra-226	7.40E-13	7.40E-13
Pb-210	1.21E-14	1.21E-14

RESRAD-BUILD Dose Tables

```
[mrem]
```

		Source 1	Total
Receptor	1	1.85E-04	1.85E-04
Total		1.85E-04	1.85E-04

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 07:56:28 Page: 31 **
 Title : SLDS DCGL Resident EMC 50 m2
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res EMC 50m2.bld
 Evaluation Time: 1000.00000 years

Pathway Detail of Doses

[mrem]

Source: 1

	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	3.78E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.48E-04	0.00E+00	1.85E-04
Total	3.78E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.48E-04	0.00E+00	1.85E-04

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 07:56:28 Page: 32 **
 Title : SLDS DCGL Resident EMC 50 m2
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res EMC 50m2.bld
 Evaluation Time: 1000.00000 years

Nuclide Detail of Doses

[mrem]

Source: 1

Nuclide	Receptor	Total
	1	
Ac-227	6.13E-20	6.13E-20
Pa-231	4.91E-07	4.91E-07
Ac-227	4.09E-06	4.09E-06
Pb-210	8.95E-21	8.95E-21
Ra-226	9.75E-06	9.75E-06
Pb-210	2.17E-07	2.17E-07
Ra-228	0.00E+00	0.00E+00
Th-228	0.00E+00	0.00E+00
Th-228	0.00E+00	0.00E+00
Th-230	1.51E-08	1.51E-08
Ra-226	5.26E-06	5.26E-06
Pb-210	1.13E-07	1.13E-07
Th-232	1.21E-08	1.21E-08
Ra-228	6.68E-06	6.68E-06
Th-228	1.56E-04	1.56E-04
U-234	1.59E-08	1.59E-08
Th-230	1.40E-10	1.40E-10
Ra-226	2.60E-08	2.60E-08
Pb-210	5.37E-10	5.37E-10
U-235	1.54E-06	1.54E-06
Pa-231	1.05E-08	1.05E-08
Ac-227	8.48E-08	8.48E-08
U-238	1.01E-06	1.01E-06
U-234	4.50E-11	4.50E-11
Th-230	1.98E-13	1.98E-13
Ra-226	2.53E-11	2.53E-11
Pb-210	5.08E-13	5.08E-13

** RESRAD-BUILD Risk Program Output, Version 4.0 02/15/24 07:59:56 Page: 1 **
 Title : SLDS DCGL Resident EMC 50 m2
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res EMC 50m2.bld

=====	
=====	
=====	=====
RESRAD-BUILD Table of Contents	=====
=====	=====
=====	

RESRAD-BUILD Input Parameters.....	2
Building Information.....	3
Source Information.....	4
Temporal Risk Summary.....	5
For time = 0.00E+00 yr	
Receptor-Source Risk Summary.....	6
Risk by Pathway Detail.....	7
Risk by Nuclide Detail.....	8
For time = 1.00E+00 yr	
Receptor-Source Risk Summary.....	9
Risk by Pathway Detail.....	10
Risk by Nuclide Detail.....	11
For time = 3.00E+00 yr	
Receptor-Source Risk Summary.....	12
Risk by Pathway Detail.....	13
Risk by Nuclide Detail.....	14
For time = 1.00E+01 yr	
Receptor-Source Risk Summary.....	15
Risk by Pathway Detail.....	16
Risk by Nuclide Detail.....	17
For time = 2.00E+01 yr	
Receptor-Source Risk Summary.....	18
Risk by Pathway Detail.....	19
Risk by Nuclide Detail.....	20
For time = 3.00E+01 yr	
Receptor-Source Risk Summary.....	21
Risk by Pathway Detail.....	22
Risk by Nuclide Detail.....	23
For time = 1.00E+02 yr	
Receptor-Source Risk Summary.....	24
Risk by Pathway Detail.....	25
Risk by Nuclide Detail.....	26
For time = 3.00E+02 yr	
Receptor-Source Risk Summary.....	27
Risk by Pathway Detail.....	28
Risk by Nuclide Detail.....	29
For time = 1.00E+03 yr	
Receptor-Source Risk Summary.....	30
Risk by Pathway Detail.....	31
Risk by Nuclide Detail.....	32

** RESRAD-BUILD Risk Program Output, Version 4.0 02/15/24 07:59:56 Page: 2 **
 Title : SLDS DCGL Resident EMC 50 m2
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res EMC 50m2.bld

```

=====
=====
=====
RESRAD-BUILD Input Parameters
=====
=====
=====
  
```

```

Number of Sources : 1
Number of Receptors: 1
Total Time : 1.095000E+04 days
Fraction Inside : 6.390000E-01
  
```

```

Transformations data from: ICRP107
Cut off half life : 180.000000 days
Library information in the Dose Coefficients and Slope Factors report
  
```

```

===== Receptor Information =====
  
```

Receptor	Room	x [m]	y [m]	z [m]	FracTime	Inhalation [m3/day]	Ingestion(Dust) [m2/hr]
1	1	5.000	5.000	1.000	1.000	1.48E+01	6.90E-04

```

===== Receptor-Source Shielding Relationship =====
  
```

Receptor	Source	Density [g/cm3]	Thickness [cm]	Material
1	1	2.40E+00	0.00E+00	Concrete

** RESRAD-BUILD Risk Program Output, Version 4.0 02/15/24 07:59:56 Page: 3 **
 Title : SLDS DCGL Resident EMC 50 m2
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res EMC 50m2.blc

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

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

Height[m]	Air Exchanges [m3/hr]	
Area [m2]		

	*	*
	*	*
	*	<=Q01: 0.00E+00
H1: 2.500	* Room 1	* Q10 : 0.00E+00
	* LAMBDA: 0.00E+00	*
Area 100.000	*	*
	*	*

Deposition velocity: 3.90E-04 [m/s] Resuspension Rate: 0.00E+00 [1/s]
 Deposition velocity: 5.00E-07 [m/s] Resuspension Rate:

** RESRAD-BUILD Risk Program Output, Version 4.0 02/15/24 07:59:56 Page: 4 **
Title : SLDS DCGL Resident EMC 50 m2
Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res EMC 50m2.bld

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

Source: 1

Location:: Room : 1 x: 5.00 y: 5.00 z: 0.00[m]
Geometry:: Type: Area Area:5.00E+01 [m2] Direction: z
Pathway ::
Direct Ingestion Rate: 0.000E+00 [1/hr]
Fraction released to air: 7.000E-02
Removable fraction: 1.000E-01
Time to Remove: 1.000E+04 [day]

Radon Release Fraction: 1.000E-01

Contamination::
Nuclide Concentration

	[dpm/m2]
Ac-227	1.000E+00
Pa-231	1.000E+00
Pb-210	1.000E+00
Ra-226	1.000E+00
Ra-228	1.000E+00
Th-228	1.000E+00
Th-230	1.000E+00
Th-232	1.000E+00
U-234	1.000E+00
U-235	1.000E+00
U-238	1.000E+00

** RESRAD-BUILD Risk Program Output, Version 4.0 02/15/24 07:59:56 Page: 5 **
 Title : SLDS DCGL Resident EMC 50 m2
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res EMC 50m2.bld
 Temporal Summary

RESRAD-BUILD Temporal Risk Tables

Risk to Receptor over the Exposure Duration

(Risk)

Evaluation Time years	Receptor 1	Total
0.000000000	2.43E-09	2.43E-09
1.000000000	2.41E-09	2.41E-09
3.000000000	2.38E-09	2.38E-09
10.00000000	2.28E-09	2.28E-09
20.00000000	2.17E-09	2.17E-09
30.00000000	2.10E-09	2.10E-09
100.0000080	2.10E-09	2.10E-09
300.0000310	2.10E-09	2.10E-09
1000.000000	2.10E-09	2.10E-09

** RESRAD-BUILD Risk Program Output, Version 4.0 02/15/24 07:59:56 Page: 6 **
 Title : SLDS DCGL Resident EMC 50 m2
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res EMC 50m2.bld
 Evaluation Time: 0.00000000E+00 years

RESRAD-BUILD Risk Tables

Source Contributions to Receptor Risks

[Risk]

	Source	Total
	1	
Receptor 1	2.43E-09	2.43E-09
Total	2.43E-09	2.43E-09

** RESRAD-BUILD Risk Program Output, Version 4.0 02/15/24 07:59:56 Page: 7 **
 Title : SLDS DCGL Resident EMC 50 m2
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res EMC 50m2.bld
 Evaluation Time: 0.00000000E+00 years

Pathway Detail of Risks

[Risk]

Source: 1

	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	9.46E-10	2.14E-10	6.36E-15	1.21E-15	1.97E-12	1.26E-09	0.00E+00	2.43E-09
Total	9.46E-10	2.14E-10	6.36E-15	1.21E-15	1.97E-12	1.26E-09	0.00E+00	2.43E-09

** RESRAD-BUILD Risk Program Output, Version 4.0 02/15/24 07:59:56 Page: 8 **
 Title : SLDS DCGL Resident EMC 50 m2
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res EMC 50m2.bld
 Evaluation Time: 0.00000000E+00 years

Nuclide Detail of Risks

[Risk]

Source: 1

Nuclide	Receptor	Total
	1	
Ac-227	1.11E-10	1.11E-10
Pa-231	3.62E-11	3.62E-11
Ac-227	5.79E-11	5.79E-11
Pb-210	1.07E-11	1.07E-11
Ra-226	3.92E-10	3.92E-10
Pb-210	5.38E-12	5.38E-12
Ra-228	5.07E-11	5.07E-11
Th-228	4.12E-10	4.12E-10
Th-228	1.46E-10	1.46E-10
Th-230	1.10E-11	1.10E-11
Ra-226	2.50E-12	2.50E-12
Pb-210	2.35E-14	2.35E-14
Th-232	1.38E-11	1.38E-11
Ra-228	1.32E-10	1.32E-10
Th-228	9.61E-10	9.61E-10
U-234	9.04E-12	9.04E-12
Th-230	1.39E-15	1.39E-15
Ra-226	2.27E-16	2.27E-16
Pb-210	1.59E-18	1.59E-18
U-235	4.57E-11	4.57E-11
Pa-231	1.08E-14	1.08E-14
Ac-227	1.26E-14	1.26E-14
U-238	3.05E-11	3.05E-11
U-234	3.51E-16	3.51E-16
Th-230	3.60E-20	3.60E-20
Ra-226	4.78E-21	4.78E-21
Pb-210	2.62E-23	2.62E-23

** RESRAD-BUILD Risk Program Output, Version 4.0 02/15/24 07:59:56 Page: 10 **
 Title : SLDS DCGL Resident EMC 50 m2
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res EMC 50m2.bld
 Evaluation Time: 1.00000000 years

Pathway Detail of Risks

[Risk]

Source: 1

	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	9.43E-10	2.07E-10	6.15E-15	1.16E-15	1.90E-12	1.26E-09	0.00E+00	2.41E-09
Total	9.43E-10	2.07E-10	6.15E-15	1.16E-15	1.90E-12	1.26E-09	0.00E+00	2.41E-09

** RESRAD-BUILD Risk Program Output, Version 4.0 02/15/24 07:59:56 Page: 11 **
 Title : SLDS DCGL Resident EMC 50 m2
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res EMC 50m2.bld
 Evaluation Time: 1.00000000 years

Nuclide Detail of Risks

[Risk]

Source: 1

Nuclide	Receptor	Total
	1	
Ac-227	1.06E-10	1.06E-10
Pa-231	3.54E-11	3.54E-11
Ac-227	5.98E-11	5.98E-11
Pb-210	1.03E-11	1.03E-11
Ra-226	3.90E-10	3.90E-10
Pb-210	5.48E-12	5.48E-12
Ra-228	4.48E-11	4.48E-11
Th-228	4.05E-10	4.05E-10
Th-228	1.02E-10	1.02E-10
Th-230	1.06E-11	1.06E-11
Ra-226	2.66E-12	2.66E-12
Pb-210	2.43E-14	2.43E-14
Th-232	1.33E-11	1.33E-11
Ra-228	1.37E-10	1.37E-10
Th-228	1.01E-09	1.01E-09
U-234	8.73E-12	8.73E-12
Th-230	1.39E-15	1.39E-15
Ra-226	2.50E-16	2.50E-16
Pb-210	1.68E-18	1.68E-18
U-235	4.53E-11	4.53E-11
Pa-231	1.10E-14	1.10E-14
Ac-227	1.33E-14	1.33E-14
U-238	3.01E-11	3.01E-11
U-234	3.52E-16	3.52E-16
Th-230	3.61E-20	3.61E-20
Ra-226	5.43E-21	5.43E-21
Pb-210	2.81E-23	2.81E-23

		Source	Total
		1	
Receptor	1	2.38E-09	2.38E-09
Total		2.38E-09	2.38E-09

** RESRAD-BUILD Risk Program Output, Version 4.0 02/15/24 07:59:56 Page: 13 **
 Title : SLDS DCGL Resident EMC 50 m2
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res EMC 50m2.bld
 Evaluation Time: 3.00000000 years

Pathway Detail of Risks

[Risk]

Source: 1

	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	9.36E-10	1.91E-10	5.69E-15	1.08E-15	1.76E-12	1.25E-09	0.00E+00	2.38E-09
Total	9.36E-10	1.91E-10	5.69E-15	1.08E-15	1.76E-12	1.25E-09	0.00E+00	2.38E-09

** RESRAD-BUILD Risk Program Output, Version 4.0 02/15/24 07:59:56 Page: 14 **
 Title : SLDS DCGL Resident EMC 50 m2
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res EMC 50m2.bld
 Evaluation Time: 3.00000000 years

Nuclide Detail of Risks

[Risk]

Source: 1

Nuclide	Receptor	Total
	1	
Ac-227	9.71E-11	9.71E-11
Pa-231	3.36E-11	3.36E-11
Ac-227	6.32E-11	6.32E-11
Pb-210	9.30E-12	9.30E-12
Ra-226	3.87E-10	3.87E-10
Pb-210	5.63E-12	5.63E-12
Ra-228	3.49E-11	3.49E-11
Th-228	3.62E-10	3.62E-10
Th-228	4.88E-11	4.88E-11
Th-230	9.83E-12	9.83E-12
Ra-226	2.97E-12	2.97E-12
Pb-210	2.61E-14	2.61E-14
Th-232	1.23E-11	1.23E-11
Ra-228	1.44E-10	1.44E-10
Th-228	1.09E-09	1.09E-09
U-234	8.10E-12	8.10E-12
Th-230	1.38E-15	1.38E-15
Ra-226	2.99E-16	2.99E-16
Pb-210	1.87E-18	1.87E-18
U-235	4.45E-11	4.45E-11
Pa-231	1.15E-14	1.15E-14
Ac-227	1.50E-14	1.50E-14
U-238	2.95E-11	2.95E-11
U-234	3.50E-16	3.50E-16
Th-230	3.64E-20	3.64E-20
Ra-226	6.93E-21	6.93E-21
Pb-210	3.27E-23	3.27E-23

** RESRAD-BUILD Risk Program Output, Version 4.0 02/15/24 07:59:56 Page: 16 **
 Title : SLDS DCGL Resident EMC 50 m2
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res EMC 50m2.bld
 Evaluation Time: 10.0000000 years

Pathway Detail of Risks

[Risk]

Source: 1

	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	9.19E-10	1.36E-10	4.06E-15	7.68E-16	1.26E-12	1.23E-09	0.00E+00	2.28E-09
Total	9.19E-10	1.36E-10	4.06E-15	7.68E-16	1.26E-12	1.23E-09	0.00E+00	2.28E-09

** RESRAD-BUILD Risk Program Output, Version 4.0 02/15/24 07:59:56 Page: 17 **
 Title : SLDS DCGL Resident EMC 50 m2
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res EMC 50m2.bld
 Evaluation Time: 10.0000000 years

Nuclide Detail of Risks

[Risk]

Source: 1

Nuclide	Receptor	Total
	1	
Ac-227	7.03E-11	7.03E-11
Pa-231	2.73E-11	2.73E-11
Ac-227	7.10E-11	7.10E-11
Pb-210	6.39E-12	6.39E-12
Ra-226	3.76E-10	3.76E-10
Pb-210	5.74E-12	5.74E-12
Ra-228	1.46E-11	1.46E-11
Th-228	1.76E-10	1.76E-10
Th-228	3.76E-12	3.76E-12
Th-230	7.11E-12	7.11E-12
Ra-226	4.05E-12	4.05E-12
Pb-210	3.28E-14	3.28E-14
Th-232	8.86E-12	8.86E-12
Ra-228	1.58E-10	1.58E-10
Th-228	1.28E-09	1.28E-09
U-234	5.87E-12	5.87E-12
Th-230	1.24E-15	1.24E-15
Ra-226	5.17E-16	5.17E-16
Pb-210	2.81E-18	2.81E-18
U-235	4.17E-11	4.17E-11
Pa-231	1.24E-14	1.24E-14
Ac-227	2.15E-14	2.15E-14
U-238	2.71E-11	2.71E-11
U-234	3.16E-16	3.16E-16
Th-230	3.61E-20	3.61E-20
Ra-226	1.47E-20	1.47E-20
Pb-210	5.91E-23	5.91E-23

** RESRAD-BUILD Risk Program Output, Version 4.0 02/15/24 07:59:56 Page: 19 **
 Title : SLDS DCGL Resident EMC 50 m2
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res EMC 50m2.bld
 Evaluation Time: 20.0000000 years

Pathway Detail of Risks

[Risk]

Source: 1

	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	9.04E-10	5.81E-11	1.74E-15	3.27E-16	5.38E-13	1.21E-09	0.00E+00	2.17E-09
Total	9.04E-10	5.81E-11	1.74E-15	3.27E-16	5.38E-13	1.21E-09	0.00E+00	2.17E-09

** RESRAD-BUILD Risk Program Output, Version 4.0 02/15/24 07:59:56 Page: 20 **
 Title : SLDS DCGL Resident EMC 50 m2
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res EMC 50m2.bld
 Evaluation Time: 20.0000000 years

Nuclide Detail of Risks

[Risk]

Source: 1

Nuclide	Receptor	Total
	1	
Ac-227	4.18E-11	4.18E-11
Pa-231	1.84E-11	1.84E-11
Ac-227	7.37E-11	7.37E-11
Pb-210	3.24E-12	3.24E-12
Ra-226	3.65E-10	3.65E-10
Pb-210	4.95E-12	4.95E-12
Ra-228	4.14E-12	4.14E-12
Th-228	5.22E-11	5.22E-11
Th-228	9.62E-14	9.62E-14
Th-230	3.23E-12	3.23E-12
Ra-226	5.56E-12	5.56E-12
Pb-210	4.12E-14	4.12E-14
Th-232	3.93E-12	3.93E-12
Ra-228	1.61E-10	1.61E-10
Th-228	1.37E-09	1.37E-09
U-234	2.70E-12	2.70E-12
Th-230	7.40E-16	7.40E-16
Ra-226	9.49E-16	9.49E-16
Pb-210	4.89E-18	4.89E-18
U-235	3.83E-11	3.83E-11
Pa-231	1.21E-14	1.21E-14
Ac-227	3.21E-14	3.21E-14
U-238	2.41E-11	2.41E-11
U-234	1.92E-16	1.92E-16
Th-230	2.71E-20	2.71E-20
Ra-226	3.48E-20	3.48E-20
Pb-210	1.39E-22	1.39E-22

		Source Contributions to Receptor Risks	
		[Risk]	
		Source	Total
	1	1	
Receptor	1	2.10E-09	2.10E-09
Total		2.10E-09	2.10E-09

** RESRAD-BUILD Risk Program Output, Version 4.0 02/15/24 07:59:56 Page: 22 **
 Title : SLDS DCGL Resident EMC 50 m2
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res EMC 50m2.bld
 Evaluation Time: 30.0000000 years

Pathway Detail of Risks

[Risk]

Source: 1

	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	9.00E-10	9.87E-24	7.09E-28	5.55E-29	2.19E-25	1.20E-09	0.00E+00	2.10E-09
Total	9.00E-10	9.87E-24	7.09E-28	5.55E-29	2.19E-25	1.20E-09	0.00E+00	2.10E-09

** RESRAD-BUILD Risk Program Output, Version 4.0 02/15/24 07:59:56 Page: 23 **
 Title : SLDS DCGL Resident EMC 50 m2
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res EMC 50m2.bld
 Evaluation Time: 30.0000000 years

Nuclide Detail of Risks

[Risk]

Source: 1

Nuclide	Receptor 1	Total
Ac-227	2.41E-11	2.41E-11
Pa-231	1.19E-11	1.19E-11
Ac-227	7.30E-11	7.30E-11
Pb-210	1.36E-12	1.36E-12
Ra-226	3.60E-10	3.60E-10
Pb-210	3.95E-12	3.95E-12
Ra-228	1.16E-12	1.16E-12
Th-228	1.52E-11	1.52E-11
Th-228	2.43E-15	2.43E-15
Th-230	3.50E-13	3.50E-13
Ra-226	7.08E-12	7.08E-12
Pb-210	4.87E-14	4.87E-14
Th-232	2.71E-13	2.71E-13
Ra-228	1.59E-10	1.59E-10
Th-228	1.39E-09	1.39E-09
U-234	3.50E-13	3.50E-13
Th-230	1.45E-16	1.45E-16
Ra-226	1.52E-15	1.52E-15
Pb-210	7.93E-18	7.93E-18
U-235	3.60E-11	3.60E-11
Pa-231	1.13E-14	1.13E-14
Ac-227	4.39E-14	4.39E-14
U-238	2.20E-11	2.20E-11
U-234	4.45E-17	4.45E-17
Th-230	9.54E-21	9.54E-21
Ra-226	6.93E-20	6.93E-20
Pb-210	2.95E-22	2.95E-22

		Source 1	Total
Receptor	1	2.10E-09	2.10E-09
Total		2.10E-09	2.10E-09

** RESRAD-BUILD Risk Program Output, Version 4.0 02/15/24 07:59:56 Page: 25 **
 Title : SLDS DCGL Resident EMC 50 m2
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res EMC 50m2.bld
 Evaluation Time: 100.000008 years

Pathway Detail of Risks

[Risk]

Source: 1

	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	9.00E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.20E-09	0.00E+00	2.10E-09
Total	9.00E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.20E-09	0.00E+00	2.10E-09

** RESRAD-BUILD Risk Program Output, Version 4.0 02/15/24 07:59:56 Page: 26 **
 Title : SLDS DCGL Resident EMC 50 m2
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res EMC 50m2.bld
 Evaluation Time: 100.000008 years

Nuclide Detail of Risks

[Risk]

Source: 1

Nuclide	Receptor	Total
	1	
Ac-227	2.59E-12	2.59E-12
Pa-231	1.19E-11	1.19E-11
Ac-227	9.44E-11	9.44E-11
Pb-210	1.53E-13	1.53E-13
Ra-226	3.49E-10	3.49E-10
Pb-210	5.02E-12	5.02E-12
Ra-228	2.51E-16	2.51E-16
Th-228	3.29E-15	3.29E-15
Th-228	2.31E-26	2.31E-26
Th-230	3.50E-13	3.50E-13
Ra-226	1.78E-11	1.78E-11
Pb-210	1.91E-13	1.91E-13
Th-232	2.71E-13	2.71E-13
Ra-228	1.60E-10	1.60E-10
Th-228	1.40E-09	1.40E-09
U-234	3.50E-13	3.50E-13
Th-230	3.70E-16	3.70E-16
Ra-226	9.56E-15	9.56E-15
Pb-210	8.34E-17	8.34E-17
U-235	3.60E-11	3.60E-11
Pa-231	2.90E-14	2.90E-14
Ac-227	1.73E-13	1.73E-13
U-238	2.20E-11	2.20E-11
U-234	1.14E-16	1.14E-16
Th-230	6.04E-20	6.04E-20
Ra-226	1.05E-18	1.05E-18
Pb-210	7.80E-21	7.80E-21

** RESRAD-BUILD Risk Program Output, Version 4.0 02/15/24 07:59:56 Page: 27 **
 Title : SLDS DCGL Resident EMC 50 m2
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res EMC 50m2.bld
 Evaluation Time: 300.000031 years

RESRAD-BUILD Risk Tables

Source Contributions to Receptor Risks

	[Risk]	
	Source	Total
	1	
Receptor 1	2.10E-09	2.10E-09
Total	2.10E-09	2.10E-09

** RESRAD-BUILD Risk Program Output, Version 4.0 02/15/24 07:59:56 Page: 28 **
 Title : SLDS DCGL Resident EMC 50 m2
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res EMC 50m2.bld
 Evaluation Time: 300.000031 years

Pathway Detail of Risks

[Risk]

Source: 1

	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	9.00E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.20E-09	0.00E+00	2.10E-09
Total	9.00E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.20E-09	0.00E+00	2.10E-09

** RESRAD-BUILD Risk Program Output, Version 4.0 02/15/24 07:59:56 Page: 29 **
 Title : SLDS DCGL Resident EMC 50 m2
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res EMC 50m2.bld
 Evaluation Time: 300.000031 years

Nuclide Detail of Risks

[Risk]

Source: 1

Nuclide	Receptor 1	Total
Ac-227	4.45E-15	4.45E-15
Pa-231	1.18E-11	1.18E-11
Ac-227	9.66E-11	9.66E-11
Pb-210	2.98E-16	2.98E-16
Ra-226	3.20E-10	3.20E-10
Pb-210	4.74E-12	4.74E-12
Ra-228	8.50E-27	8.50E-27
Th-228	1.11E-25	1.11E-25
Th-228	0.00E+00	0.00E+00
Th-230	3.49E-13	3.49E-13
Ra-226	4.68E-11	4.68E-11
Pb-210	6.17E-13	6.17E-13
Th-232	2.71E-13	2.71E-13
Ra-228	1.60E-10	1.60E-10
Th-228	1.40E-09	1.40E-09
U-234	3.50E-13	3.50E-13
Th-230	1.01E-15	1.01E-15
Ra-226	6.93E-14	6.93E-14
Pb-210	8.31E-16	8.31E-16
U-235	3.60E-11	3.60E-11
Pa-231	7.92E-14	7.92E-14
Ac-227	5.81E-13	5.81E-13
U-238	2.20E-11	2.20E-11
U-234	3.12E-16	3.12E-16
Th-230	4.51E-19	4.51E-19
Ra-226	2.08E-17	2.08E-17
Pb-210	2.29E-19	2.29E-19

** RESRAD-BUILD Risk Program Output, Version 4.0 02/15/24 07:59:56 Page: 31 **
 Title : SLDS DCGL Resident EMC 50 m2
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res EMC 50m2.bld
 Evaluation Time: 1000.00000 years

Pathway Detail of Risks

[Risk]

Source: 1

	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	9.00E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.20E-09	0.00E+00	2.10E-09
Total	9.00E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.20E-09	0.00E+00	2.10E-09

** RESRAD-BUILD Risk Program Output, Version 4.0 02/15/24 07:59:56 Page: 32 **
 Title : SLDS DCGL Resident EMC 50 m2
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res EMC 50m2.bld
 Evaluation Time: 1000.00000 years

Nuclide Detail of Risks

[Risk]

Source: 1

Nuclide	Receptor	Total
	1	
Ac-227	9.33E-25	9.33E-25
Pa-231	1.17E-11	1.17E-11
Ac-227	9.51E-11	9.51E-11
Pb-210	9.59E-26	9.59E-26
Ra-226	2.37E-10	2.37E-10
Pb-210	3.50E-12	3.50E-12
Ra-228	0.00E+00	0.00E+00
Th-228	0.00E+00	0.00E+00
Th-228	0.00E+00	0.00E+00
Th-230	3.47E-13	3.47E-13
Ra-226	1.30E-10	1.30E-10
Pb-210	1.85E-12	1.85E-12
Th-232	2.71E-13	2.71E-13
Ra-228	1.60E-10	1.60E-10
Th-228	1.40E-09	1.40E-09
U-234	3.49E-13	3.49E-13
Th-230	3.25E-15	3.25E-15
Ra-226	6.51E-13	6.51E-13
Pb-210	8.97E-15	8.97E-15
U-235	3.60E-11	3.60E-11
Pa-231	2.53E-13	2.53E-13
Ac-227	2.00E-12	2.00E-12
U-238	2.20E-11	2.20E-11
U-234	1.00E-15	1.00E-15
Th-230	4.66E-18	4.66E-18
Ra-226	6.45E-16	6.45E-16
Pb-210	8.61E-18	8.61E-18

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 08:03:27 Page: 1 **
 Title : SLDS DCGL Resident EMC 10 m2
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res EMC 10m2 2024.bld

RESRAD-BUILD Table of Contents

RESRAD-BUILD Input Parameters.....	2
Building Information.....	3
Source Information.....	4
Temporal Dose Summary.....	5
For time = 0.00E+00 yr	
Receptor-Source Dose Summary.....	6
Dose by Pathway Detail.....	7
Dose by Nuclide Detail.....	8
For time = 1.00E+00 yr	
Receptor-Source Dose Summary.....	9
Dose by Pathway Detail.....	10
Dose by Nuclide Detail.....	11
For time = 3.00E+00 yr	
Receptor-Source Dose Summary.....	12
Dose by Pathway Detail.....	13
Dose by Nuclide Detail.....	14
For time = 1.00E+01 yr	
Receptor-Source Dose Summary.....	15
Dose by Pathway Detail.....	16
Dose by Nuclide Detail.....	17
For time = 2.00E+01 yr	
Receptor-Source Dose Summary.....	18
Dose by Pathway Detail.....	19
Dose by Nuclide Detail.....	20
For time = 3.00E+01 yr	
Receptor-Source Dose Summary.....	21
Dose by Pathway Detail.....	22
Dose by Nuclide Detail.....	23
For time = 1.00E+02 yr	
Receptor-Source Dose Summary.....	24
Dose by Pathway Detail.....	25
Dose by Nuclide Detail.....	26
For time = 3.00E+02 yr	
Receptor-Source Dose Summary.....	27
Dose by Pathway Detail.....	28
Dose by Nuclide Detail.....	29
For time = 1.00E+03 yr	
Receptor-Source Dose Summary.....	30
Dose by Pathway Detail.....	31
Dose by Nuclide Detail.....	32

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 08:03:27 Page: 2 **
 Title : SLDS DCGL Resident EMC 10 m2
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res EMC 10m2 2024.bld

```

=====
=====
=====
RESRAD-BUILD Input Parameters
=====
=====
=====
  
```

```

Number of Sources : 1
Number of Receptors: 1
Total Time : 3.650000E+02 days
Fraction Inside : 6.390000E-01
  
```

```

Transformations data from: ICRP107
Cut off half life : 180.000000 days
Library information in the Dose Coefficients and Slope Factors report
  
```

```

===== Receptor Information =====
  
```

Receptor	Room	x [m]	y [m]	z [m]	FracTime	Inhalation [m3/day]	Ingestion(Dust) [m2/hr]
1	1	5.000	5.000	1.000	1.000	1.48E+01	6.90E-04

```

===== Receptor-Source Shielding Relationship =====
  
```

Receptor	Source	Density [g/cm3]	Thickness [cm]	Material
1	1	2.40E+00	0.00E+00	Concrete

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 08:03:27 Page: 3 **
 Title : SLDS DCGL Resident EMC 10 m2
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res EMC 10m2 2024.bld

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

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

Height[m]	Air Exchanges [m3/hr]	
Area [m2]		

	*	*
	*	*
	*	<=Q01: 0.00E+00
H1: 2.500	* Room 1	* Q10 : 0.00E+00
	* LAMBDA: 0.00E+00	*
Area 100.000	*	*
	*	*

Deposition velocity: 3.90E-04 [m/s] Resuspension Rate: 0.00E+00 [1/s]
 Deposition velocity: 5.00E-07 [m/s] Resuspension Rate:

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 08:03:27 Page: 4 **
Title : SLDS DCGL Resident EMC 10 m2
Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res EMC 10m2 2024.bld

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

Source: 1
Location:: Room : 1 x: 5.00 y: 5.00 z: 0.00[m]
Geometry:: Type: Area Area:1.00E+01 [m2] Direction: z
Pathway ::
Direct Ingestion Rate: 0.000E+00 [1/hr]
Fraction released to air: 7.000E-02
Removable fraction: 1.000E-01
Time to Remove: 1.000E+04 [day]

Radon Release Fraction: 1.000E-01

Contamination::
Nuclide Concentration

	[dpm/m2]
Ac-227	1.000E+00
Pa-231	1.000E+00
Pb-210	1.000E+00
Ra-226	1.000E+00
Ra-228	1.000E+00
Th-228	1.000E+00
Th-230	1.000E+00
Th-232	1.000E+00
U-234	1.000E+00
U-235	1.000E+00
U-238	1.000E+00

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 08:03:27 Page: 5 **
 Title : SLDS DCGL Resident EMC 10 m2
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res EMC 10m2 2024.bld
 Temporal Summary

RESRAD-BUILD Temporal Dose Tables

Dose to Receptor over the Exposure Duration

(mrem)

Evaluation Time years	Receptor 1	Total
0.000000000	6.13E-05	6.13E-05
1.000000000	6.15E-05	6.15E-05
3.000000000	6.11E-05	6.11E-05
10.00000000	5.97E-05	5.97E-05
20.00000000	5.77E-05	5.77E-05
30.00000000	4.91E-05	4.91E-05
100.0000080	4.91E-05	4.91E-05
300.0000310	4.91E-05	4.91E-05
1000.000000	4.91E-05	4.91E-05

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 08:03:27 Page: 6 **
 Title : SLDS DCGL Resident EMC 10 m2
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res EMC 10m2 2024.bld
 Evaluation Time: 0.00000000E+00 years

RESRAD-BUILD Dose Tables

Source Contributions to Receptor Doses

[mrem]

	Source	Total
	1	
Receptor 1	6.13E-05	6.13E-05
Total	6.13E-05	6.13E-05

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 08:03:27 Page: 7 **
 Title : SLDS DCGL Resident EMC 10 m2
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res EMC 10m2 2024.bld
 Evaluation Time: 0.00000000E+00 years

Pathway Detail of Doses

[mrem]

Source: 1

	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	2.17E-05	6.83E-06	5.21E-11	1.06E-11	7.74E-08	3.28E-05	0.00E+00	6.13E-05
Total	2.17E-05	6.83E-06	5.21E-11	1.06E-11	7.74E-08	3.28E-05	0.00E+00	6.13E-05

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 08:03:27 Page: 8 **
 Title : SLDS DCGL Resident EMC 10 m2
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res EMC 10m2 2024.bld
 Evaluation Time: 0.00000000E+00 years

Nuclide Detail of Doses

[mrem]

Source: 1

Nuclide	Receptor 1	Total
Ac-227	4.03E-06	4.03E-06
Pa-231	2.47E-06	2.47E-06
Ac-227	6.54E-08	6.54E-08
Pb-210	3.27E-07	3.27E-07
Ra-226	7.88E-06	7.88E-06
Pb-210	5.23E-09	5.23E-09
Ra-228	3.75E-06	3.75E-06
Th-228	5.99E-06	5.99E-06
Th-228	3.25E-05	3.25E-05
Th-230	9.18E-07	9.18E-07
Ra-226	1.71E-09	1.71E-09
Pb-210	7.60E-13	7.60E-13
Th-232	1.09E-06	1.09E-06
Ra-228	2.31E-07	2.31E-07
Th-228	2.50E-07	2.50E-07
U-234	1.10E-07	1.10E-07
Th-230	4.37E-12	4.37E-12
Ra-226	5.22E-15	5.22E-15
Pb-210	1.75E-18	1.75E-18
U-235	1.04E-06	1.04E-06
Pa-231	2.69E-11	2.69E-11
Ac-227	4.63E-13	4.63E-13
U-238	6.66E-07	6.66E-07
U-234	1.60E-13	1.60E-13
Th-230	4.14E-18	4.14E-18
Ra-226	2.69E-21	2.69E-21
Pb-210	1.69E-24	1.69E-24

RESRAD-BUILD Dose Tables

```
[mrem]
```

		Source	Total
		1	
Receptor	1	6.15E-05	6.15E-05
Total		6.15E-05	6.15E-05

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 08:03:27 Page: 10 **
 Title : SLDS DCGL Resident EMC 10 m2
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res EMC 10m2 2024.bld
 Evaluation Time: 1.00000000 years

Pathway Detail of Doses

[mrem]

Source: 1

	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	2.16E-05	7.15E-06	5.85E-11	1.10E-11	8.68E-08	3.26E-05	0.00E+00	6.15E-05
Total	2.16E-05	7.15E-06	5.85E-11	1.10E-11	8.68E-08	3.26E-05	0.00E+00	6.15E-05

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 08:03:27 Page: 11 **
 Title : SLDS DCGL Resident EMC 10 m2
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res EMC 10m2 2024.bld
 Evaluation Time: 1.00000000 years

Nuclide Detail of Doses

[mrem]

Source: 1

Nuclide	Receptor 1	Total
Ac-227	3.97E-06	3.97E-06
Pa-231	2.57E-06	2.57E-06
Ac-227	1.94E-07	1.94E-07
Pb-210	3.25E-07	3.25E-07
Ra-226	7.85E-06	7.85E-06
Pb-210	1.55E-08	1.55E-08
Ra-228	3.32E-06	3.32E-06
Th-228	1.45E-05	1.45E-05
Th-228	2.26E-05	2.26E-05
Th-230	9.60E-07	9.60E-07
Ra-226	5.10E-09	5.10E-09
Pb-210	5.27E-12	5.27E-12
Th-232	1.14E-06	1.14E-06
Ra-228	6.56E-07	6.56E-07
Th-228	1.53E-06	1.53E-06
U-234	1.15E-07	1.15E-07
Th-230	1.32E-11	1.32E-11
Ra-226	3.65E-14	3.65E-14
Pb-210	2.61E-17	2.61E-17
U-235	1.04E-06	1.04E-06
Pa-231	8.14E-11	8.14E-11
Ac-227	3.21E-12	3.21E-12
U-238	6.68E-07	6.68E-07
U-234	4.85E-13	4.85E-13
Th-230	2.91E-17	2.91E-17
Ra-226	5.38E-20	5.38E-20
Pb-210	3.47E-23	3.47E-23

RESRAD-BUILD Dose Tables

```
[mrem]
```

		Source	Total
		1	
Receptor	1	6.11E-05	6.11E-05
Total		6.11E-05	6.11E-05

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 08:03:27 Page: 13 **
 Title : SLDS DCGL Resident EMC 10 m2
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res EMC 10m2 2024.bld
 Evaluation Time: 3.00000000 years

Pathway Detail of Doses

[mrem]

Source: 1

	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	2.14E-05	7.15E-06	5.85E-11	1.10E-11	8.68E-08	3.24E-05	0.00E+00	6.11E-05
Total	2.14E-05	7.15E-06	5.85E-11	1.10E-11	8.68E-08	3.24E-05	0.00E+00	6.11E-05

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 08:03:27 Page: 14 **
 Title : SLDS DCGL Resident EMC 10 m2
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res EMC 10m2 2024.bld
 Evaluation Time: 3.00000000 years

Nuclide Detail of Doses

[mrem]

Source: 1

Nuclide	Receptor	Total
	1	
Ac-227	3.71E-06	3.71E-06
Pa-231	2.56E-06	2.56E-06
Ac-227	4.37E-07	4.37E-07
Pb-210	3.04E-07	3.04E-07
Ra-226	7.79E-06	7.79E-06
Pb-210	3.50E-08	3.50E-08
Ra-228	2.59E-06	2.59E-06
Th-228	2.15E-05	2.15E-05
Th-228	1.08E-05	1.08E-05
Th-230	9.60E-07	9.60E-07
Ra-226	1.18E-08	1.18E-08
Pb-210	2.72E-11	2.72E-11
Th-232	1.14E-06	1.14E-06
Ra-228	1.36E-06	1.36E-06
Th-228	6.05E-06	6.05E-06
U-234	1.15E-07	1.15E-07
Th-230	3.09E-11	3.09E-11
Ra-226	1.91E-13	1.91E-13
Pb-210	2.99E-16	2.99E-16
U-235	1.04E-06	1.04E-06
Pa-231	1.90E-10	1.90E-10
Ac-227	1.66E-11	1.66E-11
U-238	6.64E-07	6.64E-07
U-234	1.13E-12	1.13E-12
Th-230	1.54E-16	1.54E-16
Ra-226	6.38E-19	6.38E-19
Pb-210	7.39E-22	7.39E-22

		Source Contributions to Receptor Doses	
		[mrem]	
		Source 1	Total
Receptor	1	5.97E-05	5.97E-05
Total		5.97E-05	5.97E-05

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 08:03:27 Page: 16 **
 Title : SLDS DCGL Resident EMC 10 m2
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res EMC 10m2 2024.bld
 Evaluation Time: 10.0000000 years

Pathway Detail of Doses

[mrem]

Source: 1

	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	2.09E-05	7.15E-06	5.85E-11	1.10E-11	8.68E-08	3.16E-05	0.00E+00	5.97E-05
Total	2.09E-05	7.15E-06	5.85E-11	1.10E-11	8.68E-08	3.16E-05	0.00E+00	5.97E-05

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 08:03:27 Page: 17 **
 Title : SLDS DCGL Resident EMC 10 m2
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res EMC 10m2 2024.bld
 Evaluation Time: 10.0000000 years

Nuclide Detail of Doses

[mrem]

Source: 1

Nuclide	Receptor 1	Total
Ac-227	2.92E-06	2.92E-06
Pa-231	2.55E-06	2.55E-06
Ac-227	1.16E-06	1.16E-06
Pb-210	2.40E-07	2.40E-07
Ra-226	7.57E-06	7.57E-06
Pb-210	9.30E-08	9.30E-08
Ra-228	1.09E-06	1.09E-06
Th-228	1.45E-05	1.45E-05
Th-228	8.35E-07	8.35E-07
Th-230	9.60E-07	9.60E-07
Ra-226	3.45E-08	3.45E-08
Pb-210	2.23E-10	2.23E-10
Th-232	1.14E-06	1.14E-06
Ra-228	2.77E-06	2.77E-06
Th-228	2.20E-05	2.20E-05
U-234	1.14E-07	1.14E-07
Th-230	9.27E-11	9.27E-11
Ra-226	1.67E-12	1.67E-12
Pb-210	7.40E-15	7.40E-15
U-235	1.01E-06	1.01E-06
Pa-231	5.68E-10	5.68E-10
Ac-227	1.36E-10	1.36E-10
U-238	6.49E-07	6.49E-07
U-234	3.39E-12	3.39E-12
Th-230	1.38E-15	1.38E-15
Ra-226	1.65E-17	1.65E-17
Pb-210	5.59E-20	5.59E-20

		Source	Total
		1	
Receptor	1	5.77E-05	5.77E-05
Total		5.77E-05	5.77E-05

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 08:03:27 Page: 19 **
 Title : SLDS DCGL Resident EMC 10 m2
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res EMC 10m2 2024.bld
 Evaluation Time: 20.0000000 years

Pathway Detail of Doses

[mrem]

Source: 1

	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	2.01E-05	7.15E-06	5.85E-11	1.10E-11	8.68E-08	3.04E-05	0.00E+00	5.77E-05
Total	2.01E-05	7.15E-06	5.85E-11	1.10E-11	8.68E-08	3.04E-05	0.00E+00	5.77E-05

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 08:03:27 Page: 20 **
 Title : SLDS DCGL Resident EMC 10 m2
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res EMC 10m2 2024.bld
 Evaluation Time: 20.0000000 years

Nuclide Detail of Doses

[mrem]

Source: 1

Nuclide	Receptor 1	Total
Ac-227	2.08E-06	2.08E-06
Pa-231	2.54E-06	2.54E-06
Ac-227	1.91E-06	1.91E-06
Pb-210	1.72E-07	1.72E-07
Ra-226	7.25E-06	7.25E-06
Pb-210	1.54E-07	1.54E-07
Ra-228	3.14E-07	3.14E-07
Th-228	4.52E-06	4.52E-06
Th-228	2.14E-08	2.14E-08
Th-230	9.60E-07	9.60E-07
Ra-226	6.47E-08	6.47E-08
Pb-210	7.56E-10	7.56E-10
Th-232	1.14E-06	1.14E-06
Ra-228	3.40E-06	3.40E-06
Th-228	3.14E-05	3.14E-05
U-234	1.14E-07	1.14E-07
Th-230	1.81E-10	1.81E-10
Ra-226	6.11E-12	6.11E-12
Pb-210	5.00E-14	5.00E-14
U-235	9.77E-07	9.77E-07
Pa-231	1.10E-09	1.10E-09
Ac-227	4.60E-10	4.60E-10
U-238	6.27E-07	6.27E-07
U-234	6.58E-12	6.58E-12
Th-230	5.24E-15	5.24E-15
Ra-226	1.18E-16	1.18E-16
Pb-210	7.46E-19	7.46E-19

		Source 1	Total
Receptor	1	4.91E-05	4.91E-05
Total		4.91E-05	4.91E-05

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 08:03:27 Page: 22 **
 Title : SLDS DCGL Resident EMC 10 m2
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res EMC 10m2 2024.bld
 Evaluation Time: 30.0000000 years

Pathway Detail of Doses

[mrem]

Source: 1

	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	1.95E-05	9.01E-18	1.78E-22	1.39E-23	2.65E-19	2.95E-05	0.00E+00	4.91E-05
Total	1.95E-05	9.01E-18	1.78E-22	1.39E-23	2.65E-19	2.95E-05	0.00E+00	4.91E-05

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 08:03:27 Page: 23 **
 Title : SLDS DCGL Resident EMC 10 m2
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res EMC 10m2 2024.bld
 Evaluation Time: 30.0000000 years

Nuclide Detail of Doses

[mrem]

Source: 1

Nuclide	Receptor 1	Total
Ac-227	8.41E-07	8.41E-07
Pa-231	3.12E-07	3.12E-07
Ac-227	1.38E-06	1.38E-06
Pb-210	6.84E-08	6.84E-08
Ra-226	6.92E-06	6.92E-06
Pb-210	1.08E-07	1.08E-07
Ra-228	8.68E-08	8.68E-08
Th-228	1.31E-06	1.31E-06
Th-228	5.46E-10	5.46E-10
Th-230	1.05E-08	1.05E-08
Ra-226	9.20E-08	9.20E-08
Pb-210	8.27E-10	8.27E-10
Th-232	8.15E-09	8.15E-09
Ra-228	3.34E-06	3.34E-06
Th-228	3.32E-05	3.32E-05
U-234	1.09E-08	1.09E-08
Th-230	2.93E-12	2.93E-12
Ra-226	1.29E-11	1.29E-11
Pb-210	8.32E-14	8.32E-14
U-235	8.61E-07	8.61E-07
Pa-231	2.02E-10	2.02E-10
Ac-227	5.16E-10	5.16E-10
U-238	5.25E-07	5.25E-07
U-234	9.39E-13	9.39E-13
Th-230	1.26E-16	1.26E-16
Ra-226	3.72E-16	3.72E-16
Pb-210	1.87E-18	1.87E-18

RESRAD-BUILD Dose Tables

```
[mrem]
```

		Source	Total
		1	
Receptor	1	4.91E-05	4.91E-05
Total		4.91E-05	4.91E-05

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 08:03:27 Page: 25 **
 Title : SLDS DCGL Resident EMC 10 m2
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res EMC 10m2 2024.bld
 Evaluation Time: 100.000008 years

Pathway Detail of Doses

[mrem]

Source: 1

	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	1.95E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.95E-05	0.00E+00	4.91E-05
Total	1.95E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.95E-05	0.00E+00	4.91E-05

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 08:03:27 Page: 26 **
 Title : SLDS DCGL Resident EMC 10 m2
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res EMC 10m2 2024.bld
 Evaluation Time: 100.000008 years

Nuclide Detail of Doses

[mrem]

Source: 1

Nuclide	Receptor 1	Total
Ac-227	9.06E-08	9.06E-08
Pa-231	3.12E-07	3.12E-07
Ac-227	2.13E-06	2.13E-06
Pb-210	7.68E-09	7.68E-09
Ra-226	6.71E-06	6.71E-06
Pb-210	1.64E-07	1.64E-07
Ra-228	1.88E-11	1.88E-11
Th-228	2.83E-10	2.83E-10
Th-228	5.18E-21	5.18E-21
Th-230	1.04E-08	1.04E-08
Ra-226	2.99E-07	2.99E-07
Pb-210	5.27E-09	5.27E-09
Th-232	8.15E-09	8.15E-09
Ra-228	3.43E-06	3.43E-06
Th-228	3.45E-05	3.45E-05
U-234	1.09E-08	1.09E-08
Th-230	9.66E-12	9.66E-12
Ra-226	1.39E-10	1.39E-10
Pb-210	1.96E-12	1.96E-12
U-235	8.61E-07	8.61E-07
Pa-231	6.64E-10	6.64E-10
Ac-227	3.31E-09	3.31E-09
U-238	5.25E-07	5.25E-07
U-234	3.09E-12	3.09E-12
Th-230	1.37E-15	1.37E-15
Ra-226	1.32E-14	1.32E-14
Pb-210	1.56E-16	1.56E-16

		Source Contributions to Receptor Doses	
		[mrem]	
		Source 1	Total
Receptor	1	4.91E-05	4.91E-05
Total		4.91E-05	4.91E-05

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 08:03:27 Page: 28 **
 Title : SLDS DCGL Resident EMC 10 m2
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res EMC 10m2 2024.bld
 Evaluation Time: 300.000031 years

Pathway Detail of Doses

[mrem]

Source: 1

	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	1.95E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.95E-05	0.00E+00	4.91E-05
Total	1.95E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.95E-05	0.00E+00	4.91E-05

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 08:03:27 Page: 29 **
 Title : SLDS DCGL Resident EMC 10 m2
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res EMC 10m2 2024.bld
 Evaluation Time: 300.000031 years

Nuclide Detail of Doses

[mrem]

Source: 1

Nuclide	Receptor 1	Total
Ac-227	1.56E-10	1.56E-10
Pa-231	3.11E-07	3.11E-07
Ac-227	2.21E-06	2.21E-06
Pb-210	1.49E-11	1.49E-11
Ra-226	6.16E-06	6.16E-06
Pb-210	1.58E-07	1.58E-07
Ra-228	6.36E-22	6.36E-22
Th-228	9.58E-21	9.58E-21
Th-228	0.00E+00	0.00E+00
Th-230	1.04E-08	1.04E-08
Ra-226	8.55E-07	8.55E-07
Pb-210	1.94E-08	1.94E-08
Th-232	8.15E-09	8.15E-09
Ra-228	3.43E-06	3.43E-06
Th-228	3.45E-05	3.45E-05
U-234	1.09E-08	1.09E-08
Th-230	2.88E-11	2.88E-11
Ra-226	1.21E-09	1.21E-09
Pb-210	2.48E-11	2.48E-11
U-235	8.61E-07	8.61E-07
Pa-231	1.98E-09	1.98E-09
Ac-227	1.26E-08	1.26E-08
U-238	5.25E-07	5.25E-07
U-234	9.25E-12	9.25E-12
Th-230	1.22E-14	1.22E-14
Ra-226	3.45E-13	3.45E-13
Pb-210	6.48E-15	6.48E-15

		Source	Total
		1	
Receptor	1	4.91E-05	4.91E-05
Total		4.91E-05	4.91E-05

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 08:03:27 Page: 31 **
 Title : SLDS DCGL Resident EMC 10 m2
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res EMC 10m2 2024.bld
 Evaluation Time: 1000.00000 years

Pathway Detail of Doses

[mrem]

Source: 1

	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	1.95E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.95E-05	0.00E+00	4.91E-05
Total	1.95E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.95E-05	0.00E+00	4.91E-05

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 08:03:27 Page: 32 **
 Title : SLDS DCGL Resident EMC 10 m2
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res EMC 10m2 2024.bld
 Evaluation Time: 1000.00000 years

Nuclide Detail of Doses

[mrem]

Source: 1

Nuclide	Receptor 1	Total
Ac-227	3.26E-20	3.26E-20
Pa-231	3.06E-07	3.06E-07
Ac-227	2.18E-06	2.18E-06
Pb-210	4.80E-21	4.80E-21
Ra-226	4.55E-06	4.55E-06
Pb-210	1.16E-07	1.16E-07
Ra-228	0.00E+00	0.00E+00
Th-228	0.00E+00	0.00E+00
Th-228	0.00E+00	0.00E+00
Th-230	1.04E-08	1.04E-08
Ra-226	2.45E-06	2.45E-06
Pb-210	6.04E-08	6.04E-08
Th-232	8.15E-09	8.15E-09
Ra-228	3.43E-06	3.43E-06
Th-228	3.45E-05	3.45E-05
U-234	1.09E-08	1.09E-08
Th-230	9.56E-11	9.56E-11
Ra-226	1.21E-08	1.21E-08
Pb-210	2.88E-10	2.88E-10
U-235	8.61E-07	8.61E-07
Pa-231	6.55E-09	6.55E-09
Ac-227	4.51E-08	4.51E-08
U-238	5.25E-07	5.25E-07
U-234	3.08E-11	3.08E-11
Th-230	1.35E-13	1.35E-13
Ra-226	1.18E-11	1.18E-11
Pb-210	2.72E-13	2.72E-13

** RESRAD-BUILD Risk Program Output, Version 4.0 02/15/24 08:02:06 Page: 1 **
 Title : SLDS DCGL Resident EMC 10 m2
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res EMC 10m2 2024.bld

=====	
=====	
=====	=====
RESRAD-BUILD Table of Contents	=====
=====	=====
=====	

RESRAD-BUILD Input Parameters.....	2
Building Information.....	3
Source Information.....	4
Temporal Risk Summary.....	5
For time = 0.00E+00 yr	
Receptor-Source Risk Summary.....	6
Risk by Pathway Detail.....	7
Risk by Nuclide Detail.....	8
For time = 1.00E+00 yr	
Receptor-Source Risk Summary.....	9
Risk by Pathway Detail.....	10
Risk by Nuclide Detail.....	11
For time = 3.00E+00 yr	
Receptor-Source Risk Summary.....	12
Risk by Pathway Detail.....	13
Risk by Nuclide Detail.....	14
For time = 1.00E+01 yr	
Receptor-Source Risk Summary.....	15
Risk by Pathway Detail.....	16
Risk by Nuclide Detail.....	17
For time = 2.00E+01 yr	
Receptor-Source Risk Summary.....	18
Risk by Pathway Detail.....	19
Risk by Nuclide Detail.....	20
For time = 3.00E+01 yr	
Receptor-Source Risk Summary.....	21
Risk by Pathway Detail.....	22
Risk by Nuclide Detail.....	23
For time = 1.00E+02 yr	
Receptor-Source Risk Summary.....	24
Risk by Pathway Detail.....	25
Risk by Nuclide Detail.....	26
For time = 3.00E+02 yr	
Receptor-Source Risk Summary.....	27
Risk by Pathway Detail.....	28
Risk by Nuclide Detail.....	29
For time = 1.00E+03 yr	
Receptor-Source Risk Summary.....	30
Risk by Pathway Detail.....	31
Risk by Nuclide Detail.....	32

** RESRAD-BUILD Risk Program Output, Version 4.0 02/15/24 08:02:06 Page: 2 **
 Title : SLDS DCGL Resident EMC 10 m2
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res EMC 10m2 2024.bld

```

=====
=====
=====
RESRAD-BUILD Input Parameters
=====
=====
    
```

```

Number of Sources : 1
Number of Receptors: 1
Total Time : 1.095000E+04 days
Fraction Inside : 6.390000E-01
    
```

Transformations data from: ICRP107
 Cut off half life : 180.000000 days
 Library information in the Dose Coefficients and Slope Factors report

```

===== Receptor Information =====
    
```

Receptor	Room	x [m]	y [m]	z [m]	FracTime	Inhalation [m3/day]	Ingestion(Dust) [m2/hr]
1	1	5.000	5.000	1.000	1.000	1.48E+01	6.90E-04

```

===== Receptor-Source Shielding Relationship =====
    
```

Receptor	Source	Density [g/cm3]	Thickness [cm]	Material
1	1	2.40E+00	0.00E+00	Concrete

** RESRAD-BUILD Risk Program Output, Version 4.0 02/15/24 08:02:06 Page: 3 **
 Title : SLDS DCGL Resident EMC 10 m2
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res EMC 10m2 2024.bld

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

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

Height[m]	Air Exchanges [m3/hr]	
Area [m2]		

	*	*
	*	*
	*	<=Q01: 0.00E+00
H1: 2.500	* Room 1	* Q10 : 0.00E+00
	* LAMBDA: 0.00E+00	*
Area 100.000	*	*
	*	*

Deposition velocity: 3.90E-04 [m/s] Resuspension Rate: 0.00E+00 [1/s]
 Deposition velocity: 5.00E-07 [m/s] Resuspension Rate:

** RESRAD-BUILD Risk Program Output, Version 4.0 02/15/24 08:02:06 Page: 4 **
Title : SLDS DCGL Resident EMC 10 m2
Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res EMC 10m2 2024.bld

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

Source: 1
Location:: Room : 1 x: 5.00 y: 5.00 z: 0.00[m]
Geometry:: Type: Area Area:1.00E+01 [m2] Direction: z
Pathway ::
Direct Ingestion Rate: 0.000E+00 [1/hr]
Fraction released to air: 7.000E-02
Removable fraction: 1.000E-01
Time to Remove: 1.000E+04 [day]

Radon Release Fraction: 1.000E-01

Contamination::
Nuclide Concentration

	[dpm/m2]
Ac-227	1.000E+00
Pa-231	1.000E+00
Pb-210	1.000E+00
Ra-226	1.000E+00
Ra-228	1.000E+00
Th-228	1.000E+00
Th-230	1.000E+00
Th-232	1.000E+00
U-234	1.000E+00
U-235	1.000E+00
U-238	1.000E+00

** RESRAD-BUILD Risk Program Output, Version 4.0 02/15/24 08:02:06 Page: 5 **
 Title : SLDS DCGL Resident EMC 10 m2
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res EMC 10m2 2024.bld
 Temporal Summary

RESRAD-BUILD Temporal Risk Tables

Risk to Receptor over the Exposure Duration

(Risk)

Evaluation Time years	Receptor 1	Total
0.000000000	7.85E-10	7.85E-10
1.000000000	7.81E-10	7.81E-10
3.000000000	7.73E-10	7.73E-10
10.00000000	7.48E-10	7.48E-10
20.00000000	7.20E-10	7.20E-10
30.00000000	7.06E-10	7.06E-10
100.0000080	7.06E-10	7.06E-10
300.0000310	7.06E-10	7.06E-10
1000.000000	7.06E-10	7.06E-10

		Source	Total
		1	
Receptor	1	7.85E-10	7.85E-10
Total		7.85E-10	7.85E-10

** RESRAD-BUILD Risk Program Output, Version 4.0 02/15/24 08:02:06 Page: 7 **
 Title : SLDS DCGL Resident EMC 10 m2
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res EMC 10m2 2024.bld
 Evaluation Time: 0.00000000E+00 years

Pathway Detail of Risks

[Risk]

Source: 1

	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	4.89E-10	4.29E-11	1.27E-15	2.41E-16	3.93E-13	2.53E-10	0.00E+00	7.85E-10
Total	4.89E-10	4.29E-11	1.27E-15	2.41E-16	3.93E-13	2.53E-10	0.00E+00	7.85E-10

** RESRAD-BUILD Risk Program Output, Version 4.0 02/15/24 08:02:06 Page: 8 **
 Title : SLDS DCGL Resident EMC 10 m2
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res EMC 10m2 2024.bld
 Evaluation Time: 0.00000000E+00 years

Nuclide Detail of Risks

[Risk]

Source: 1

Nuclide	Receptor	Total
	1	
Ac-227	4.42E-11	4.42E-11
Pa-231	1.25E-11	1.25E-11
Ac-227	2.34E-11	2.34E-11
Pb-210	3.43E-12	3.43E-12
Ra-226	1.79E-10	1.79E-10
Pb-210	1.74E-12	1.74E-12
Ra-228	2.47E-11	2.47E-11
Th-228	1.05E-10	1.05E-10
Th-228	3.73E-11	3.73E-11
Th-230	2.37E-12	2.37E-12
Ra-226	1.14E-12	1.14E-12
Pb-210	7.77E-15	7.77E-15
Th-232	2.89E-12	2.89E-12
Ra-228	6.45E-11	6.45E-11
Th-228	2.45E-10	2.45E-10
U-234	1.99E-12	1.99E-12
Th-230	3.02E-16	3.02E-16
Ra-226	1.04E-16	1.04E-16
Pb-210	5.38E-19	5.38E-19
U-235	2.28E-11	2.28E-11
Pa-231	3.81E-15	3.81E-15
Ac-227	5.19E-15	5.19E-15
U-238	1.35E-11	1.35E-11
U-234	7.77E-17	7.77E-17
Th-230	7.87E-21	7.87E-21
Ra-226	2.19E-21	2.19E-21
Pb-210	9.07E-24	9.07E-24

		Source	Total
		1	
Receptor	1	7.81E-10	7.81E-10
Total		7.81E-10	7.81E-10

** RESRAD-BUILD Risk Program Output, Version 4.0 02/15/24 08:02:06 Page: 10 **
 Title : SLDS DCGL Resident EMC 10 m2
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res EMC 10m2 2024.bld
 Evaluation Time: 1.00000000 years

Pathway Detail of Risks

[Risk]

Source: 1

	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	4.87E-10	4.14E-11	1.23E-15	2.33E-16	3.80E-13	2.52E-10	0.00E+00	7.81E-10
Total	4.87E-10	4.14E-11	1.23E-15	2.33E-16	3.80E-13	2.52E-10	0.00E+00	7.81E-10

** RESRAD-BUILD Risk Program Output, Version 4.0 02/15/24 08:02:06 Page: 11 **
 Title : SLDS DCGL Resident EMC 10 m2
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res EMC 10m2 2024.bld
 Evaluation Time: 1.00000000 years

Nuclide Detail of Risks

[Risk]

Source: 1

Nuclide	Receptor	Total
	1	
Ac-227	4.25E-11	4.25E-11
Pa-231	1.24E-11	1.24E-11
Ac-227	2.45E-11	2.45E-11
Pb-210	3.29E-12	3.29E-12
Ra-226	1.78E-10	1.78E-10
Pb-210	1.80E-12	1.80E-12
Ra-228	2.19E-11	2.19E-11
Th-228	1.03E-10	1.03E-10
Th-228	2.58E-11	2.58E-11
Th-230	2.30E-12	2.30E-12
Ra-226	1.22E-12	1.22E-12
Pb-210	8.23E-15	8.23E-15
Th-232	2.79E-12	2.79E-12
Ra-228	6.70E-11	6.70E-11
Th-228	2.56E-10	2.56E-10
U-234	1.92E-12	1.92E-12
Th-230	3.04E-16	3.04E-16
Ra-226	1.14E-16	1.14E-16
Pb-210	5.84E-19	5.84E-19
U-235	2.26E-11	2.26E-11
Pa-231	3.96E-15	3.96E-15
Ac-227	5.59E-15	5.59E-15
U-238	1.34E-11	1.34E-11
U-234	7.83E-17	7.83E-17
Th-230	7.97E-21	7.97E-21
Ra-226	2.49E-21	2.49E-21
Pb-210	1.01E-23	1.01E-23

		Source Contributions to Receptor Risks	
		[Risk]	
		Source	Total
	1	1	
Receptor	1	7.73E-10	7.73E-10
Total		7.73E-10	7.73E-10

** RESRAD-BUILD Risk Program Output, Version 4.0 02/15/24 08:02:06 Page: 13 **
 Title : SLDS DCGL Resident EMC 10 m2
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res EMC 10m2 2024.bld
 Evaluation Time: 3.00000000 years

Pathway Detail of Risks

[Risk]

Source: 1

	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	4.84E-10	3.83E-11	1.14E-15	2.15E-16	3.52E-13	2.50E-10	0.00E+00	7.73E-10
Total	4.84E-10	3.83E-11	1.14E-15	2.15E-16	3.52E-13	2.50E-10	0.00E+00	7.73E-10

** RESRAD-BUILD Risk Program Output, Version 4.0 02/15/24 08:02:06 Page: 14 **
 Title : SLDS DCGL Resident EMC 10 m2
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res EMC 10m2 2024.bld
 Evaluation Time: 3.00000000 years

Nuclide Detail of Risks

[Risk]

Source: 1

Nuclide	Receptor	Total
	1	
Ac-227	3.93E-11	3.93E-11
Pa-231	1.20E-11	1.20E-11
Ac-227	2.64E-11	2.64E-11
Pb-210	3.01E-12	3.01E-12
Ra-226	1.77E-10	1.77E-10
Pb-210	1.90E-12	1.90E-12
Ra-228	1.70E-11	1.70E-11
Th-228	9.20E-11	9.20E-11
Th-228	1.24E-11	1.24E-11
Th-230	2.14E-12	2.14E-12
Ra-226	1.36E-12	1.36E-12
Pb-210	9.21E-15	9.21E-15
Th-232	2.60E-12	2.60E-12
Ra-228	7.10E-11	7.10E-11
Th-228	2.77E-10	2.77E-10
U-234	1.80E-12	1.80E-12
Th-230	3.06E-16	3.06E-16
Ra-226	1.37E-16	1.37E-16
Pb-210	6.89E-19	6.89E-19
U-235	2.24E-11	2.24E-11
Pa-231	4.26E-15	4.26E-15
Ac-227	6.45E-15	6.45E-15
U-238	1.32E-11	1.32E-11
U-234	7.89E-17	7.89E-17
Th-230	8.17E-21	8.17E-21
Ra-226	3.18E-21	3.18E-21
Pb-210	1.26E-23	1.26E-23

		Source Contributions to Receptor Risks	
		[Risk]	
		Source	Total
	1		
Receptor	1	7.48E-10	7.48E-10
Total		7.48E-10	7.48E-10

** RESRAD-BUILD Risk Program Output, Version 4.0 02/15/24 08:02:06 Page: 16 **
 Title : SLDS DCGL Resident EMC 10 m2
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res EMC 10m2 2024.bld
 Evaluation Time: 10.0000000 years

Pathway Detail of Risks

[Risk]

Source: 1

	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	4.75E-10	2.73E-11	8.12E-16	1.54E-16	2.51E-13	2.46E-10	0.00E+00	7.48E-10
Total	4.75E-10	2.73E-11	8.12E-16	1.54E-16	2.51E-13	2.46E-10	0.00E+00	7.48E-10

** RESRAD-BUILD Risk Program Output, Version 4.0 02/15/24 08:02:06 Page: 17 **
 Title : SLDS DCGL Resident EMC 10 m2
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res EMC 10m2 2024.bld
 Evaluation Time: 10.0000000 years

Nuclide Detail of Risks

[Risk]

Source: 1

Nuclide	Receptor	Total
	1	
Ac-227	2.96E-11	2.96E-11
Pa-231	1.06E-11	1.06E-11
Ac-227	3.16E-11	3.16E-11
Pb-210	2.18E-12	2.18E-12
Ra-226	1.73E-10	1.73E-10
Pb-210	2.13E-12	2.13E-12
Ra-228	7.13E-12	7.13E-12
Th-228	4.49E-11	4.49E-11
Th-228	9.57E-13	9.57E-13
Th-230	1.60E-12	1.60E-12
Ra-226	1.86E-12	1.86E-12
Pb-210	1.32E-14	1.32E-14
Th-232	1.90E-12	1.90E-12
Ra-228	7.86E-11	7.86E-11
Th-228	3.27E-10	3.27E-10
U-234	1.35E-12	1.35E-12
Th-230	2.88E-16	2.88E-16
Ra-226	2.38E-16	2.38E-16
Pb-210	1.21E-18	1.21E-18
U-235	2.16E-11	2.16E-11
Pa-231	5.17E-15	5.17E-15
Ac-227	1.00E-14	1.00E-14
U-238	1.26E-11	1.26E-11
U-234	7.54E-17	7.54E-17
Th-230	8.78E-21	8.78E-21
Ra-226	6.78E-21	6.78E-21
Pb-210	2.70E-23	2.70E-23

		Source	Total
		1	
Receptor	1	7.20E-10	7.20E-10
Total		7.20E-10	7.20E-10

** RESRAD-BUILD Risk Program Output, Version 4.0 02/15/24 08:02:06 Page: 19 **
 Title : SLDS DCGL Resident EMC 10 m2
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res EMC 10m2 2024.bld
 Evaluation Time: 20.0000000 years

Pathway Detail of Risks

[Risk]

Source: 1

	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	4.67E-10	1.16E-11	3.48E-16	6.54E-17	1.08E-13	2.42E-10	0.00E+00	7.20E-10
Total	4.67E-10	1.16E-11	3.48E-16	6.54E-17	1.08E-13	2.42E-10	0.00E+00	7.20E-10

** RESRAD-BUILD Risk Program Output, Version 4.0 02/15/24 08:02:06 Page: 20 **
 Title : SLDS DCGL Resident EMC 10 m2
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res EMC 10m2 2024.bld
 Evaluation Time: 20.0000000 years

Nuclide Detail of Risks

[Risk]

Source: 1

Nuclide	Receptor	Total
	1	
Ac-227	1.94E-11	1.94E-11
Pa-231	8.73E-12	8.73E-12
Ac-227	3.61E-11	3.61E-11
Pb-210	1.30E-12	1.30E-12
Ra-226	1.68E-10	1.68E-10
Pb-210	2.19E-12	2.19E-12
Ra-228	2.05E-12	2.05E-12
Th-228	1.33E-11	1.33E-11
Th-228	2.45E-14	2.45E-14
Th-230	8.16E-13	8.16E-13
Ra-226	2.56E-12	2.56E-12
Pb-210	1.95E-14	1.95E-14
Th-232	9.15E-13	9.15E-13
Ra-228	8.12E-11	8.12E-11
Th-228	3.50E-10	3.50E-10
U-234	7.11E-13	7.11E-13
Th-230	2.03E-16	2.03E-16
Ra-226	4.38E-16	4.38E-16
Pb-210	2.44E-18	2.44E-18
U-235	2.07E-11	2.07E-11
Pa-231	6.15E-15	6.15E-15
Ac-227	1.62E-14	1.62E-14
U-238	1.19E-11	1.19E-11
U-234	5.52E-17	5.52E-17
Th-230	8.28E-21	8.28E-21
Ra-226	1.61E-20	1.61E-20
Pb-210	7.16E-23	7.16E-23

** RESRAD-BUILD Risk Program Output, Version 4.0 02/15/24 08:02:06 Page: 22 **
 Title : SLDS DCGL Resident EMC 10 m2
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res EMC 10m2 2024.bld
 Evaluation Time: 30.0000000 years

Pathway Detail of Risks

[Risk]

Source: 1

	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	4.65E-10	1.97E-24	1.42E-28	1.11E-29	4.38E-26	2.41E-10	0.00E+00	7.06E-10
Total	4.65E-10	1.97E-24	1.42E-28	1.11E-29	4.38E-26	2.41E-10	0.00E+00	7.06E-10

** RESRAD-BUILD Risk Program Output, Version 4.0 02/15/24 08:02:06 Page: 23 **
 Title : SLDS DCGL Resident EMC 10 m2
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res EMC 10m2 2024.bld
 Evaluation Time: 30.0000000 years

Nuclide Detail of Risks

[Risk]

Source: 1

Nuclide	Receptor	Total
	1	
Ac-227	1.28E-11	1.28E-11
Pa-231	7.42E-12	7.42E-12
Ac-227	3.89E-11	3.89E-11
Pb-210	7.45E-13	7.45E-13
Ra-226	1.66E-10	1.66E-10
Pb-210	2.16E-12	2.16E-12
Ra-228	5.95E-13	5.95E-13
Th-228	3.90E-12	3.90E-12
Th-228	6.24E-16	6.24E-16
Th-230	2.40E-13	2.40E-13
Ra-226	3.27E-12	3.27E-12
Pb-210	2.66E-14	2.66E-14
Th-232	1.83E-13	1.83E-13
Ra-228	8.16E-11	8.16E-11
Th-228	3.56E-10	3.56E-10
U-234	2.40E-13	2.40E-13
Th-230	9.91E-17	9.91E-17
Ra-226	7.05E-16	7.05E-16
Pb-210	4.33E-18	4.33E-18
U-235	2.02E-11	2.02E-11
Pa-231	7.07E-15	7.07E-15
Ac-227	2.34E-14	2.34E-14
U-238	1.14E-11	1.14E-11
U-234	3.04E-17	3.04E-17
Th-230	6.53E-21	6.53E-21
Ra-226	3.20E-20	3.20E-20
Pb-210	1.61E-22	1.61E-22

** RESRAD-BUILD Risk Program Output, Version 4.0 02/15/24 08:02:06 Page: 25 **
 Title : SLDS DCGL Resident EMC 10 m2
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res EMC 10m2 2024.bld
 Evaluation Time: 100.000008 years

Pathway Detail of Risks

[Risk]

Source: 1

	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	4.65E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.41E-10	0.00E+00	7.06E-10
Total	4.65E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.41E-10	0.00E+00	7.06E-10

** RESRAD-BUILD Risk Program Output, Version 4.0 02/15/24 08:02:06 Page: 26 **
 Title : SLDS DCGL Resident EMC 10 m2
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res EMC 10m2 2024.bld
 Evaluation Time: 100.000008 years

Nuclide Detail of Risks

[Risk]

Source: 1

Nuclide	Receptor	Total
	1	
Ac-227	1.38E-12	1.38E-12
Pa-231	7.41E-12	7.41E-12
Ac-227	5.02E-11	5.02E-11
Pb-210	8.38E-14	8.38E-14
Ra-226	1.62E-10	1.62E-10
Pb-210	2.74E-12	2.74E-12
Ra-228	1.29E-16	1.29E-16
Th-228	8.43E-16	8.43E-16
Th-228	5.91E-27	5.91E-27
Th-230	2.39E-13	2.39E-13
Ra-226	8.24E-12	8.24E-12
Pb-210	1.04E-13	1.04E-13
Th-232	1.83E-13	1.83E-13
Ra-228	8.22E-11	8.22E-11
Th-228	3.59E-10	3.59E-10
U-234	2.40E-13	2.40E-13
Th-230	2.53E-16	2.53E-16
Ra-226	4.42E-15	4.42E-15
Pb-210	4.55E-17	4.55E-17
U-235	2.02E-11	2.02E-11
Pa-231	1.80E-14	1.80E-14
Ac-227	9.23E-14	9.23E-14
U-238	1.14E-11	1.14E-11
U-234	7.78E-17	7.78E-17
Th-230	4.14E-20	4.14E-20
Ra-226	4.86E-19	4.86E-19
Pb-210	4.26E-21	4.26E-21

		Source	Total
		1	
Receptor	1	7.06E-10	7.06E-10
Total		7.06E-10	7.06E-10

** RESRAD-BUILD Risk Program Output, Version 4.0 02/15/24 08:02:06 Page: 28 **
 Title : SLDS DCGL Resident EMC 10 m2
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res EMC 10m2 2024.bld
 Evaluation Time: 300.000031 years

Pathway Detail of Risks

[Risk]

Source: 1

	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	4.65E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.41E-10	0.00E+00	7.06E-10
Total	4.65E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.41E-10	0.00E+00	7.06E-10

** RESRAD-BUILD Risk Program Output, Version 4.0 02/15/24 08:02:06 Page: 29 **
 Title : SLDS DCGL Resident EMC 10 m2
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res EMC 10m2 2024.bld
 Evaluation Time: 300.000031 years

Nuclide Detail of Risks

[Risk]

Source: 1

Nuclide	Receptor	Total
	1	
Ac-227	2.37E-15	2.37E-15
Pa-231	7.38E-12	7.38E-12
Ac-227	5.14E-11	5.14E-11
Pb-210	1.63E-16	1.63E-16
Ra-226	1.48E-10	1.48E-10
Pb-210	2.59E-12	2.59E-12
Ra-228	4.36E-27	4.36E-27
Th-228	2.85E-26	2.85E-26
Th-228	0.00E+00	0.00E+00
Th-230	2.39E-13	2.39E-13
Ra-226	2.16E-11	2.16E-11
Pb-210	3.37E-13	3.37E-13
Th-232	1.83E-13	1.83E-13
Ra-228	8.22E-11	8.22E-11
Th-228	3.59E-10	3.59E-10
U-234	2.40E-13	2.40E-13
Th-230	6.93E-16	6.93E-16
Ra-226	3.21E-14	3.21E-14
Pb-210	4.54E-16	4.54E-16
U-235	2.02E-11	2.02E-11
Pa-231	4.93E-14	4.93E-14
Ac-227	3.09E-13	3.09E-13
U-238	1.14E-11	1.14E-11
U-234	2.13E-16	2.13E-16
Th-230	3.09E-19	3.09E-19
Ra-226	9.63E-18	9.63E-18
Pb-210	1.25E-19	1.25E-19

		Source Contributions to Receptor Risks	
		[Risk]	
		Source	Total
	1		
Receptor	1	7.06E-10	7.06E-10
Total		7.06E-10	7.06E-10

** RESRAD-BUILD Risk Program Output, Version 4.0 02/15/24 08:02:06 Page: 31 **
 Title : SLDS DCGL Resident EMC 10 m2
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res EMC 10m2 2024.bld
 Evaluation Time: 1000.00000 years

Pathway Detail of Risks

[Risk]

Source: 1

	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	4.65E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.41E-10	0.00E+00	7.06E-10
Total	4.65E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.41E-10	0.00E+00	7.06E-10

** RESRAD-BUILD Risk Program Output, Version 4.0 02/15/24 08:02:06 Page: 32 **
 Title : SLDS DCGL Resident EMC 10 m2
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res EMC 10m2 2024.bld
 Evaluation Time: 1000.00000 years

Nuclide Detail of Risks

[Risk]

Source: 1

Nuclide	Receptor	Total
	1	
Ac-227	4.97E-25	4.97E-25
Pa-231	7.27E-12	7.27E-12
Ac-227	5.07E-11	5.07E-11
Pb-210	5.24E-26	5.24E-26
Ra-226	1.09E-10	1.09E-10
Pb-210	1.91E-12	1.91E-12
Ra-228	0.00E+00	0.00E+00
Th-228	0.00E+00	0.00E+00
Th-228	0.00E+00	0.00E+00
Th-230	2.37E-13	2.37E-13
Ra-226	6.01E-11	6.01E-11
Pb-210	1.01E-12	1.01E-12
Th-232	1.83E-13	1.83E-13
Ra-228	8.22E-11	8.22E-11
Th-228	3.59E-10	3.59E-10
U-234	2.39E-13	2.39E-13
Th-230	2.22E-15	2.22E-15
Ra-226	3.01E-13	3.01E-13
Pb-210	4.90E-15	4.90E-15
U-235	2.02E-11	2.02E-11
Pa-231	1.58E-13	1.58E-13
Ac-227	1.07E-12	1.07E-12
U-238	1.14E-11	1.14E-11
U-234	6.86E-16	6.86E-16
Th-230	3.19E-18	3.19E-18
Ra-226	2.98E-16	2.98E-16
Pb-210	4.70E-18	4.70E-18

APPENDIX B

INTEGRATED SURVEY PLAN FOR CONSOLIDATED MATERIALS, CRUSHATE, OVERBURDEN, EQUIPMENT, AND MATERIALS

THIS PAGE INTENTIONALLY LEFT BLANK

TABLE OF CONTENTS

<u>SECTION</u>	<u>PAGE</u>
TABLE OF CONTENTS.....	B-i
LIST OF TABLES	B-ii
LIST OF IMAGES.....	B-ii
LIST OF ATTACHMENTS.....	B-ii
B-1.0 PURPOSE AND SCOPE.....	B-1
B-2.0 ROADMAP.....	B-3
B-2.1 INTRODUCTION	B-3
B-2.2 PROCESS OVERVIEW	B-3
B-2.3 USE OF THIS DOCUMENT	B-5
B-3.0 SURVEY OPTIONS.....	B-7
B-3.1 MARSAME APPROACH	B-7
B-3.1.1 General	B-7
B-3.1.2 Process Map.....	B-7
B-3.1.3 Survey Design	B-8
B-3.1.4 Quality Assurance/Quality Control Measurements	B-10
B-3.1.5 Minimum Detectable Concentration	B-10
B-3.1.6 Minimum Detectable Concentration Calculation – Fixed Measurements.....	B-10
B-3.1.7 Beta Minimum Detectable Concentration Calculation – Scanning Measurements.....	B-11
B-3.1.8 Alpha Scan Probability Calculation – Scanning Measurements.....	B-12
B-3.1.9 Scanning.....	B-12
B-3.1.10 Data Evaluation.....	B-13
B-3.2 THE CRUSHATE/OVERBURDEN PILES APPROACH	B-13
B-3.2.1 General	B-13
B-3.2.2 Prerequisites	B-13
B-3.2.3 Radiological and Chemical Contaminants of Concern – Criteria	B-13
B-3.2.4 Survey Protocol.....	B-14
B-3.2.5 Pile Classification.....	B-14
B-3.2.6 Maximum Pile Volumes.....	B-14
B-3.2.7 Estimating the Number of Radiological Samples (<i>n</i>).....	B-15
B-3.2.8 Generating Simple Random Sample Locations.....	B-16
B-3.2.9 Drawing Simple Random Samples.....	B-16
B-3.2.10 Sampling for Chemical Contaminants of Concern	B-17
B-3.2.11 Toxic Characteristics Leaching Properties Samples	B-17
B-3.2.12 Quality Assurance/Quality Control Samples	B-17
B-3.2.13 Re-Evaluate the Number of Samples	B-17
B-3.2.14 Radiological Data Evaluation – FUSRAP Backfill or Clearance.....	B-18
B-3.2.15 Radiological Data Evaluation – Disposal Option	B-18
B-3.2.16 Data Evaluation – Chemical Contaminants of Concern	B-19
B-3.2.17 Data Evaluation – Toxic Characteristics Leaching Properties.....	B-19

TABLE OF CONTENTS (Continued)

<u>SECTION</u>	<u>PAGE</u>
B-3.2.18 Data Evaluation – Quality Assurance/Quality Control Samples.....	B-19
B-3.2.19 Scanning.....	B-19
B-3.2.20 Minimum Detectable Activity.....	B-20
B-3.3 IN-SITU APPROACH.....	B-20
B-3.3.1 General	B-20
B-3.3.2 Limits	B-20
B-3.3.3 Overburden Classification.....	B-21
B-3.3.4 Survey Protocol.....	B-21
B-4.0 MATERIAL-SPECIFIC INSTRUCTIONS	B-23
B-4.1 EQUIPMENT/MATERIALS OR CONSOLIDATED MATERIALS	B-23
B-4.1.1 Responsibilities	B-23
B-4.1.2 General	B-23
B-4.1.3 Prerequisites	B-23
B-4.2 CRUSHATE PILES/OVERBURDEN PILES.....	B-24
B-4.2.1 Responsibilities (Clearance or Disposal Option).....	B-24
B-4.2.2 Responsibilities (FUSRAP Backfill Option).....	B-24
B-4.2.3 General	B-25
B-4.2.4 Prerequisites	B-25
B-4.3 IN-SITU OVERBURDEN.....	B-25
B-4.3.1 Responsibilities	B-25
B-4.3.2 Prerequisites	B-26
B-5.0 RECORDS.....	B-27

LIST OF TABLES

<u>NUMBER</u>	<u>PAGE</u>
Table B-1. Materials Summary	B-3
Table B-2. Maximum Survey Unit Areas.....	B-8
Table B-3. Surface Contamination Screening Action Levels	B-9
Table B-4. Crushate/Overburden Limits – Radiological and Chemical Contaminants of Concern	B-13
Table B-5. Maximum Pile Volumes.....	B-15

LIST OF IMAGES

Image B-1. Overview of Survey and Evaluation Steps.....	B-4
Image B-2. Survey Options.....	B-5
Image B-3. MARSAME Decision-Making Process	B-7
Image B-4. MARSSIM-Based Evaluation Process for Piles.....	B-14
Image B-5. Identifying a Pile Sample Location.....	B-16

LIST OF ATTACHMENTS

ATTACHMENT B-1	TECHNICAL BASIS FOR SURVEY OF CONSOLIDATED MATERIALS AND EQUIPMENT
ATTACHMENT B-2	DATA QUALITY OBJECTIVES FOR MARSAME MATERIAL SURVEYS
ATTACHMENT B-3	DERIVATION OF SPECIFIC ACTION LEVELS FOR ST. LOUIS FUSRAP EQUIPMENT AND MATERIALS
ATTACHMENT B-4	TECHNICAL BASIS FOR SURVEY OF CRUSHATE/OVERBURDEN PILES
ATTACHMENT B-5	MARSSIM TABLES FOR SELECTING (<i>n</i>) NUMBER OF SAMPLES
ATTACHMENT B-6	DETERMINING THE NUMBER (<i>n</i>) OF CHEMICAL SAMPLES TO BE OBTAINED
ATTACHMENT B-7	STATISTICAL TABLE FOR EVALUATING SAMPLES FOR DISPOSAL
ATTACHMENT B-8	SOIL DATA QUALITY OBJECTIVE SUMMARY FOR ST. LOUIS SITES
ATTACHMENT B-9	INFORMATION TO BE SUBMITTED WHEN REQUESTING A PLANNING PACKAGE

THIS PAGE INTENTIONALLY LEFT BLANK

B-1.0 PURPOSE AND SCOPE

This appendix provides a reference to be used to guide the survey and/or sampling of equipment/materials, consolidated materials, crushate, in-situ overburden and overburden that is removed to piles that are located within, the impacted areas of the SLS.

The objective of the sampling and/or survey activities is to obtain data of sufficient quality to evaluate the suitability of the material for clearance, for off-site disposal, or on-site reuse as FUSRAP backfill. The evaluation process may include both radiological and chemical sampling activities, depending on the nature of the material and the requirements of the applicable decision document(s).

The FSS of structures and monoliths that are to be left in-situ is discussed in Appendix A.

The principles outlined in this appendix may also be applied to those materials that are currently located outside of impacted areas.

This appendix supersedes any guidance relative to the following:

- Survey design,
- Sampling and sampling protocols,
- Sample analysis, and
- The interpretation of sample results.

This appendix supersedes any guidance contained within the following documents:

- *Backfill Study for the St. Louis Downtown Site* (IT Corporation 1999a);
- *Materials Handling and Transportation Plan* (IT Corporation 1999b);
- *Work Assignment Plan for Crushate, Soil, and Concrete Sampling* (Shaw Corporation 2002b);
- *Sampling and Analysis Plan for the 50 Series Building Crushate* (USACE 1997);
- *Waste Management Plan for Unexpected Materials Found During Remediation at the FUSRAP St. Louis Sites* (USACE 1998c);
- *Methodology for Release of Railroad Ties from the St. Louis Downtown Site* (SAIC 2002); and
- *Final Status Survey Plan for Accessible Soil within Mallinckrodt Property and the Vicinity Properties, Excluding Plants 1, 2 and the City Property at the St. Louis Downtown Site* (USACE 2002a).

THIS PAGE INTENTIONALLY LEFT BLANK

B-2.0 ROADMAP

B-2.1 INTRODUCTION

This appendix describes the processes to be followed in planning and executing the survey of four categories of materials. Each category is briefly described in Table B-1.

Table B-1. Materials Summary

	Category	Process Inputs	Disposition ^a	Survey Protocol
1.	Equipment/Materials	- Known Impacted Areas - Undetermined Adjacent Areas	- Clearance - Disposal	MARSSIM (DOD 2000)/MARSAME (DoD 2009)-Based Survey Design Approach
2.	Consolidated Materials	- Ex-Situ Pavement in/from Impacted Areas - Ex-Situ Building Materials in/from Impacted Areas - Undetermined Adjacent Areas	- Crusher/Crushate Piles - Clearance - Disposal	- MARSSIM/MARSAME-Based Survey Design Approach. - ANSI/Health Physics Society (HPS) N13.12 (ANSI/HPS 2022)
3.	Crushate Piles/Overburden Piles	- Consolidated Materials - Overburden - Existing Piles with Known History - Existing Piles with Poor History	- Clearance - Use as Backfill - Disposal	Piles Evaluation Process (MARSSIM Techniques)
4.	In-Situ Overburden	Impacted Areas	- Clearance - Use as Backfill - Disposal - Overburden Piles (Stockpile)	MARSSIM

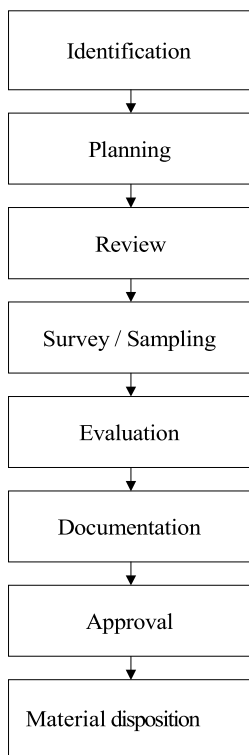
^a Materials exceeding the CERCLA risk range for release with unrestricted use generally require institutional controls and/or long-term stewardship.

Detailed directions for the survey and evaluation of each category of materials are provided in Sections B-3.0 and B-4.0.

B-2.2 PROCESS OVERVIEW

This appendix presents procedures for the survey and evaluation of equipment/materials, consolidated materials, crushate/overburden piles, and in-situ overburden. The procedures follow the general outline shown on Image B-1.

Image B-1. Overview of Survey and Evaluation Steps



Identification: The material to be surveyed, evaluated, and dispensed is identified. This includes the segregation of materials into similar types and characteristics, dividing materials into piles or groups so that volume, surface, or area limits are met, and the flagging or tagging of materials so that traceability can be maintained.

Planning: Information is gathered and decisions are made about how the materials will be dispensed (i.e., where the materials should go based on suspected contamination levels and waste goals) and what survey approach is most beneficial. Specific details of the survey and sampling design and DQOs are documented by the verification contractor in a planning package, based upon the guidance from this appendix. Historical information and characterization data for the materials and/or area where the materials originated, as appropriate, are included in the planning package.

Review: The planning package is presented to the USACE for review and concurrence. The data used in decision making are reviewed and validated. The USACE decides who will perform the survey and sampling functions, who will perform the data evaluation and reporting, and what government oversight will be necessary during the survey and sampling operations.

Survey/Sampling: Samples are obtained and surveys are taken in support of the planning package. verification contractor or government oversight may be required.

Evaluation: Survey and sample results are evaluated and conclusions are drawn as to the acceptability of the materials for disposition as described in the planning package. Additional survey or sampling may be required.

Documentation: Information from the planning package is combined with evaluation results and supporting data to create a report. The report will eventually be filed as a permanent record.

Approval: The evaluation report is sent to the USACE for review and approval. Approval indicates that the material is acceptable to be dispensed as described in the planning package.

Material Disposition: The responsible party physically moves the material to the final approved destination. Some confirmatory surveys or surveying may be required (as discussed in this appendix and the planning package) during material disposition to provide an additional assurance that areas of elevated activity that may have been missed during the survey/sampling phase are identified.

B-2.3 USE OF THIS DOCUMENT

The general sequence of steps for the use of this document are summarized as follows.

1. Review the roadmap explained in Section B-2.0 to become familiar with the overall process.
2. Identify the material to be evaluated and gather history/process knowledge for the material.
3. Select an option for the disposition of the material (i.e., Clearance, Disposal, or Backfill).
4. Select the best survey and evaluation option for the material from Section B-3.0.
(**NOTE:** For piles, the piles evaluation approach discussed in Section B-3.2 is the preferred method).
5. Review the responsibilities, supplementary information, and data analysis criteria from Section B-4.0 for the type of material being evaluated.
6. Prepare a planning package for the material, obtain USACE Health Physics concurrence, and perform surveys/sampling.
7. Evaluate survey/sampling data. Compare data to the action level.
8. Review the material's disposition option for acceptability. Choose a new option, if necessary.
9. Solicit concurrence from USACE Health Physics before material disposition.
10. Dispense material as approved by the USACE.

THIS PAGE INTENTIONALLY LEFT BLANK

B-3.0 SURVEY OPTIONS

B-3.1 MARSAME APPROACH

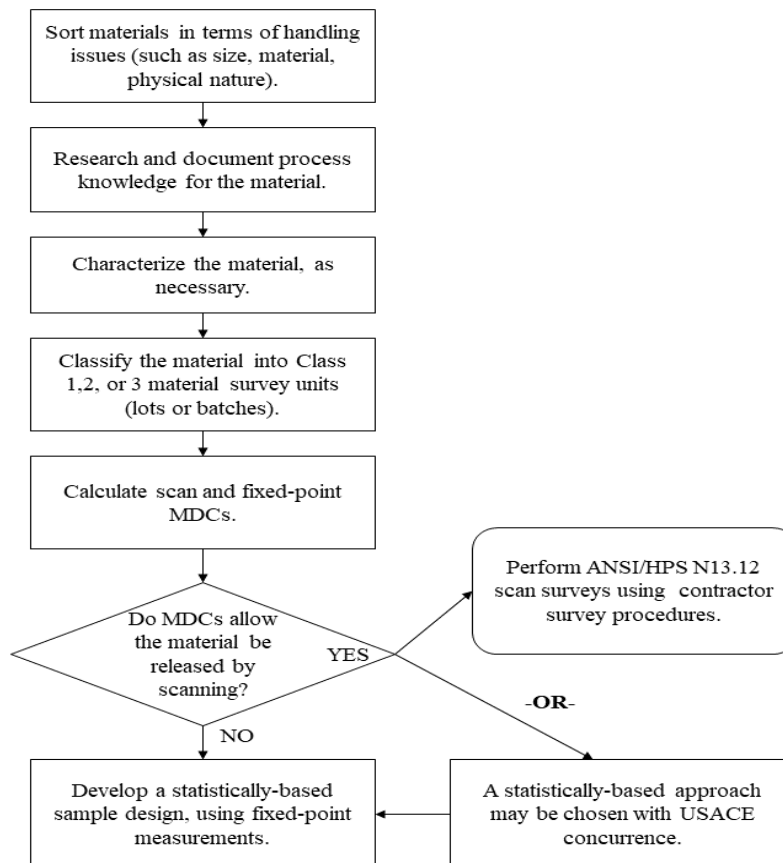
B-3.1.1 General

- (a) MARSAME guidance describes a method in which a MARSSIM-based survey design approach may be used to evaluate a wide variety of materials (DoD 2009).
- (b) This approach will be used only for consolidated materials and equipment using surficial measurements. Volumetric releases will not be performed. The USACE has determined that the MARSSIM survey design approach described in MARSAME for the survey and evaluation of material is acceptable for use at the SLS.
- (c) The technical basis for surveys of consolidated materials and equipment and DQOs are provided in Attachments B-1 and B-2, respectively.

B-3.1.2 Process Map

- (a) The general steps to be followed in the decision to use the MARSSIM/MARSAME survey design approach are summarized in Image B-3.

Image B-3. MARSAME Decision-Making Process



B-3.1.3 Survey Design**(a) Classification of SUs (batches, lots)**

- (1) MARSSIM guidance for the area classification will be directly applied to the batches or lots of materials (i.e., SUs) that are evaluated using the MARSAME process.

REMINDER: The classification guidance compares contamination potential to the applicable limit. If a disposal option is chosen, the limit(s) may be significantly higher.

- (2) A fraction of the MARSSIM SU area recommendations for structures will be applied to SUs where materials are laid out for survey and evaluation. These are provided in Table B-2.

Table B-2. Maximum Survey Unit Areas

Material (SU) Classification	Maximum SU Area
Class 1	10 m ²
Class 2	25 m ²
Class 3	50 m ²

- (3) Materials should be laid out as flat as possible, and spaces between materials should be minimized. The outer perimeter of materials will be used as the SU boundary and to estimate the area of the SU.

(b) Decision Errors

- (1) Type I errors: 0.05.
- (2) Type II errors: 0.20.
- (3) The null hypothesis follows: The contamination on/in the material surveyed exceeds the release criterion.

(c) Action Level

Total activity action levels are discussed in Table B-3. Surveys will be performed to ensure that surface contamination levels are less than the respective action levels specified in Table B-3. Based on the SLS AFs, the action level will be 600 dpm/100 cm² alpha, which is used as a surrogate to account for beta activity. See Attachment B-3 for the derivation of the St. Louis-specific action level. More restrictive action levels may be utilized in lieu of SLS action levels derived from Table B-3.

Table B-3. Surface Contamination Screening Action Levels

Radionuclide Groups^a	Surface Screening Action Levels^{b,c} (dpm/100 cm²)
High-energy gamma, radium, thorium, transuranics, and mobile beta-gamma emitters: Sodium-22, scandium-46, manganese-54, cobalt (Co)-56, Co-60, zinc-65, niobium-94, ruthenium-106, silver (Ag)-110m, antimony-125, iodine-129, cesium (Cs)-134, Cs-137, europium (Eu)-152, Eu-154, tantalum-182, bismuth (Bi)-207, polonium (Po)-210, Pb-210, Ra-226, Ra-228, Th-228, Th-229, Th-230, Th-232, U-232, plutonium (Pu)-238, Pu-239, Pu-240, Pu-242, Pu-244, Am-241, Am-243, curium (Cm)-245, Cm-246, Cm-247, Cm-248, californium (Cf)-249, Cf-251, einsteinium-254, and associated decay chains ^d , and others ^a	600
Uranium and selected beta-gamma emitters: Carbon-14, chlorine-36, iron-59, Co-57, Co-58, selenium-75, strontium (Sr)-85, Sr-90, zirconium-95, technetium-99, Ag-105, cadmium-109, Cs-134, tin-113, antimony-124, tellurium-123m, cerium-139, barium-140, Eu-155, terbium-160, hafnium-181, osmium-185, iridium (Ir)-190, Ir-192, thallium (Tl)-204, Bi-206, U-233, U-234, U-235, U-238, natural uranium ^e , neptunium-237, Pu-236, Cm-243, Cm-244, Cf-248, Cf-250, Cf-252, Cf-254, and associated decay chains ^d and others ^a	6,000

^a To determine the specific group for radionuclides not shown, a comparison of the screening factors, by exposure scenario, listed in Tables B.1, C.1, and D.1 of National Council on Radiation Protection and Measurements (NCRP) Report No. 1231, *Screening Models for Releases of Radionuclides to Atmosphere, Surface Water, and Ground* (NCRP 1996), for the radionuclides in question and the radionuclides in the general groups should be performed and a determination of the proper group made, as described in Annex A of ANSI N13.12-2013 (ANSI/HPS 2013).

^b The screening levels for clearance have been rounded to one significant figure. The levels may be averaged over 1 m² provided no single measurement made to calculate an average in any area of 100 cm² exceeds 10 times the surface screening levels.

^c Natural background radiation from the materials being surveyed may be determined and subtracted from survey measurements, with the net result being compared to the levels in Table B-3 (see Section 4.6 of ANSI N13.12-2013 [ANSI/HPS 2013]).

^d For decay chains, the screening levels represent the total activity (i.e., the activity of the parent plus the activity of all decay chain isotopes) present.

^e The natural uranium screening levels for clearance shall be lowered from Group 2 to Group 1 if decay chain isotopes are present (i.e., uranium ore versus process or separated uranium, for example, in the form of yellowcake). The natural uranium activity equals the activity from uranium isotopes (i.e., 48.9 percent from U-238, plus 48.9 percent from U-234, plus 2.2 percent from U-235).

(d) **Relative Shift and the Number of Samples (*n*)**

Follow the guidance provided in Section B-3.2.7.

(e) **Estimate the Sample Grid Spacing**

(1) Triangular grids will be used.

(2) Grid spacing will be determined by use of Equation B-1.

Equation B-1

$$L = \sqrt{\frac{A}{0.866 \times n}}$$

where:

L = the length between fixed-point measurements

A = the area of the SU

n = the number of fixed-point measurements that are needed

(3) A random starting point will be selected when establishing Class 1 or 2 fixed-point measurement grids.

- (f) Small Areas of Elevated Activity
 - (1) The DCGL for Clearance – A small elevated area may be averaged over one square meter provided no single measurement made to calculate an average in any area of 100 cm² exceeds 10 times the surface screening levels.
 - (2) Materials with areas of elevated activity that exceed the action levels should be removed from the SU and decontaminated or dispensed along with other similar materials (as directed by the USACE).
- (g) Determine if the Number of Measurements is Reasonable
 - (1) Even if MARSSIM guidance is strictly followed, not enough survey points to produce the desired “level of comfort” may exist.
 - (2) Site managers and health physicists have the responsibility to evaluate if the number of survey points is reasonable and to select additional fixed-point locations for measurement where appropriate.
- (h) Re-Evaluate the Number of Measurements
 - (1) When survey and analysis is complete, recalculate (*n*) using actual data.
 - (2) Perform additional fixed-point measurements, if necessary.

B-3.1.4 Quality Assurance/Quality Control Measurements

- (a) Surficial Contamination Measurements
 - (1) For direct measurements and scan surveys, precision, or reproducibility, is best assessed by source response checks. Daily pre- and post-use checks will be performed.

B-3.1.5 Minimum Detectable Concentration

- (a) MDCs shall be less than the applicable action level from Table B-3 and as discussed in Section B-3.1.3 (c) of this appendix or a DCGL developed for the area/property.
- (b) Where possible, the target value for MDCs should be 50 percent or less of the action level.

B-3.1.6 Minimum Detectable Concentration Calculation – Fixed Measurements

- (a) MDCs shall be calculated for each instrument type to be used and for each radiation to be detected.
- (b) MDCs shall be less than the applicable action level that is to be applied to the material.
- (c) The measurement MDC shall be documented on the material’s survey record.
- (d) For laboratory analysis of material samples (i.e., smears or volumetric samples) existing laboratory protocols will be used to determine and document MDCs.
- (e) Equation B-2, taken from NUREG-1507 (NRC 1998), will be used to determine the MDC.

Equation B-2

$$MDC = \frac{3 + 3.29 \sqrt{R_b t_g \left(1 + \frac{t_g}{t_b}\right)}}{t_g E_i E_s \left(\frac{\text{Probe Area cm}^2}{100 \text{ cm}^2}\right)}$$

where:

- R_b = the background count rate (cpm)
- t_g = the gross sample count time (minutes)
- t_b = the background count time (minutes)
- E_i = the detector efficiency
- E_s = the surface efficiency (0.25 for alpha and low-energy beta, 0.50 for beta greater than 0.4 MeV)

B-3.1.7 Beta Minimum Detectable Concentration Calculation – Scanning Measurements

- (a) Scan MDCs shall be calculated for each instrument to be used and for each radiation to be detected.
- (b) Scan parameters should be adjusted such that the scan MDCs are less than the applicable action level that is to be applied to the material.
- (c) The scan MDC shall be documented on the material's survey record.
- (d) When calculating the scan MDC, the index of detectability (d') will be set at a value of 1.38, and the surveyor efficiency (p) will be assumed to be 0.50.
- (e) The following equations, taken from NUREG-1507 (NRC 1998), will be used to determine the scan MDC:

Equation B-3

$$i = \frac{w}{s}$$

where:

- i = the time that the probe face is exposed to a point of contamination (seconds)
- w = the probe face width, in the direction of scanning (inches)
- s = the scan speed (inches/second)

Equation B-4

$$MDCR = d' \sqrt{b \left(\frac{i}{60}\right)} \left(\frac{60}{i}\right)$$

where:

- d' = the index of detectability (Table 6.1 in NUREG-1507 [NRC 1998]) (i.e., 1.38)
- b = the background count rate (cpm)
- i = taken from Equation B-3 (second)

Equation B-5

$$MDC = \frac{MDCR}{\sqrt{p}E_iE_s \left(\frac{\text{probe area cm}^2}{100 \text{ cm}^2} \right)}$$

where:

MDCR = the minimum increase exceeding background that can be seen reliably (cpm)

p = the surveyor efficiency (i.e., 0.5)

E_i = the detector efficiency

E_s = the surface efficiency (see Equation B-2)

B-3.1.8 Alpha Scan Probability Calculation – Scanning Measurements

Scanning for alpha emitting radionuclides differs significantly from scanning for beta and gamma emitters in that the expected background response of most alpha detectors is very close to zero. Instead, it is more useful to determine the probability of detecting an area of contamination at a predetermined action level or DCGL for given scan rates.

Given a known scanning rate and a surface contamination IL, the probability of detecting a single count while passing over the contaminated area is provided in Equation B-6.

Equation B-6 – Alpha Scan Probability

$$P(n \geq 1) = 1 - e^{-\frac{(-G)(\varepsilon_i)(d)}{(60)(v)}}$$

where:

P = the probability of observing a single count

G = the IL (dpm/100 cm²)

ε_i = the detector efficiency (cpm/dpm)

d = the width of the detector face in the direction of scan (cm)

v = the scan speed (cm/second)

When a single count is detected, the surveyor should pause over the suspect area for 10 seconds (or a sufficient time to determine if a measurement would exceed the IL) while continuing to monitor the instrument's audible and visual response. If additional counts are seen, this situation may warrant a static measurement in the area to determine the true contamination level.

B-3.1.9 Scanning

- (a) Scanning will be performed on all materials within the SU.
- (b) The amount of scanning will be based on the SU classification, as discussed in MARSSIM guidance (DoD 2000).
- (c) Scanning may warrant that additional fixed-point measurements be taken to confirm the results of suspect scan results. These additional fixed-point measurements are biased and shall not be included in the statistical analysis of the material in the SU.

B-3.1.10 Data Evaluation

- (a) Radiological COCs
 - (1) Clearance – Compare individual survey results directly to Table B-3 action levels as discussed in Section B-3.1.3 (c) of this appendix. In addition, the null hypothesis is rejected when applying the WRS Test or Sign Test, as applicable.
- (b) QA/QC Samples
 - (1) Verify that daily pre- and post-source check passed daily checks.

B-3.2 THE CRUSHATE/OVERBURDEN PILES APPROACH**B-3.2.1 General**

- (a) MARSSIM-based techniques will be used in the survey and evaluation of crushate piles and/or ex-situ overburden.
- (b) Piles should consist of similar material types (e.g., soil and crushate should not be mixed into a single pile).
- (c) Consolidated materials should be excluded from crushate/overburden piles when the piles are formed and/or when piles are relocated.
- (d) A separate planning package should be written for each pile to be surveyed.
- (e) Simple random sampling during the creation of the crushate/overburden pile is preferred to in-situ pile sampling because fewer logistical and safety concerns exist.
- (f) A systematic grid and systematic sampling scheme for in-situ piles may be substituted for the simple random sampling techniques described in this section, when directed to do so by the USACE.

B-3.2.2 Prerequisites

- (a) Materials have been isolated, segregated, quarantined, etc. such that surveyed materials will not be cross-contaminated or that non-surveyed materials will not be inadvertently mixed with surveyed materials.
- (b) Refer to Attachment B-4 for more detailed information on the basis for the survey approach.

B-3.2.3 Radiological and Chemical Contaminants of Concern – Criteria

Table B-4 summarizes the limits to be applied when evaluating the survey results.

Table B-4. Crushate/Overburden Limits – Radiological and Chemical Contaminants of Concern

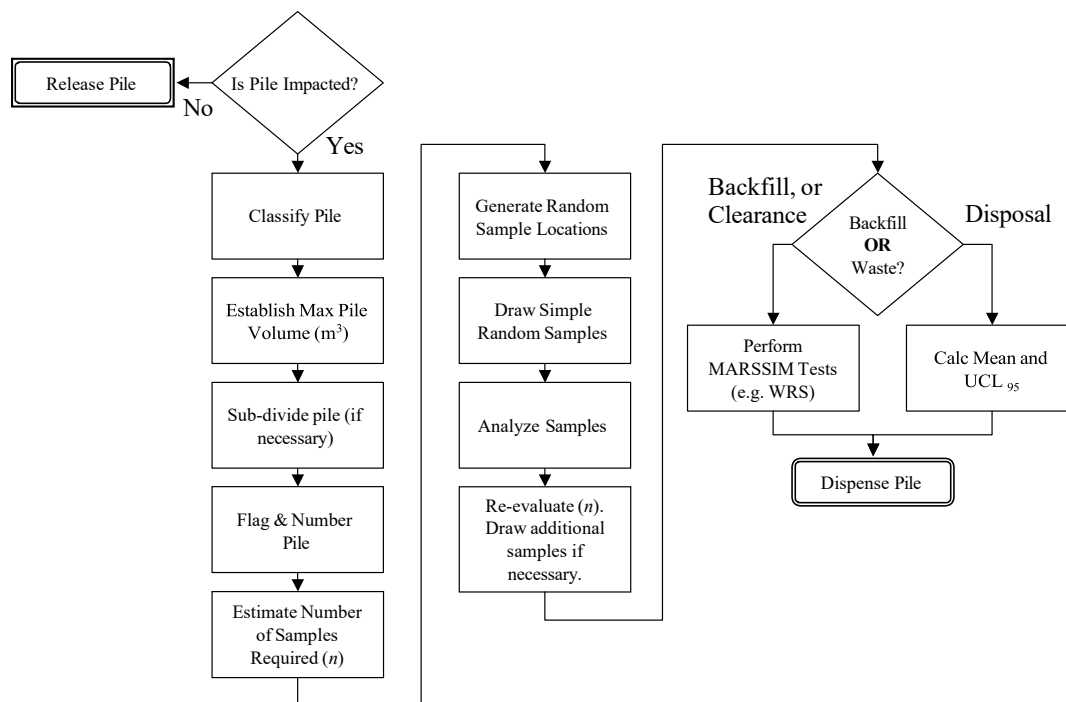
Disposition	Limit
Properly Permitted Subtitle D Landfill	Per the landfill's Waste Acceptance Criteria (WAC)
Properly Permitted Subtitle C Landfill	Per the landfill's WAC
FUSRAP Backfill	Per the applicable ROD guidance listed in Tables 6 and 8 of this FSSP for the SLDS and North St. Louis County Sites, respectively
Clearance	Per the applicable ROD guidance listed in Tables 6 and 8 of this FSSP for the SLDS and North St. Louis County Sites, respectively

Note:

Care must also be taken to ensure compliance with the source material disposal requirements of 10 *CFR* 40.

B-3.2.4 Survey Protocol

Image B-4. MARSSIM-Based Evaluation Process for Piles



B-3.2.5 Pile Classification

- The standard MARSSIM criteria for the classification of land areas will be applied to the classification of crushate/overburden piles.
- Information used in the classification of crushate/overburden piles will be based upon the location (e.g., SU, impacted area in which the material originated).
- If the crushate/overburden pile is located in an area where surrounding activities could impact the radiological status of the pile, then that information will also be considered in the pile classification.
- Each pile will constitute an SU. Separate SUs should not be applied to a single pile.
- In accordance with MARSSIM guidance, a pile of impacted materials will be initially considered to be Class 1, unless there is adequate supporting evidence to assign a different classification. The rationale used shall be documented.

B-3.2.6 Maximum Pile Volumes

- Crushate/overburden piles will be limited in volume (based upon MARSSIM guidance for land areas and modified to consider a theoretical contamination depth of 15 cm to create a volume limit).
- Table B-5 provides maximum pile volumes based upon the pile's survey classification.

Table B-5. Maximum Pile Volumes

SU Classification	Maximum Pile Volume ^a
Class 1	300 m ³
Class 2	1,500 m ³
Class 3	7,500 m ³

^a Maximum pile volumes are guidelines and variances of ± 10 percent are acceptable.

- (c) If a crushate/overburden pile is estimated to exceed the Table B-5 value, then the pile should be physically sub-divided and each new pile should be evaluated separately. The USACE may elect not to physically sub-divide a pile or may elect to evaluate physically separate piles with a single sampling campaign and single evaluation.

B-3.2.7 Estimating the Number of Radiological Samples (n)

The number of samples to be obtained from a crushate/overburden pile will be calculated using standard MARSSIM techniques. The steps are summarized as follows for ease of reference.

- (a) Calculate the Relative Shift (Δ/σ)
- (1) Determine the intended disposition of the pile, and then the corresponding limit from Table B-4.
 - (2) Determine the LBGR.
 - (3) MARSSIM recommends initial selection of the LBGR as half of the limit.
 - (4) Δ = Table B-4 limit(s) – LBGR
 - (5) Estimate standard deviation (σ)

An initial value for standard deviation can be determined from previous survey data from the pile or from the land area from which that the pile was obtained.

Alternately, standard deviation can be estimated via a small preliminary investigation technique¹ in which some small number of samples are obtained and analyzed. The resulting value of standard deviation from the initial sample set is used to calculate a value of n that is used to complete the sampling.

Alternately, standard deviation may be assumed to be on the order of 30 percent if it is reasonable (based on previous experience).

- (6) Determine the relative shift with the following equation:

$$\text{Relative Shift} = \Delta/\sigma$$

- (b) Determine the Decision Error Percentiles

Decision errors are to be set at 0.05 for Type I and at 0.20 for Type II errors.

- (c) Determine the Number of Data Points

Refer to the tables in Attachment B-5 to determine (n), the number of samples required for MARSSIM statistical tests.

A minimum of 20 samples² should be obtained on any pile, regardless of the calculated value of n .

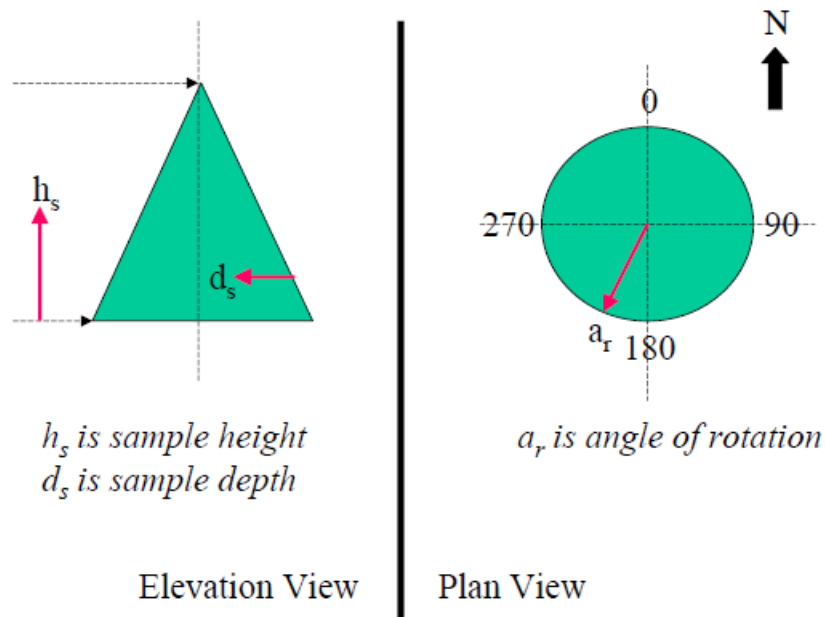
¹ Discussed in MARSSIM, Section 5.5.2.2 (DoD 2000).

² Refer to Attachment B-4 for an explanation.

B-3.2.8 Generating Simple Random Sample Locations

- (a) Samples will be obtained from each crushate/overburden pile using a simple random sampling strategy (unless the USACE dictates that systematic sampling should be performed).
- (b) Where feasible, samples will be obtained during pile creation by selecting random end-loader buckets of pile material. Care should be taken to ensure that some samples are representative of the later portions of the material.
- (c) Sample locations for existing piles will be identified using three values: angle of rotation (a_r), height above ground level (h_s), and depth from the pile surface (d_s) in a horizontal direction, as depicted in Image B-5.
 - (1) Zero degrees pile rotation will be established as true north.
 - (2) Values for a_r , h_s , and d_s should be generated via random number generator, table, etc. (a Microsoft™ Excel worksheet is available that takes the pile height and radius and generates random sample points that are restricted to the bounds of the physical pile).
 - (3) A tabulation of random sample points, along with documentation of the method used to generate the sample points, should be retained in the planning package.

Image B-5. Identifying a Pile Sample Location



B-3.2.9 Drawing Simple Random Samples

- (a) Using approved FUSRAP methods (i.e., the SAG [USACE 2000] and relevant USACE-approved WPs), obtain samples at the locations and/or frequencies identified in Section B-3.2.8.
- (b) Radiological samples taken from in-situ piles shall not be composited.
- (c) Portable radiation instrumentation shall not be used to bias the sample locations or the sample aliquot.

B-3.2.10 Sampling for Chemical Contaminants of Concern

- (a) Chemical COCs are defined in, and their limits/evaluation criteria will be taken from, the applicable ROD or the WAC for the intended disposal facility.
- (b) FUSRAP Backfill or Clearance – The number of chemical samples to be obtained and analyzed is calculated using Attachment B-6. In any case, at least one (composite) sample for chemical COCs will generally be obtained or as directed by the USACE.
- (c) Disposal – The number of chemical COC samples will be determined by the disposal facility's WAC.

B-3.2.11 Toxic Characteristics Leaching Properties Samples

- (a) FUSRAP Backfill or Clearance – Sampling for toxic characteristics leaching properties (TCLP) is generally required if total metals exceed relevant criteria.
- (b) Disposal – Sampling for TCLP may be required by the disposal facility's WAC.
- (c) The number of TCLP samples to be obtained and analyzed is calculated using Attachment B-6, as required by the disposal facility or other method approved by the USACE.

B-3.2.12 Quality Assurance/Quality Control Samples

- (a) FUSRAP Backfill:
 - (1) QA (split) samples should be collected and analyzed at a frequency of approximately once every 20 samples. If fewer than 10 radiological samples are required, then no QA (split) samples will be obtained.
 - (2) QC (duplicate) samples should be collected and analyzed at a frequency of approximately once every 20 samples. If fewer than 10 radiological samples are required, then no QC (duplicate) samples will be obtained.
- (b) Disposal – The number of QC samples will be determined by the WAC of the disposal facility and feedback from the applicable regulatory body.

B-3.2.13 Re-Evaluate the Number of Samples

- (a) When laboratory analysis is complete, re-calculate n (for radiological, chemical, and TCLP samples, as appropriate) using actual data as described in Section B-3.2.7, B-3.2.10 or B-3.2.11.
- (b) If the new value for n is greater than 20 for radiological samples, then identify, obtain, and analyze $n-20$ additional simple random samples.
- (c) If the new value for n is larger than what was obtained for chemical or TCLP samples, then obtain and analyze the additional samples.

B-3.2.14 Radiological Data Evaluation – FUSRAP Backfill or Clearance

- (a) If a crushate/overburden pile is to be placed into backfill on a FUSRAP property, then evaluate the laboratory results via the WRS Test as described in MARSSIM Section 8.4.1 guidance (DoD 2000).
 - (b) In the WRS Test, use reference area measurements that are appropriate to the location from which the overburden pile came.
 - (c) If a suitable background data set is not available for the material, then evaluate the laboratory results via the Sign Test as described in MARSSIM Section 8.3.1 guidance (i.e., background will not be subtracted).
 - (d) The DCGL_{EMC} will not be applied to crushate/overburden piles when using a soil RG from the applicable ROD.
 - (e) If the null hypothesis cannot be rejected, then the pile is not acceptable for backfill.
 - (1) Areas of elevated activity may be removed from the pile. Re-sampling of the pile may not be necessary. The sample results from the removed portion of the pile should be excluded from the final dataset.
- OR**
- (2) The pile's disposition will need to be re-evaluated.
- OR**
- (3) The pile will need to be flattened to approximately 15 cm thickness and re-evaluated using standard MARSSIM techniques for land areas.

B-3.2.15 Radiological Data Evaluation – Disposal Option

- (a) If the crushate/overburden pile is to be sent for disposal, then parametric statistics³ will be calculated for the pile to provide a “best estimate” of the contamination concentration(s) for shipping and disposal purposes. (Alternately, the pile may be taken to the appropriate rail spur and sampled with other soil destined for disposal.)
- (b) Calculate the mean and the sample standard deviation for the laboratory results (for results that are less than the detection limit, substitute half of the detection limit in the calculations).
- (c) Determine the UCL₉₅ per Equation B-7.

Equation B-7

$$\mu_{U\alpha} = \bar{x} + t_{1-\alpha,df} \frac{s}{\sqrt{n}}$$

where:

 $\bar{x}$ = the mean s = the sample standard deviation $t_{1-\alpha,df}$ = taken from the table in Attachment B-7 n = the number of samples evaluated

³ *Methods for Evaluating the Attainment of Cleanup Standards Volume 1: Soils and Media*, Section 6.3.3 (USEPA 1989a).

- (d) Determine if the crushate/overburden pile meets the appropriate limit from Table B-4 (for the intended disposition) by using the following inequalities:

If $\mu_{U\alpha}$ is less than the limit, conclude that the pile is acceptable for the intended disposition.

If $\mu_{U\alpha}$ is greater than or equal to the limit, conclude that the pile is not acceptable for the intended disposition.

- (e) If a pile is not acceptable for the intended disposition, then additional steps must be taken.
- (1) Areas of elevated activity may be removed from the pile. Re-sampling of the pile may not be necessary. The sample results from the removed portion of the pile should be excluded from the final dataset, and pile statistics should be recalculated.

OR

- (2) Another disposition may be chosen. Re-test as described in (d) previously.

B-3.2.16 Data Evaluation – Chemical Contaminants of Concern

- (a) If required pursuant to FUSRAP backfill or clearance – Compare individual sample results to the applicable ROD RGs for FUSRAP backfill. For clearance, compare individual sample results to the UCL₉₅ value for that contaminant as listed in the relevant background study or to the values found in *Geochemical Survey of Missouri: Geography of Soil Geochemistry and Classification by Factor Analysis of Missouri Agricultural Soils* (Tidball 1984).
- (b) Disposal – Compare individual sample results to the disposal facility's WAC.

B-3.2.17 Data Evaluation – Toxic Characteristics Leaching Properties

- (a) Inspect individual sample results to verify that the material does not exhibit hazardous characteristics.

B-3.2.18 Data Evaluation – Quality Assurance/Quality Control Samples

- (a) Verify that sample results meet the DQO listed in Attachment B-8. For backfill, the final evaluation will be included in the appropriate quality control summary report (QCSR).

B-3.2.19 Scanning

- (a) Informational scanning should be performed in an attempt to identify areas of elevated activity.
- (1) GPS-assisted scans are not required.
- (2) The results of scans should be documented on a survey, or as an entry (or series of entries) in an appropriate logbook.
- (b) Scanning will be performed using one of the following approaches:
- (1) On in-situ materials, prior to excavation and subsequent deposition of soil/material in a pile, where applicable, on subsequent exposed layers prior to removal or on end-loader buckets of materials as the pile is being formed;
- (2) On intact piles as part of the sampling protocol; or
- (3) On excavator buckets of pile material and exposed faces of the pile as material is removed from the pile for disposal or backfill.

- (c) Scanning action levels for piles will be determined as follows:
 - (1) Established by the site Radiation Safety Officer (RSO) and/or Certified Health Physicist (CHP);
 - (2) Documented in a planning package; and
 - (3) Based upon the results of the laboratory analysis of pile samples or historical information.
- (d) If elevated scan readings are found during pile removal (i.e., disposition of the pile), guidance follows.
 - (1) The area of elevated readings should be removed from the pile.
 - (2) The elevated material should be placed in an appropriate location so that it can be subsequently sent to the correct disposal facility.
 - (3) Re-sampling of the pile is not required.

B-3.2.20 Minimum Detectable Activity

- (a) FUSRAP Backfill or Clearance – The minimum detectable activities (MDAs) necessary to properly evaluate sample results will be determined by the applicable decision document.
- (b) Disposal – The MDAs necessary to properly evaluate sample results will be determined by the applicable WAC.

B-3.3 IN-SITU APPROACH

B-3.3.1 General

- (a) Survey of in-situ overburden is not the preferred method to evaluate the material. The USACE will critique the selection of this option and may prohibit the in-situ approach because of the following reasons.
 - (1) Some amount of potentially clean overburden could be in close contact with contaminated materials.
 - (2) Contaminated material may be inadvertently removed with the surveyed overburden during the excavation process.
 - (3) If the overburden was surveyed in-situ and then removed, there is no mechanism to detect this contamination.
 - (4) Survey in-situ will require MARSSIM land-area techniques, which will result in a large number of samples.
- (b) Guidance in this FSSP addresses all SLS property types. The appropriate existing guidance will be used to design and execute a survey of in-situ overburden, with the modifications provided in the following sections.
- (c) Data analysis, requirements of sampling for chemical COCs, TCLP, and requirements for QA/QC samples will all be performed in accordance with the relevant existing guidance in this FSSP that is applicable to the overburden area.

B-3.3.2 Limits

- (a) Table B-4 limits apply, based on the intended disposition of the overburden.

- (b) The area limitations of MARSSIM SUs will be applied to overburden sampling.

B-3.3.3 Overburden Classification

- (a) Overburden that is separated from contaminated materials by an intact liner material may be considered a Class 3 SU, in the absence of other information to the contrary.
- (b) Overburden that is in contact with contaminated materials may be considered a Class 2 SU, in the absence of other information to the contrary.
- (c) The boundaries of an overburden Class 2 SU may extend no closer than 1 ft in any direction to contaminated materials.

B-3.3.4 Survey Protocol

- (a) Each overburden area and media type will be approved by the USACE.
- (b) The survey contractor will submit a survey design to the USACE for approval prior to sampling. If prior sampling data supports the use of overburden soil as backfill material, an evaluation of the data may be performed with USACE approval.
- (c) Survey laboratory results will be evaluated using MARSSIM guidance (e.g., Sign Test or WRS Test, as appropriate).
- (d) Samples in each SU will be obtained at 0.5-ft intervals, up to the depth of interest (e.g., within 1 ft of the contaminated region). When authorized by the USACE, up to a 2-ft layer of soil may be evaluated when the entire evaluation length has been scanned with an NaI gamma scintillation detector (or instrumentation with equal or greater sensitivity), and a sample will be collected based on highest count rate, or if count rates are uniform, from the deepest 0.5 ft of the first evaluation length as described in Section 4.3.2 of this FSSP.
- (e) Each grouping of 0.5-ft intervals (i.e., each 0.5-ft layer), or the approved evaluation length, will be evaluated as an independent data set, using the Sign Test or WRS Test as appropriate.
- (f) If analysis of an interval fails to reject the null hypothesis, then options follow:
- (1) The entire interval (layer) must be excluded from the overburden, or
 - (2) The region of samples that caused the failure must be excluded from the overburden and must be included in a remediation effort.
- If a region is excluded, then additional samples may need to be obtained to achieve the following objectives:
- Better define the boundary of the contaminated region.
 - Raise the number of samples in the remainder of the overburden interval to an acceptable level of statistical power.
- (g) Where feasible, each 0.5-ft lift of material should receive an in-situ GWS prior to removal to look for the presence of small areas of elevated activity. Scans at less frequent levels than each 0.5-ft lift may be performed as directed by USACE Health Physicists.

THIS PAGE INTENTIONALLY LEFT BLANK

B-4.0 MATERIAL-SPECIFIC INSTRUCTIONS

NOTE: The USACE may direct the RAC or verification contractor to perform any and/or all the steps outlined in any subsection of this appendix. This will generally be established in the review phase.

B-4.1 EQUIPMENT/MATERIALS OR CONSOLIDATED MATERIALS

B-4.1.1 Responsibilities

- (a) RAC (MARSAME Approach [DoD 2009])
 - (1) Identify materials for survey and evaluation.
 - (2) Gather and document historical information/process knowledge for the material to be evaluated.
 - (3) Classify the materials (i.e., MARSSIM class [DoD 2000]).
 - (4) Notify the verification contractor of the need for a MARSAME-based planning package. Supply historical information and supply input to the planning package.
 - (5) Using an approved planning package, obtain samples and conduct the surveys necessary to evaluate the materials in question.
 - (6) Solicit USACE approval before the clearance or disposal of materials.
- (b) Verification Contractor (MARSAME Approach)
 - (1) Solicit RAC input for planning packages.
 - (2) Develop MARSAME-based planning packages, and review them with the RAC.
 - (3) Submit planning packages to the USACE for concurrence.
 - (4) Perform supplementary sampling and/or confirmatory measurements of materials as needed.
 - (5) Evaluate data and generate a material survey evaluation report to be used by the USACE in decision making.

B-4.1.2 General

- (a) A separate MARSAME-based package should be written for each type of material and for each MARSSIM classification of the material to be surveyed.
- (b) Any and all of the survey and evaluation steps may be performed by the RAC when directed to do so by the USACE.

B-4.1.3 Prerequisites

- (a) Materials are sufficiently dry so as not to adversely impact the survey results.
- (b) Materials are free from large amounts of dirt, soil, oils, grease, and vegetation.
- (c) Materials have been isolated, segregated, quarantined, etc. such that surveyed materials will not be cross-contaminated or that non-surveyed materials will not be inadvertently mixed with surveyed materials.

B-4.2 CRUSHATE PILES/OVERBURDEN PILES

B-4.2.1 Responsibilities (Clearance or Disposal Option)

- (a) RAC
 - (1) Identify materials for survey and evaluation.
 - (2) Gather and document historical information/process knowledge for the material to be evaluated.
 - (3) Create a piles planning package.
 - (4) Submit the planning package to the USACE for concurrence.
 - (5) Using an approved planning package, obtain samples from crushate/overburden piles.
 - (6) Scan pile materials in an attempt to identify areas of elevated activity.
 - (7) Evaluate pile sample results and scan data.
 - (8) Determine the appropriate disposal option.
 - (9) Submit survey documentation and basis for disposal option to the USACE for concurrence.
- (b) Verification Contractor – No actions required

B-4.2.2 Responsibilities (FUSRAP Backfill Option)

- (a) RAC
 - (1) Identify materials for survey and evaluation.
 - (2) Gather and document historical information/process knowledge for the material to be evaluated.
 - (3) Notify the verification contractor of the need for a piles planning package. Supply historical information and supply input to the planning package.
 - (4) When directed by the USACE (using an approved planning package) obtain samples from crushate/overburden material while generating a pile, or from in-situ piles. The degree of government oversight will be determined by the USACE.
 - (5) Scan pile materials in an attempt to identify areas of elevated activity, while generating a pile, and during pile removal. This will be done under government oversight, with the degree of oversight to be determined by the USACE.
 - (6) Solicit USACE approval before using the material as backfill.
- (b) Verification Contractor
 - (1) Solicit RAC input for planning packages.
 - (2) Develop piles planning packages, and review them with the RAC.
 - (3) Submit piles planning packages to the USACE for concurrence.
 - (4) Obtain samples from in-situ crushate/overburden piles (unless the USACE has directed the RAC to do this).

- (5) Scan piles in-situ in an attempt to identify areas of elevated activity (unless the USACE has directed the RAC to do this).
- (6) Evaluate data and generate a material survey evaluation report to be used by the USACE in decision making.

B-4.2.3 General

- (a) A separate piles planning package should be written for each type of material and each pile of material to be surveyed.
- (b) Any and all of the survey and evaluation steps may be performed by the RAC when directed to do so by the USACE.

B-4.2.4 Prerequisites

- (a) Materials are relatively dry.
- (b) Materials have been isolated, segregated, quarantined, etc. such that surveyed materials will not be cross-contaminated or that non-surveyed materials will not be inadvertently mixed with surveyed materials.

B-4.3 IN-SITU OVERBURDEN

B-4.3.1 Responsibilities

- (a) RAC
 - (1) Identify materials for survey and evaluation.
 - (2) Gather and document historical information/process knowledge for the material to be evaluated.
 - (3) Classify the material.
 - (4) Notify the verification contractor of the need for a planning package. Supply historical information and supply input to the package.
 - (5) Obtain samples from in-situ overburden under government oversight, when directed by the USACE. The degree of oversight will be determined by the USACE.
 - (6) Develop cut lines from the PDI and in-situ overburden sample results when in-situ samples are collected, and submit an excavation package to the USACE for concurrence prior to excavation.
- (b) Verification Contractor
 - (1) Solicit RAC input for planning packages.
 - (2) Develop in-situ overburden planning packages, and review them with the RAC.
 - (3) Submit planning packages to the USACE for concurrence.
 - (4) Obtain samples from in-situ overburden when needed.
 - (5) Scan overburden in an attempt to identify areas of elevated activity.
 - (6) Evaluate sample results and scan data.
 - (7) Create and submit survey documentation to the USACE prior to excavation.

B-4.3.2 Prerequisites

- (a) The area of interest has been characterized. The depth and expected boundaries of subsurface contamination is known.
- (b) Known areas of surface contamination have been removed/remediated.
- (c) The area has been barricaded and/or quarantined to prevent cross-contamination during overburden removal.

B-5.0 RECORDS

No new records or record types are generated as a result of this procedure.

THIS PAGE INTENTIONALLY LEFT BLANK

ATTACHMENT B-1

**TECHNICAL BASIS FOR SURVEY OF CONSOLIDATED MATERIALS AND
EQUIPMENT**

THIS PAGE INTENTIONALLY LEFT BLANK

ATTACHMENT B-1

TECHNICAL BASIS FOR SURVEY OF CONSOLIDATED MATERIALS AND EQUIPMENT

Background

The purpose of this attachment is to provide an appropriate methodology for the survey of impacted (i.e., potentially contaminated) materials encountered during remedial activities at the SLS for eventual release without radiological restrictions using MARSAME guidance (DoD 2009).

Materials surveyed for release without use restrictions shall meet the criteria specified in ANSI/HPS N13.12-2013, *Surface and Volume Radioactivity Standards for Unrestricted Clearance* (ANSI/HPS 2013).

ANSI 13.12-2013 guidance meet the intent of the CERCLA decision document(s) for the attainment of ARARs.

The materials that are determined to be impacted and are to be released without radiological restrictions will require surveying with handheld instrumentation (for total contamination levels), as outlined on Image B-1.

The surveyor shall document the results of all surficial testing results demonstrating that the appropriate release criteria have been met.

Basis for Action Levels – Surficial Contamination

ANSI 13.12-2013, *Surface and Volume Radioactivity Standards for Unrestricted Clearance*, which were derived based on a primary dose criterion of 1 mrem/year to a member of the modeled critical group of receptors. As such, the criteria specified in ANSI N13.12-2013 are all fully protective of human health.

Minimum Detectable Concentrations

NUREG-1507, *Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions* (NRC 2020), and MARSSIM (DoD 2000) contain a methodology for the calculation of MDCs.

The MDC is the minimum concentration (activity) of the contaminant that can be measured with certainty. The MDC is dependent on background count rate and the efficiency of the detector to detect the contaminant on the surface being surveyed.

A scanning MDC is strongly dependent on the speed at which the surveyor moves the detector probe along the surface being surveyed.

It is necessary to determine the MDCs for an instrument to demonstrate that the instrument selected for the survey is sensitive enough to detect the contaminant at or below the release criterion. The steps include the following:

1. Calculating the minimum detectable count rate (MDCR) by selecting a given level of performance, scan speed, and background level of the detector, and
2. Selecting a surveyor efficiency, if applicable.

NOTE: Loose aggregate materials such as crushate, crushate piles, soil, and soil piles are addressed in Section B-3.2 and Attachment B-4.

Materials suspect of volumetric contamination will not be released using this FSSP.

Averaging

When small areas of elevated (fixed) surface contamination exist, reference documents allow for a limited averaging of measurements in demonstrating compliance with action levels. The following guidelines shall be applied if averaging will be used to support the clearance of materials.

1. USACE permission shall be granted (and documented on the survey or logbook) when using averaging to support the clearance of materials.
2. Multiple surface measurements may be averaged over a surface area not to exceed 1 m². For items with a surface area less than 1 m², an average over the entire surface shall be derived for each item.
3. No single measurement used in calculating an average surface activity concentration shall exceed 10 times the release criteria.

ATTACHMENT B-2

DATA QUALITY OBJECTIVES FOR MARSAME MATERIAL SURVEYS

THIS PAGE INTENTIONALLY LEFT BLANK

ATTACHMENT B-2

DATA QUALITY OBJECTIVES FOR MARSAME MATERIAL SURVEYS

State the Problem

The sample design will be used to demonstrate that radionuclide concentrations comply with the action levels of Table B-3 of this appendix and pass the appropriate statistical test, based upon the intended disposition of the material.

Identify the Decision

The materials are expected to meet the applicable action levels prior to final survey and evaluation. Several questions must be answered:

1. Is the average of the contamination measurements below the applicable action level?
2. Is the maximum contamination measurement below the maximum measurement action level?
3. Do inaccessible areas for measurement exist, and have they been adequately addressed?

Identify Inputs to the Decision

Field activities will consist of the following:

- Surface scans with contamination detection equipment to identify areas of elevated activity.
- Fixed-point measurements of suspect areas, and of systematic or random measurement locations to determine the average surface contamination level.

Scan and fixed-point measurement MDCs will be calculated using guidance from Sections B-3.1.5 through B-3.1.8.

Define the Study Boundary

SUs will be established so that material of similar physical characteristics and contamination potential are grouped together.

Materials within an SU will be laid-out in an orderly fashion to facilitate gridding and the collection of survey data.

Develop the Decision Rule

1. Equipment/Materials – Clearance: If the average surface contamination level is greater than Table B-3 action levels as discussed in Section B-3.1.3 (c) or the null hypothesis cannot be rejected when applying the WRS Test (or Sign Test, as applicable) then consider decontamination or disposal options.

2. Consolidated Materials – Backfill: If the average surface contamination level is greater than Table B-3 limits or the null hypothesis cannot be rejected when applying the WRS Test (or Sign Test, as applicable), then consider disposal options.

Specify Tolerable Limits on Decision Error

1. Type I errors: 0.05
2. Type II errors: 0.20
3. QC splits and duplicates will agree within 30 percent for measurements that are greater than or equal to 50 percent of the limit.
4. The null hypothesis will state the following: *The contamination on/in the material surveyed exceeds the release criterion.*

Optimize the Design

Field screening techniques and the DQA process will be used, as appropriate, throughout the survey and evaluation to focus efforts and minimize impacts.

ATTACHMENT B-3

**DERIVATION OF SPECIFIC ACTION LEVELS FOR ST. LOUIS FUSRAP
EQUIPMENT AND MATERIALS**

THIS PAGE INTENTIONALLY LEFT BLANK

ATTACHMENT B-3**DERIVATION OF SPECIFIC ACTION LEVELS FOR ST. LOUIS FUSRAP
EQUIPMENT AND MATERIALS**

The purpose of this attachment is to document the process used for calculating a single health-conservative surrogate total alpha activity action level that can be applied to all equipment and materials present on the SLS (e.g., the SLDS and North St. Louis County Sites).

This calculation applies the dose-based radionuclide-specific surface screening action levels listed in Table B-3 and the site-specific COC AFs to derive a St. Louis FUSRAP-specific action level.

Site-specific COC AFs are developed using recent (i.e., calendar year 2021) railcar sampling data to determine action levels that are relevant to current RA activities.

DETERMINATION OF TOTAL ACTIVITY FRACTIONS

Contaminated soil is remediated and shipped via rail to disposal facilities. Prior to shipment, the railcars are sampled to determine the activity associated with the shipment. In calendar year 2021, sample results for 132 North St. Louis County railcar samples and 82 SLDS railcar samples resulted in the average COC concentrations listed in Table B-3-1. The sample identifiers for this dataset are listed in Table B-3-4.

Several COCs have short-lived decay chain isotopes that are assumed to be in secular equilibrium with the longer-lived parent. The number of radionuclides in the equilibrium decay chain (i.e., parent and decay chain isotopes in secular equilibrium with the parent) are listed in Table B-3-1 as well as the number of radioactive decay types associated with the parent equilibrium decay chain. For example, the Pb-210 equilibrium decay chain consists of three radionuclides, Pb-210 and two short-lived decay chain isotopes, which account for one alpha (α) decay and two beta (β) decays.

Table B-3-1. Activity Fractions

Radionuclide	Average Railcar Activity Parent Only (pCi/g)		Number of Emissions in Equilibrium Decay Chain			Average Railcar Activity COC-Equilibrium Chain (pCi/g)		AF of Equilibrium Chain	
	North St. Louis County	SLDS	Total	Alpha	Beta	North St. Louis County	SLDS	North St. Louis County	SLDS
Ac-227	0.67	0.33	8	5	3	5.32	2.63	0.0658	0.0535
Pa-231	0.45	0.21	1	1	0	0.45	0.21	0.0056	0.0043
Pb-210	4.84	2.00	3	1	2	14.51	6.01	0.1794	0.1222
Ra-226	2.01	1.54	6	4	2	12.09	9.25	0.1495	0.1880
Ra-228	0.60	0.44	2	0	2	1.21	0.89	0.0150	0.0180
Th-228	0.61	0.44	7	5	2	4.24	3.10	0.0524	0.0630
Th-230	38.09	2.63	1	1	0	38.09	2.63	0.4709	0.0535
Th-232	0.61	0.44	1	1	0	0.61	0.44	0.0075	0.0090
U-234	1.07	5.83	1	1	0	1.07	5.83	0.0133	0.1185
U-235	0.04	0.36	2	1	1	0.08	0.72	0.0010	0.0145
U-238	1.07	5.83	3	1	2	3.22	17.50	0.0398	0.3555
Total	NA	NA	35	21	14	80.88	49.22	1.00	1.00

TABLE B-3 SURFACE ACTIVITY ACTION LEVELS

Of the 11 COCs, 8 (i.e., Ac-227, Pa-231, Pb-210, Ra-226, Ra-228, Th-228, Th-230, and Th-232) have a surface activity action level of 600 dpm/100 cm². The 3 uranium COCs (i.e., U-234, U-235, and U-238) have a surface activity action level of 6,000 dpm/100 cm².

The surface activity action levels listed in Table B-3 are dose-based levels that were developed and documented in ANSI/HPS N13.12-2013, *Surface and Volume Radioactivity Standards for Unrestricted Clearance* (ANSI/HPS 2013). These action levels are based on a dose of 1 mrem/year to the receptor assumed to use the material or equipment after it is released.

CONTAMINANT-OF-CONCERN EQUILIBRIUM DECAY CHAINS

The eleven COCs listed in Table B-3-1 are the long-lived radionuclides that are not likely to be in secular equilibrium with a parent nuclide due to their longer half-lives. All short-lived decay chain isotopes within the decay chain are assumed to be in equilibrium with the parent nuclide. That means those decay chain isotopes nuclides have the same activity (or are emitting radioactivity at the same rate) as the parent nuclide. Four nuclides, Pa-231, Th-230, Th-232, and U-234, have only single nuclide chains, which means they have no decay chain isotopes nuclides in equilibrium and therefore are the only nuclide in their chain.

As shown in Table B-3-1, 35 total decays (i.e., radiation emissions) exist in the 11 COC chains; 21 emissions are alpha decays, and the other 14 emissions are beta decays.

The 11 COC decay chains are then separated by their respective Table B-3 surface activity action level, with 8 decay chains associated with the 600 dpm/100 cm² action level and 3 uranium decay chains associated with the 6,000 dpm/100 cm² action level. Because the decay chains may emit both alpha and beta radiations, the percentage of each type of radiation emission was calculated for both North St. Louis County and the SLDS for each associated action level grouping. For example, in North St. Louis County, 5.4 percent of the total activity is from the uranium decay chains associated with the 6,000 dpm/100 cm² action level, with 2.7 percent of that activity from alpha emissions and 2.7 percent from beta emissions because 3 alpha emissions and 3 beta emissions are associated with those chains. These values are presented in Table B-3-2.

Table B-3-2. Action Level and Radiation Type Activity Fractions

Radionuclide	AF of Equilibrium Chain		Number of Emissions in Equilibrium Decay Chain			North St. Louis County Radiation Type AF		SLDS Radiation Type AF	
600 dpm/100 cm ² COC Decay Chains									
Radionuclide	North St. Louis County	SLDS	Total	Alpha	Beta	Alpha	Beta	Alpha	Beta
Ac-227	0.0658	0.0535	8	5	3	0.0411	0.0247	0.0334	0.0201
Pa-231	0.0056	0.0043	1	1	0	0.0056	0.0000	0.0043	0.0000
Pb-210	0.1794	0.1222	3	1	2	0.0598	0.1196	0.0407	0.0815
Ra-226	0.1495	0.1880	6	4	2	0.0997	0.0498	0.1253	0.0627
Ra-228	0.0150	0.0180	2	0	2	0.0000	0.0150	0.0000	0.0180
Th-228	0.0524	0.0630	7	5	2	0.0374	0.0150	0.0450	0.0180
Th-230	0.4709	0.0535	1	1	0	0.4709	0.0000	0.0535	0.0000
Th-232	0.0075	0.0090	1	1	0	0.0075	0.0000	0.0090	0.0000
Total	94.6%	51.1%				72.2%	22.4%	31.1%	20.0%
6,000 dpm/100 cm ² COC Decay Chains									
Radionuclide	North St. Louis County	SLDS	Total	Alpha	Beta	Alpha	Beta	Alpha	Beta
U-234	0.0133	0.1185	1	1	0	0.0133	0.0000	0.1185	0.0000
U-235	0.0010	0.0145	2	1	1	0.0005	0.0005	0.0073	0.0073
U-238	0.0398	0.3555	3	1	2	0.0133	0.0265	0.1185	0.2370
Total	5.4%	48.9%				2.7%	2.7%	24.4%	24.4%

TOTAL ALPHA ACTIVITY AND TOTAL BETA ACTIVITY ACTION LEVELS

To obtain a total activity action level for each type of radiation, the percentage of activity for the specific type of radiation was multiplied by the associated action level and those values were then summed. For example, in North St. Louis County, alpha radiation accounted for 2.7 percent of the total activity was from alpha emissions in the 6,000 dpm/100 cm² action level, and 72.2 percent of the total activity was from alpha emissions in the 600 dpm/100 cm² action level.

$$\text{Alpha Action Level}_{NC} = (2.7\% * 6,000) + (72.2\% * 600) + 162 + 433$$

$$= 595 \text{ dpm/100 cm}^2$$

Table B-3-3 presents the total activity action level for each type of radiation.

Table B-3-3. Total Alpha and Total Beta Action Levels

Table B-3 Action Level	North St. Louis County			SLDS		
	Total	Alpha	Beta	Total	Alpha	Beta
6,000	5.4%	2.7%	2.7%	48.9%	24.4%	24.4%
600	94.6%	72.2%	22.4%	51.1%	31.1%	20.0%
Units	dpm/100 cm²			dpm/100 cm²		
6,000	324	162	162	2932	1466	1466
600	568	433	134	307	187	120
Total	892	595	296	3238	1653	1586

As shown in Table B-3-3, the North St. Louis County total activity action level is 892 dpm/100 cm² with 595 of the decays associated with alpha radiation and 296 of the decays associated with alpha radiation. The beta value is too small to be distinguishable within the variation of beta emissions

due to natural background radioactivity. Natural background radioactivity varies by thousands of dpm/100 cm² because of varying material types and variations in plate-out of radon decay chain isotopes due to atmospheric pressure changes. In addition, this value would have to be decreased to account for the beta emissions that are not detected by the instrument because of insufficient energy to penetrate its mylar window. The AFs for MED/AEC COCs in soil associated with the SLS result in too few beta-emitting contributions to the total activity for a total beta action level to be useful for surveying equipment and materials.

CONCLUSION

The total alpha action level of 595 dpm/100 cm² rounded to an even value of 600 dpm/100 cm² will be used as a surrogate action level for the release of equipment and materials at all the SLS (i.e., North St. Louis County and the SLDS). Although it is rounded up, this action level is both health-conservative and as low as reasonably achievable (ALARA) because it still equates to approximately 1 mrem per year to the receptor. The effort to produce a beta action level was not fruitful because the site-specific AFs produce insufficient detectable beta emissions. Nonetheless, a total beta action level based on other references may be selected with USACE concurrence as a conservative measure.

Table B-3-4. Railcar Dataset

SDT3234RC	SDT3235RC	SDT3236RC	SDT3237RC	SDT3238RC	SDT3239RC	SDT3240RC	SDT3241RC	SDT3242RC
SDT3243RC	SDT3244RC	SDT3245RC	SDT3246RC	SDT3247RC	SDT3248RC	SDT3249RC	SDT3250RC	SDT3251RC
SDT3252RC	SDT3253RC	SDT3254RC	SDT3255RC	SDT3256RC	SDT3257RC	SDT3258RC	SDT3259RC	SDT3260RC
SDT3261RC	SDT3262RC	SDT3263RC	SDT3264RC	SDT3265RC	SDT3266RC	SDT3267RC	SDT3268RC	SDT3269RC
SDT3270RC	SDT3271RC	SDT3272RC	SDT3273RC	SDT3274RC	SDT3275RC	SDT3276RC	SDT3277RC	SDT3278RC
SDT3279RC	SDT3280RC	SDT3281RC	SDT3282RC	SDT3283RC	SDT3284RC	SDT3285RC	SDT3286RC	SDT3287RC
SDT3288RC	SDT3289RC	SDT3290RC	SDT3291RC	SDT3292RC	SDT3293RC	SDT3294RC	SDT3295RC	SDT3296RC
SDT3297RC	SDT3298RC	SDT3299RC	SDT3300RC	SDT3301RC	SDT3302RC	SDT3303RC	SDT3304RC	SDT3305RC
SDT3306RC	SDT3307RC	SDT3308RC	SDT3309RC	SDT3310RC	SDT3311RC	SDT3312RC	SDT3313RC	SDT3314RC
SDT3315RC	NCV2732RC	NCV2733RC	NCV2734RC	NCV2735RC	NCV2736RC	NCV2737RC	NCV2738RC	NCV2739RC
NCV2740RC	NCV2741RC	NCV2742RC	NCV2743RC	NCV2744RC	NCV2745RC	NCV2746RC	NCV2747RC	NCV2748RC
NCV2749RC	NCV2750RC	NCV2751RC	NCV2752RC	NCV2753RC	NCV2754RC	NCV2755RC	NCV2756RC	NCV2757RC
NCV2758RC	NCV2759RC	NCV2760RC	NCV2761RC	NCV2762RC	NCV2763RC	NCV2764RC	NCV2765RC	NCV2766RC
NCV2767RC	NCV2768RC	NCV2769RC	NCV2770RC	NCV2771RC	NCV2772RC	NCV2773RC	NCV2774RC	NCV2775RC
NCV2776RC	NCV2777RC	NCV2778RC	NCV2779RC	NCV2780RC	NCV2781RC	NCV2782RC	NCV2783RC	NCV2784RC
NCV2785RC	NCV2786RC	NCV2787RC	NCV2788RC	NCV2789RC	NCV2790RC	NCV2791RC	NCV2792RC	NCV2793RC
NCV2794RC	NCV2795RC	NCV2796RC	NCV2797RC	NCV2798RC	NCV2799RC	NCV2800RC	NCV2801RC	NCV2802RC
NCV2803RC	NCV2804RC	NCV2805RC	NCV2806RC	NCV2807RC	NCV2808RC	NCV2809RC	NCV2810RC	NCV2811RC
NCV2812RC	NCV2813RC	NCV2814RC	NCV2815RC	NCV2816RC	NCV2817RC	NCV2818RC	NCV2819RC	NCV2820RC
NCV2821RC	NCV2822RC	NCV2823RC	NCV2824RC	NCV2825RC	NCV2826RC	NCV2827RC	NCV2828RC	NCV2829RC
NCV2830RC	NCV2831RC	NCV2832RC	NCV2833RC	NCV2834RC	NCV2835RC	NCV2836RC	NCV2837RC	NCV2838RC
NCV2839RC	NCV2840RC	NCV2841RC	NCV2842RC	NCV2843RC	NCV2844RC	NCV2845RC	NCV2846RC	NCV2847RC
NCV2848RC	NCV2849RC	NCV2850RC	NCV2851RC	NCV2852RC	NCV2853RC	NCV2854RC	NCV2855RC	NCV2856RC
NCV2857RC	NCV2858RC	NCV2859RC	NCV2860RC	NCV2861RC	NCV2862RC	NCV2863RC		

ATTACHMENT B-4

TECHNICAL BASIS FOR SURVEY OF CRUSHATE/OVERBURDEN PILES

THIS PAGE INTENTIONALLY LEFT BLANK

ATTACHMENT B-4

TECHNICAL BASIS FOR SURVEY OF CRUSHATE/OVERBURDEN PILES

Background

The scope of MARSSIM guidance (DoD 2000) is limited to surface soil. Surveys are based on area units, and the scope of the survey evaluation is limited to the first 0.5 ft of soil. Because of these limitations, MARSSIM guidance cannot be directly applied to volumes such as crushate or overburden piles.

However, with some modifications, MARSSIM statistical techniques can be applied to volume units.

Limitations of the MARSSIM Technique

In attempting to apply MARSSIM guidance directly to a volume unit, one should consider the following limitations.

- MARSSIM guidance relies on scanning to detect small areas of elevated activity. Scanning will not detect contaminants at a depth exceeding 0.5 ft; therefore, much of the volume will not be evaluated by scanning.
- Using MARSSIM guidance to evaluate each 0.5-ft interval independently would result in a large number of samples that would need to be obtained and analyzed.
- Variations in the surface contour can make the assessment of individual 0.5-ft intervals difficult.
- The shape and contours of a crushate/overburden pile make gridding and the collection of accurate systematic samples difficult.

Parametric versus Non-Parametric Statistics

MARSSIM guidance uses non-parametric statistical techniques for the following reasons.

- Contamination within an SU may not be normally distributed (i.e., contamination gradients and areas of elevated activity).
- SU data is obtained systematically versus randomly.

Parametric techniques may be appropriate for crushate/overburden piles for the following reasons.

- The excavation, movement, and stockpiling of materials will tend to distribute the contamination more normally.
- Simple random sampling is more readily achievable in a “pile” geometry.

- Parametric procedures perform well even when their underlying assumptions of the distribution of the data are not strictly true. This occurs with sample sizes in the range of 20 or greater.

Field detection equipment is not used to scan the piles prior to simple random sampling because this might lead to bias in the sampling results. Such bias can have a significant impact on a parametric evaluation of the survey data.

The compositing of field samples is not performed for crushate/overburden piles. Compositing will “mechanically average” the individual sample result and skew the UCL₉₅ result.

ATTACHMENT B-5

MARSSIM TABLES FOR SELECTING (n) NUMBER OF SAMPLES

THIS PAGE INTENTIONALLY LEFT BLANK

ATTACHMENT B-5

MARSSIM TABLES FOR SELECTING (n) NUMBER OF SAMPLESWRS Test^a

MARSSIM Table 5.3			
$\alpha = 0.05$			
	β		
rel shift	0.10	0.20	0.25
0.10	2,157	1,558	1,355
0.20	542	391	341
0.30	243	175	153
0.40	139	100	87
0.50	90	65	57
0.60	64	46	40
0.70	48	34	30
0.80	38	27	24
0.90	31	22	20
1.00	26	18	16
1.10	22	16	14
1.20	19	14	12
1.30	17	12	11
1.40	15	11	10
1.50	14	10	9
1.60	13	9	8
1.70	12	8	8
1.80	11	8	7
1.90	11	7	7
2.00	10	7	7
2.25	9	6	6
2.50	9	6	6
2.75	8	6	5
3.00	8	5	5
3.50	8	5	5
4.00	7	5	5

^a Listed values for n reflect the number of samples to be taken in the SU only. Strictly speaking, the values provided for MARSSIM Table 5.3 are actually $N/2$ values. See MARSSIM guidance for further explanation (DoD 2000).

Sign Test

MARSSIM Table 5.5			
$\alpha = 0.05$			
	β		
rel shift	0.10	0.20	0.25
0.10	1,620	1,170	1,018
0.20	410	295	258
0.30	185	133	117
0.40	107	77	68
0.50	71	51	45
0.60	52	36	33
0.70	40	28	26
0.80	32	22	21
0.90	27	19	17
1.00	23	16	15
1.10	21	14	14
1.20	18	13	12
1.30	17	11	11
1.40	16	11	10
1.50	15	8	10
1.60	14	9	9
1.70	14	9	9
1.80	12	9	9
1.90	12	8	9
2.00	12	8	8
2.50	11	8	8
3.00	11	7	8

NOTE 1: The values for n provided in these tables have already been increased by 20 percent as recommended per MARSSIM guidance.

NOTE 2: If an actual value of the relative shift is not listed, always select the next lower value that appears in the table. For example, if the relative shift = 1.67, then 1.6 should be used to determine n .

THIS PAGE INTENTIONALLY LEFT BLANK

ATTACHMENT B-6

DETERMINING THE NUMBER (n) OF CHEMICAL SAMPLES TO BE OBTAINED

THIS PAGE INTENTIONALLY LEFT BLANK

ATTACHMENT B-6**DETERMINING THE NUMBER (*n*) OF CHEMICAL SAMPLES TO BE OBTAINED**

Two separate USEPA statistical methods have been identified for estimation of the required number of chemical and/or TCLP samples (*n*) needed to determine, with a specified level of confidence, the average contaminant concentrations in soil, concrete, crushate, etc. Each of these methods is described following, with a discussion of their application.

Method 1

This method is derived from solid waste (SW)-846, *Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods*, Volume II, Chapter 9 (USEPA 1988). This method is based on the following equation:

$$n = \frac{t^2 s^2}{d^2}$$

Equation B-8

where:

n = the sample size

t = the Student's *t* value at a specified significance level⁴ (see Attachment B-7)

s = a sample estimate of the population standard deviation

d = the regulatory threshold (cleanup standard) minus the sample mean⁵

Method 2

This method is derived from guidance presented in *Methods for Evaluating the Attainment of Cleanup Standards, Volume I: Soils and Solid Media* (USEPA 1989a). This method is based on the following equation:

$$n = s^2 \left[\frac{Z_{1-\beta} + Z_{1-\alpha}}{cs - \mu_1} \right]^2$$

Equation B-9

⁴ Use a 5 percent significance level (or $t_{0.95}$) to determine (*t*).

⁵ If the sample mean is unknown, use a value of 20 percent of the regulatory threshold (cleanup standard) for the value of (*d*).

where:

n = the required sample size

s = an estimate of the standard deviation

$z_{1-\beta}$ and $Z_{1-\alpha}$ = the critical values for the normal distribution with probabilities of $1-\alpha$ and $1-\beta$

α = the false negative rate for the statistical test⁶

β = the false positive rate for the statistical test⁷

CS = the cleanup/release standard

μ_l = an estimate of the mean concentration

Sample Number (n) Determination

Equations B-8 and B-9 require sample estimates of the mean and standard deviation of the “true” (population) contaminant concentrations to calculate sample size. The basic approach for determining these statistics is as follows.

Analytical data are already available (for COC concentrations and/or TCLP results in the material to be evaluated): Use this data to calculate (n).

Analytical data are not available:

1. Use existing data from related areas/materials or from a prior study to calculate (n).
2. When sample results become available, use these results to re-calculate (n) to validate that the appropriate number of samples have been taken (as illustrated on Image B-4).
3. Obtain additional samples, if needed, to satisfy (n).

Neither equation includes a variable for material volume; therefore, the estimate of sample size is independent of the total volume of material. The sample size estimate is dependent on only the characteristics of the sample concentration distribution. The required number of samples for each chemical COC should be calculated separately from both equations, and the largest resulting sample size should be used.

Additionally, Equations B-8 and B-9 may result in unusually small or large sample sizes, dependent on the value of the sample standard deviation. Therefore, it is appropriate to place bounds on the total number of samples collected by relating this number to the material volume. For any volume of material to be sampled, the minimum number of samples required⁸ should be one sample per 500 yd³, and the maximum number of samples⁹ should be one sample per 100 yd³.

⁶ The false negative rate is the probability that the area will be declared clean when it actually contains COCs with levels above cleanup criteria. For this project, α has been set equal to 0.05.

⁷ The false positive rate is the probability that the area will be declared to contain COCs above cleanup levels when it is actually clean. For this project, β has been set equal to 0.20

⁸ CERCLA default value.

⁹ Common requirement for treated material sampling.

ATTACHMENT B-7

STATISTICAL TABLE FOR EVALUATING SAMPLES FOR DISPOSAL

THIS PAGE INTENTIONALLY LEFT BLANK

ATTACHMENT B-7**STATISTICAL TABLE FOR EVALUATING SAMPLES FOR DISPOSAL**(Student's t Distribution, right-tail test)

The following table is to be used with Section B-3.2.15 and Equation B-7 to determine the value for $t_{1-\alpha, df}$.

This table is also used with Attachment B-6 and Equation B-8 of this plan to determine (n) for chemical COCs and TCLP sampling.

df^a	0.05^b
1	6.314
2	2.920
3	2.353
4	2.132
5	2.015
6	1.943
7	1.895
8	1.860
9	1.833
10	1.812
11	1.796
12	1.782
13	1.771
14	1.761
15	1.753
16	1.746
17	1.740
18	1.743
19	1.729
20	1.725
21	1.721
22	1.717
23	1.714
24	1.711
25	1.708
26	1.706
27	1.703
28	1.701
29	1.699
30	1.697
40	1.684
60	1.671
120	1.658
Infinite	1.645

^a df is equal to $n-1$ (or the number of samples evaluated minus one).

^b This represents the one-sided UCL_{95} .

THIS PAGE INTENTIONALLY LEFT BLANK

ATTACHMENT B-8

SOIL DATA QUALITY OBJECTIVE SUMMARY FOR THE ST. LOUIS SITES

THIS PAGE INTENTIONALLY LEFT BLANK

ATTACHMENT B-8**SOIL DATA QUALITY OBJECTIVE SUMMARY FOR THE ST. LOUIS SITES**

NOTE: Part of SAG Table 3-1 is repeated in this attachment for ease of use. The SAG remains the governing document and should be referenced frequently to ensure that the provided table is true and correct (USACE 2000).

Table B-8-1. SAG Table 3-1

Data Use	Sample Type	Analytical Method	Precision Field Duplicates (RPD^a)	Laboratory Duplicates (RPD)	Acceptable Accuracy (Percent Recovery)	Completeness (%)
Confirmation of Contamination Extent	Discrete	SW-8260B Volatile Organics (USEPA 1996a)	<50	<35	50-150	90
	Discrete or Composite	SW-8270C Semivolatile Organics (USEPA 1996b)	<50	<35	30-140	90
		SW-8081A Pesticides (USEPA 1996c)/ SW-8082 Polychlorinated Biphenyls (USEPA 1996d)	<50	<35	35-135	90
		SW-6010A (USEPA 1992a)/ SW-6020 (USEPA 1994)/ SW-7000A (USEPA 1992b)/ SW-7000B (USEPA 1998b) Metals	<50	<35	75-125	90
		Radiochemical Various	<50	<35	75-125	90
		Other Waste Characteristics	NA	<40	50-150	90
		Physical Testing	NA	<40	NA	90

^a At values within five times the reporting level, the comparison is acceptable when values are plus or minus three times the reporting level.

THIS PAGE INTENTIONALLY LEFT BLANK

ATTACHMENT B-9

INFORMATION TO BE SUBMITTED WHEN REQUESTING A PLANNING PACKAGE

THIS PAGE INTENTIONALLY LEFT BLANK

ATTACHMENT B-9

INFORMATION TO BE SUBMITTED WHEN REQUESTING A PLANNING PACKAGE

This attachment details the types of information that should be supplied by the RAC to the USACE when requesting a planning package:

- A detailed description of the material;
- Historical information on the materials;
- Characterization data, including any PDI data and/or PDI reports;
- Current survey maps or survey reports;
- Rationale and basis for the material's MARSSIM classification (DoD 2000);
- Rationale for the selection of the survey approach;
- Intended disposition of the material and timeframe/schedule;
- Current location of the material;
- Dimensions, weights, volumes of the material; and
- Any existing drawings, sketches, or photographs of the material.

THIS PAGE INTENTIONALLY LEFT BLANK

APPENDIX C

**FINAL STATUS SURVEY PLAN ADDENDUM—EVALUATION OF
DIFFICULT-TO-ACCESS SOIL**

THIS PAGE INTENTIONALLY LEFT BLANK

TABLE OF CONTENTS

<u>SECTION</u>	<u>PAGE</u>
LIST OF TABLES	C-i
LIST OF FIGURES	C-i
C-1.0 INTRODUCTION.....	C-1
C-2.0 SITE DESCRIPTION.....	C-3
C-3.0 ORGANIZATION AND RESPONSIBILITIES	C-5
C-4.0 DATA QUALITY OBJECTIVES	C-7
C-4.1 STATE THE PROBLEM.....	C-7
C-4.2 IDENTIFY THE DECISION	C-7
C-4.3 IDENTIFY INPUTS TO THE DECISION	C-7
C-4.4 DEFINE THE STUDY BOUNDARY	C-8
C-4.5 DEVELOP THE DECISION RULE	C-8
C-4.6 SPECIFY TOLERABLE LIMITS ON DECISION ERROR	C-8
C-4.7 OPTIMIZE THE DESIGN.....	C-9
C-5.0 TESTING FOR COMPLIANCE WITH CLEANUP GOALS	C-11
C-5.1 CALCULATION METHOD	C-11
C-5.2 GRID LOCATIONS AND NUMBER OF SAMPLES REQUIRED.....	C-11
C-6.0 SAMPLE SCREENING AND SUBMITTAL	C-13
C-7.0 LABORATORY ANALYSIS.....	C-15
C-8.0 REPORT OF SURVEY FINDINGS.....	C-17

LIST OF TABLES

<u>NUMBER</u>	<u>PAGE</u>
Table C-1. Soil Volume Boundary Criteria	C-8

LIST OF FIGURES

Figure C-1. Locating Supplemental Sampling Stations for Excavations

THIS PAGE INTENTIONALLY LEFT BLANK

C-1.0 INTRODUCTION

The purpose of this appendix is to define processes for confirming that soil achieve cleanup goals when soil cannot be subjected to the established protocols for an FSS. The additional population of sample results obtained because of implementing a sampling plan in accordance with this appendix will be used as supporting information in PRARs and other site closeout documents.

This appendix defines processes for dealing with non-standard situations. Situation-specific sampling, based on the guidance in this appendix, will be approved by the USACE prior to implementation (when appropriate).

THIS PAGE INTENTIONALLY LEFT BLANK

C-2.0 SITE DESCRIPTION

Specific site descriptions may be found in this FSSP.

The need for an alternate sampling plan (in accordance with this appendix) may arise under the following circumstances:

- When an excavation requires shielding or shoring to protect entrants or to prevent the collapse of the faces of the excavation;
- When the soil volume to be evaluated is beneath the surface of an excavation;
- When the soil volume to be evaluated is beneath the surface of the foundation of adjacent buildings or structures; or
- When other situations necessitate as determined by the USACE.

In these examples, the shielding or shoring, depth of the soil to be evaluated, or location under a structure may prevent access to perform survey activities and sampling using standard approaches defined in this FSSP. An alternate approach is warranted.

THIS PAGE INTENTIONALLY LEFT BLANK

C-3.0 ORGANIZATION AND RESPONSIBILITIES

The verification contractor, under contract to the USACE, has developed this appendix.

The USACE, or verification contractor, is responsible for the implementation of the alternate sampling plan developed pursuant to this appendix and will maintain independence in the survey process.

The RAC may recommend an alternate sampling plan pursuant to this appendix to the USACE and collect samples under direct USACE supervision.

THIS PAGE INTENTIONALLY LEFT BLANK

C-4.0 DATA QUALITY OBJECTIVES

DQOs from this FSSP will be applied to these survey efforts. Additional criteria are described in the following sections.

C-4.1 STATE THE PROBLEM

Problems typically encountered include, but are not limited to, the situations listed following:

- Shielding or shoring within an excavation obstructs access to the face(s) of the excavation for survey/sampling,
- The soil is located beneath the surface of an excavation, or
- The soil is located beneath the surface of a foundation of an adjacent building or structure.

In these cases, additional sampling of the soil volume is required to determine if concentrations of COCs exceed cleanup goals.

C-4.2 IDENTIFY THE DECISION

The data acquired during this sampling event will be used to answer the following questions.

- Does the soil volume associated with the faces of an excavation (behind shielding or shoring) meet the remediation criteria for the applicable decision document (as stated in this FSSP)?
- Does the soil volume located beneath the surface of an excavation, or beneath the foundation of an adjacent building or structure, meet the cleanup criteria for the applicable decision document (as stated in this FSSP)?
- If contamination is identified at one or more of the sampling stations, the following questions will be answered.
 - Was the sample representative of the SU?
 - Is additional sampling appropriate to determine the extent (horizontal and vertical) pursuant to EMC (or dose assessments), or does the information indicate that remediation is required?

C-4.3 IDENTIFY INPUTS TO THE DECISION

SOR_N values will be calculated from the radiological analytical data acquired during this sampling event and compared to the cleanup criteria of the applicable decision document.

If contamination is identified, the extent of the contamination will be estimated based on all available information including laboratory analytical results and the geological information recorded on the geological logs. This estimate will be used to determine the appropriate course of action (i.e., additional sampling or remediation).

C-4.4 DEFINE THE STUDY BOUNDARY

The study area consists of a volume of subsurface soil that may be potentially contaminated and cannot be subjected to the established protocols for an FSS. This volume of soil will initially be bounded by the criteria in Table C-1.

Table C-1. Soil Volume Boundary Criteria

Volume Boundary	Criteria
Linear distance from the face(s) of an excavation (when assessing the potential for contamination that extends beyond the excavation)	• Within a distance derived from the soil concentration relative to the appropriate EMC (i.e., a distance of 1 m from the outer perimeter of the excavation would be expected to be typical), and/or • Additional factors as deemed appropriate by the USACE (e.g., geology, preferential pathways, etc....)
Linear distance from face(s) of the excavation (when assessing the potential for contamination that extends beneath the foundation of a building or structure)	• Within a distance derived from the soil concentration relative to the appropriate EMC (i.e., a distance of 2 m or upon penetration refusal would be expected to be typical), and/or • Additional factors as deemed appropriate by the USACE (e.g., geology, preferential pathways, etc....)
Vertical depth of the investigation	• Equal to the maximum depth seen in the excavation at the proximity of the contamination, and/or • Additional factors as deemed appropriate by the USACE (e.g., geology, preferential pathways, etc....)

If contamination exceeding decision document criteria is identified, the DQOs will be re-assessed, and the study boundary may be adjusted as part of a sequential sampling strategy.

The actual coordinates of the sampling stations will be established by appropriate land survey (generally a civil survey or equivalent) at the time of sampling.

C-4.5 DEVELOP THE DECISION RULE

The following decisions will be made based upon the radiological analytical data and the geological information obtained during this sampling event.

- The study area meets the decision document's cleanup goals if contamination is less than cleanup goals and achieves applicable dose criteria.
- The study area meets the decision document's cleanup goals if contamination exceeding criteria is present at one or more locations, but the EMC demonstrates that the average concentration is less than the criteria.
- The study area does not meet the decision document's cleanup goals (and remediation may be required) unless each of the previous conditions is achieved.

C-4.6 SPECIFY TOLERABLE LIMITS ON DECISION ERROR

The criteria for the precision, accuracy, representativeness, completeness, and comparability parameters and reporting limits for the radiological contaminants may be found in this FSSP for the study area.

C-4.7 OPTIMIZE THE DESIGN

To the extent practicable, the sampling stations will be defined by extending any existing Class 1 grids that have already been established for the associated excavation's SU.

The overall sampling approach was designed to ensure adequate coverage of the study area and to provide the information necessary to determine if the soil meets the decision document's cleanup criteria. Field screening techniques, soil sample analysis, and the DQO process will be used, as appropriate, throughout the supplemental sampling process to focus efforts and to minimize costs.

THIS PAGE INTENTIONALLY LEFT BLANK

C-5.0 TESTING FOR COMPLIANCE WITH CLEANUP GOALS

C-5.1 CALCULATION METHOD

Guidance from this FSSP for the study area will be used. If the EMC is to be applied, it will be applied to each horizontal 0.5-ft layer of contamination independently.

C-5.2 GRID LOCATIONS AND NUMBER OF SAMPLES REQUIRED

The initial number of sample stations (when assessing the potential for contamination that extends beyond an excavation) will be determined by extending the Class 1 sample grid from the excavation out past the faces of the excavation. New sample stations will be placed on the grid intersection, but they will be moved in along the grid lines toward the area of concern so they fall within the distance from the face of the excavation as established in the criteria of Section C-4.4. Refer to Figure C-1.

The initial number of sampling stations (when assessing the potential for contamination beneath the surface of an excavation or foundation of an adjacent building) will be determined by the verification contractor and will be submitted for USACE concurrence.

Recovery penetrations will be extended downward to a depth that is determined by the depth equal to the maximum depth of contamination seen in the adjacent excavation, or as determined by the USACE based upon other factors.

Each penetration will be evaluated and sampled as described in Section C-6.

If sample results indicate contamination may be present, the USACE will determine the location and number of additional samples that may be required.

The recovery penetrations will be backfilled in accordance with SAG Table 2-5 (USACE 2000).

THIS PAGE INTENTIONALLY LEFT BLANK

C-6.0 SAMPLE SCREENING AND SUBMITTAL

The general approach for sample screening is described following.

- Recovery penetrations will be advanced through any backfill that is known to be non-contaminated. No samples will be collected from the backfill.
- A geological examination of each 2-ft evaluation length will generally be performed, with USACE concurrence.
- Field measurements may be performed for chemical contaminants, if directed by the USACE.
- Each 2-ft evaluation length will be scanned with field detection equipment. Scan results will be documented on a hazardous, toxic, and radioactive waste (HTRW) drilling log form.
- A 0.5-ft sample will be collected (for lab analysis) from each 2-ft evaluation length, at the location most likely to be contaminated. An additional sample will be taken at the area of the most elevated count rate, where appropriate.
- All other 0.5-ft intervals will be containerized and archived for use if the EMC will need to be applied per USACE direction.
- Subject to concurrence by the USACE, additional sample(s) may be collected and/or submitted for laboratory analysis based on the geological inspection, and/or the presence of potential preferential pathways.

All samples will be submitted to a USACE-certified radioanalytical laboratory for analysis as discussed in Section C-7.

QC duplicate and split samples will be collected at a frequency described in this FSSP.

Samples will be given a sample ID and a sample description that is consistent with the *Data Management Process for the St Louis FUSRAP Sites* (USACE 1999h).

THIS PAGE INTENTIONALLY LEFT BLANK

C-7.0 LABORATORY ANALYSIS

Samples will be analyzed (as defined in this FSSP) with an initial analysis by gamma spectroscopy and subsequent additional analysis by other methods such as alpha spectroscopy, when necessary, to achieve the required method detection limits as specified in this FSSP.

Analysis for TCLP or chemical COCs is not required unless geological inspection or field measurements, if performed, indicate a potential problem. If so, the USACE will be contacted for guidance prior to proceeding.

Laboratory parameters, detection limits, and COCs are provided in this FSSP for the study area.

THIS PAGE INTENTIONALLY LEFT BLANK

C-8.0 REPORT OF SURVEY FINDINGS

Supplemental samples are generally separately reported rather than being included in a MARSSIM statistical evaluation. In the case where supplemental samples identify contamination that exceeds cleanup goals, that soil volume will need to be included in some appropriate Class 1 SU. The USACE should be consulted for direction.

THIS PAGE INTENTIONALLY LEFT BLANK

APPENDIX C

FIGURE

THIS PAGE INTENTIONALLY LEFT BLANK

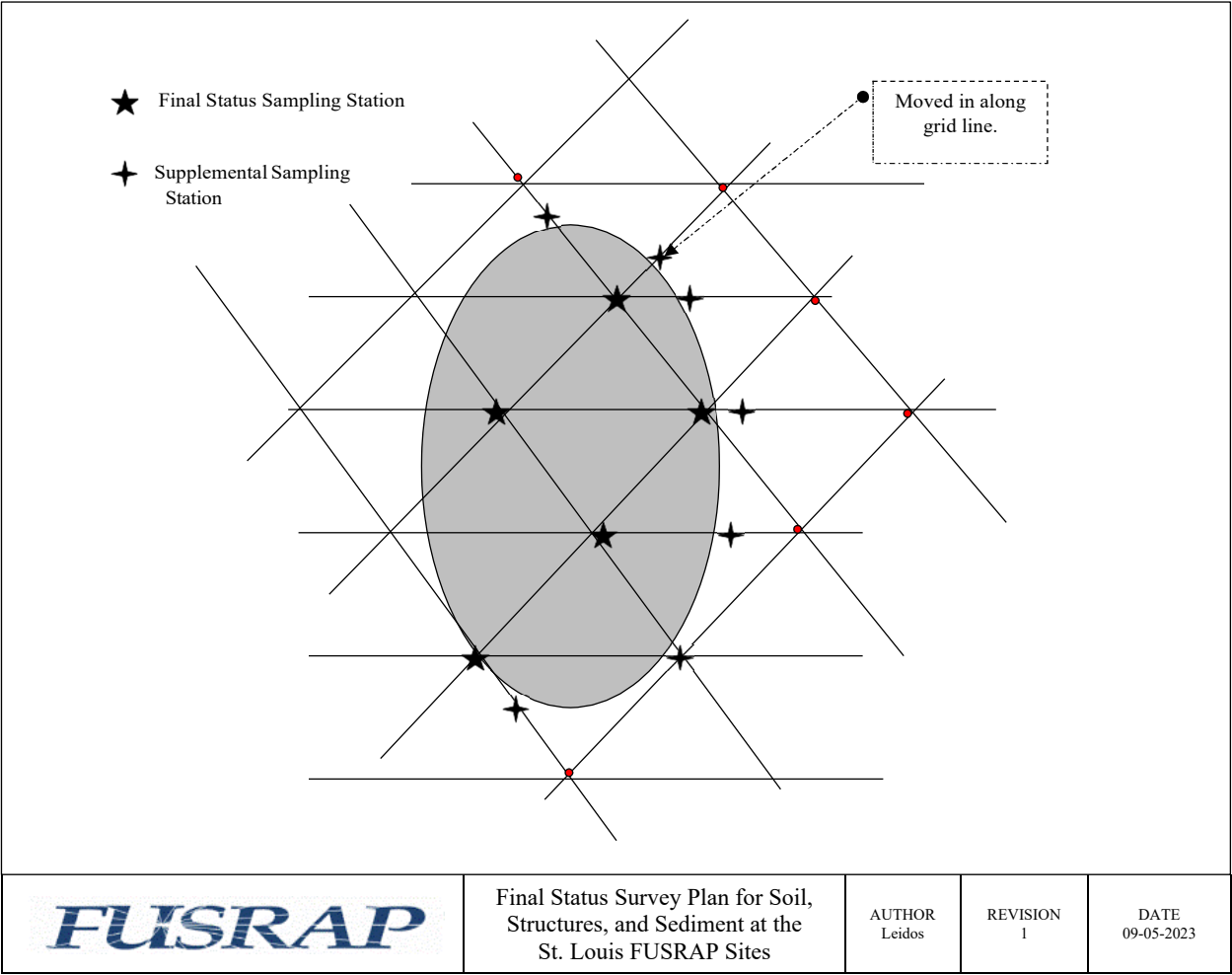


Figure C-1. Locating Supplemental Sampling Stations for Excavations

APPENDIX D

**DERIVED CONCENTRATION GUIDELINE LEVEL FOR STRUCTURES ON
NORTH ST. LOUIS COUNTY SITES**

THIS PAGE INTENTIONALLY LEFT BLANK

DERIVED CONCENTRATION GUIDELINE LEVEL FOR STRUCTURES ON NORTH ST. LOUIS COUNTY SITES

INTRODUCTION

The purpose of this appendix is to document the evaluation and the process used for calculating a single health-conservative surrogate gross total alpha DCGL for structures¹ and consolidated material present on North St. Louis County Sites in accordance with the NC ROD. The surrogate total alpha DCGL developed in this appendix can then be consistently applied for any structure on any North St. Louis County Sites property and will also meet the NC ROD Section 2.8.2.2 requirement that states, “Surrogate gross [total] alpha and gross [total] beta surface DCGLs will be developed for each structure based on the activity fraction of each radionuclide present in the soils where the structure is located” (USACE 2005a).

NC ROD Table 2-10 contains radionuclide-specific RGs, also called DCGLs, for structure surfaces. These radionuclide-specific RGs are based upon a dose of 15 mrem/year to a hypothetical maximally exposed person. Using 15 mrem/year is a health-conservative decrease from the 19 mrem/year benchmark dose identified in the NC ROD. However, handheld field instruments used for structure surveys measure gross alpha and/or gross beta emissions but do not measure the radioactivity for individual radionuclides. Background radiation (e.g., from general area, from the materials that make up the structure, and from radon decay chain isotopes plate out) may be subtracted from the gross instrument readings.

NORTH ST. LOUIS COUNTY SITES STRUCTURE REMEDIATION GOALS

Table D-1 presents the radionuclide-specific RGs identified in the NC ROD, with the exception of Pb-210. The method for deriving the RGs is included in the *Derivation of Site-Specific DCGLs for North County Structures* (USACE 2004). The same methods and parameters established in the *Derivation of Site-Specific DCGLs for North County Structures* are applied for Pb-210 using RESRAD-BUILD² Version 4.0 for the limiting scenario. The resulting DSR for source 1 is 2.98×10^{-6} mrem/year per pCi/m² and for sources 2 through 5 is 5.46×10^{-7} mrem/year per pCi/m²; Attachment D-1 contains the RESRAD-BUILD output. Summing these DSRs yields a total DSR for Pb-210 of 5.16×10^{-6} mrem/year per pCi/m². The Pb-210 RG is calculated by the following equation, where 15 mrem/year is the dose limit used in the NC ROD for deriving the structure RGs. The result is rounded down to 64,000 dpm/100 cm² for use as the RG.

$$RG_{Pb-210} = \frac{15 \text{ mrem/year}}{0.00000516 \text{ mrem/year per pCi/m}^2} * \frac{2.22 \text{ dpm}}{\text{pCi}} * \frac{1 \text{ m}^2}{100 * 100 \text{ cm}^2} = 64,535 \text{ dpm/100 cm}^2$$

Table D-1. North St. Louis County Sites Radionuclide-Specific Remediation Goals

Radionuclide	Ac-227	Pa-231	Pb-210	Ra-226	Ra-228	Th-228	Th-230	Th-232	U-234	U-235	U-238
	(dpm/100 cm ²)										
RG	400	1,400	64,000	15,000	7,700	4,400	6,900	1,300	17,000	16,000	19,000

¹ The term “structures” includes consolidated materials, such as asphalt, concrete, and piping.

² Under the sponsorship of the U.S. Department of Energy (DOE), Argonne National Laboratory (ANL) developed the RESRAD family of computer codes to assess human health and environmental risk at sites contaminated with radioactive materials. Additional information on the RESRAD family of codes, including RESRAD-BUILD, can be found at <https://resrad.evs.anl.gov/>.

DETERMINATION OF TOTAL ACTIVITY FRACTIONS

North St. Louis County Sites property-specific data are used to calculate the total AFs necessary for developing surrogate DCGLs. Initially, the soil sampling results associated with CWC in Attachment 5 of NC FS Appendix D (USACE 2003d) were used to estimate the AFs for CWC downstream of Dunn Road before PDI sample results were available. Those initial AFs resulted in a surrogate alpha DCGL of 2,800 dpm/100 cm². As of March 2023, PDI sample data with SOR_N values exceeding 1.0 collected from all North St. Louis County Sites property groups provides improved datasets for determining geographically based AFs associated with MED/AEC radioactivity. These datasets (e.g., Hazelwood Avenue properties, “C” properties, Frost Avenue properties, Pershall Road properties, etc.) are then used to calculate geographically based/property-specific surrogate total alpha DCGLs, which ranged from 5,300 to 6,100 dpm/100 cm². The limiting surrogate total alpha DCGL identified by this process is associated with the Hazelwood Properties, which resulted in a surrogate alpha DCGL of 5,300 dpm/100 cm². The sample identifiers for the Hazelwood Properties dataset are listed in Attachment D-2.

For each dataset, the average background concentration³ for each radionuclide is subtracted from each sample result to obtain the net sample result exceeding background. The net results are averaged for each radionuclide. Because sampling results are not available for Pb-210 and U-234, known relationships were documented in Table D-2 of NC FS Appendix D (USACE 2003d) as follows: Pb-210 = 2.4 x Ra-226 and U-234 = U-238. These known relationships are applied to the net results for Ra-226 and U-234 to obtain the net results for Pb-210 and U-234, respectively. The net average result for each radionuclide is divided by the total net average concentration for all radionuclides to determine the site-specific AF for each COC radionuclide equilibrium chain. Table D-2 contains the net results and AFs for the limiting Hazelwood Properties dataset. These AFs are for total radioactivity so both alpha and beta emissions are included.

Table D-2. Total Activity Fractions

Radionuclide	Ac-227	Pa-231	Pb-210	Ra-226	Ra-228	Th-228	Th-230	Th-232	U-234	U-235	U-238
Average Background Data (pCi/g)	0.21	0.20	NA	1.05	0.98	1.18	1.66	1.11	NA	0.06	1.18
Net Result (pCi/g)	2.69	3.06	8.36	3.49	-0.16	-0.15	162.93	-0.19	2.44	0.13	2.44
Total Net Result (pCi/g)	243.57										
AF	0.0145	0.0165	0.0451	0.0188	0	0	0.8781	0	0.0131	0.0007	0.0131

³ These background samples were collected between August 21, 1998, and October 21, 1998, from representative native soil at Saint Ann Park, Aubuchon Park, and Howdershell Park. Summary statistics for these data are included in *Evaluation of Background Concentrations in Soil at the North St. Louis County Sites* (USACE 2024). The average soil background values for Ra-226, Th-230, and U-238 are listed in the NC ROD (USACE 2005a).

TOTAL ACTIVITY SURROGATE DERIVED CONCENTRATION GUIDELINE LEVEL

The MARSSIM equation for calculating a surrogate DCGL is based on total radioactivity, as shown in the following equation:

$$Activity\ DCGL_{(Total)} = \frac{1}{\frac{AF_1}{DCGL_1} + \frac{AF_2}{DCGL_2} + \cdots + \frac{AF_n}{DCGL_n}}$$

where:

AF_i = the site-specific AF for each radionuclide of interest

DCGL_i = the DCGL for each radionuclide of interest

For Hazelwood Properties, the total activity DCGL follows:

$$\begin{aligned} Activity\ DCGL_{(Total)} &= \frac{1}{\frac{0.0145}{400} + \frac{0.0165}{1,400} + \frac{0.0451}{64,000} + \frac{0.0188}{15,000} + \frac{0}{7,700} + \frac{0}{4,400} + \frac{0.8781}{6,900} + \frac{0}{1,300} + \frac{0.0131}{17,000} + \frac{0.0007}{16,000} + \frac{0.0131}{19,000}} \\ &= 5,594\ dpm/100\ cm^2 \end{aligned}$$

TOTAL ALPHA ACTIVITY AND TOTAL BETA ACTIVITY SURROGATE DERIVED CONCENTRATION GUIDELINE LEVELS

To obtain separate total surrogate DCGLs for alpha activity and for beta activity, the AFs are separated into alpha and beta portions. Separation involves the relative number of alpha and beta emissions for each radionuclide during decay to the next long-lived radionuclide in the decay chain. For the purposes of developing total surrogate DCGLs, the emissions from short-lived decay chain isotopes are counted with the emissions from their long-lived parent because the long-lived radionuclides have RGs. The short-lived decay chain isotopes are in secular equilibrium with these long-lived parent radionuclides. Table D-3 contains the decay chains and the decay emissions.

Table D-3. Decay Chain Emissions

U-238 Decay Chain	Decay Type with Average Beta keV	Th-232 Decay Chain	Decay Type with Average Beta keV	U-235 Decay Chain	Decay Type with Average Beta keV
U-238 ^a	Alpha	Th-232 ^a	Alpha	U-235 ^a	Alpha
Th-234	Beta, 47.9	Ra-228 ^a	Beta, 7.2 ^b	Th-231	Beta, 80
Pa-234	Beta, 811	Ac-228	Beta, 370	Pa-231 ^a	Alpha
U-234 ^a	Alpha	Th-228 ^a	Alpha	Ac-227 ^a	Beta, 9.9 ^b
Th-230 ^a	Alpha	Ra-224	Alpha	Th-227	Alpha
Ra-226 ^a	Alpha	Radon (Rn)-220	Alpha	Ra-223	Alpha
Rn-222	Alpha	Po-216	Alpha	Rn-219	Alpha
Po-218	Alpha	Pb-212	Beta, 101	Po-215	Alpha
Pb-214	Beta, 224	Bi-212 ^c	64% Beta, 771 36% Alpha	Pb-211	Beta, 445
Bi-214	Beta, 641	64% Po-212 ^c	Alpha	Bi-211	Alpha
Po-214	Alpha	36% Tl-208 ^c	Beta, 560	Tl-207	Beta, 492
Pb-210 ^a	Beta, 6.1 ^b	Pb-208	STABLE	Pb-207	STABLE
Bi-210	Beta, 389				
Po-210	Alpha				
Pb-206	STABLE				

^a Long-lived parent radionuclide, which has an RG.

^b Energy is lower than the 25 keV threshold to penetrate the 1.2 mg/cm² mylar window of the Ludlum Model 43-89.

^c This decay branch effectively produces one alpha and one beta from the decay chain of Bi-212 to Pb-208.

The alpha and beta portions of the AFs are calculated for each long-lived radionuclide based upon the alpha and beta ratios of the parent plus decay chain isotopes radionuclides assumed to be in secular equilibrium. As an example, the following equation is used to calculate the alpha portion of the AF for Ac-227 for the limiting Hazelwood Properties.

$$\text{Alpha Portion of } AF_{Ac-227} = AF_{Ac-227} * \frac{\#Emissions_{Ac-227}^{Alpha}}{\#Emissions_{Ac-227}^{Alpha+Beta}} = 0.0145 * \frac{5}{8} = 0.0091$$

The alpha portions of each radionuclide are summed to obtain the total alpha portion of the AF; the equivalent summation provides the total beta portion of the AF. Table D-4 contains the values associated with these calculations for the limiting Hazelwood Properties. From the results in Table D-4, the alpha portion of the AF is approximately 95 percent of the AF.

Table D-4. Alpha Activity Fractions and Beta Activity Fractions

Radionuclide	Ac-227	Pa-231	Pb-210	Ra-226	Ra-228	Th-228	Th-230	Th-232	U-234	U-235	U-238
AF	0.0145	0.0165	0.0451	0.0188	0	0	0.8781	0	0.0131	0.0007	0.0131
Number of Alpha Emissions	5	1	1	4	0	5	1	1	1	1	1
Number of Beta Emissions	3	0	2	2	2	2	0	0	0	1	2
Total Number of Emissions	8	1	3	6	2	7	1	1	1	2	3
Alpha Portion of AF	0.0091	0.0165	0.0150	0.0125	0	0	0.8781	0	0.0131	0.0004	0.0044
Total Alpha Portion of AF	0.949										
Beta Portion of AF	0.0054	0	0.0301	0.0063	0	0	0	0	0	0.0004	0.0087
Total Beta Portion of AF	0.051										

The total alpha surrogate DCGL is calculated by multiplying the total alpha portion of the AF by the total surrogate DCGL, which resulted in a total alpha surrogate DCGL of 5,309 dpm/100 cm² as shown in the following equation for the limiting Hazelwood Properties. For the purposes of implementation and as a health-conservative measure, the value is rounded down to 5,300 dpm/100 cm² for use as the alpha surrogate DCGL for structures on all North St. Louis County Sites properties.

$$\begin{aligned} \text{Total Activity DCGL}_{(\text{Alpha})} &= \text{Total Alpha Portion of AF} * \text{Activity DCGL}_{(\text{Total})} = 0.949 * 5,594 \\ &= 5,309 \text{ dpm/100 cm}^2 \end{aligned}$$

A similar calculation for a total beta surrogate DCGL yields a value of 285 dpm/100 cm² for the limiting Hazelwood Properties. This value is too small to be distinguishable within the variation of beta emissions due to natural background radioactivity. Natural background radioactivity varies by thousands of dpm/100 cm² because of varying material types and variations in plate-out of radon decay chain isotopes due to atmospheric pressure changes. In addition, this value of 285 dpm/100 cm² would have to be decreased to account for the beta emissions that are not detected by the instrument because of insufficient energy to penetrate its mylar window. The AFs for MED/AEC COCs in soil associated with Hazelwood Properties, as well as all other North St. Louis County Sites properties, result in too few beta-emitting contributions to the total activity for a total beta DCGL to be useful as a surrogate DCGL for structures.

CONCLUSION

The health-conservative total alpha surrogate DCGL calculated using PDI data to enable field evaluation of structure surfaces for all North St. Louis County Sites properties is 5,300 dpm/100 cm². The effort to produce a total beta surrogate DCGL was not fruitful because the site-specific AFs produce insufficient detectable beta emissions. Nonetheless, a total beta DCGL based on other references may be selected with USACE concurrence as a conservative measure.

THIS PAGE INTENTIONALLY LEFT BLANK

ATTACHMENT D-1
RESRAD-BUILD OUTPUT FILES FOR LEAD-210

THIS PAGE INTENTIONALLY LEFT BLANK

** RESRAD-BUILD Dose Program Output, Version 4.0 03/24/23 12:31:24 Page: 1 **
Title : Limiting NC Surf Scenario Pb-210
Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\Pb-210 DCGL 2023-03-22.bld

RESRAD-BUILD Table of Contents

RESRAD-BUILD Input Parameters.....	2
Building Information.....	3
Source Information.....	4
Temporal Dose Summary.....	7
For time = 0.00E+00 yr	
Receptor-Source Dose Summary.....	8
Dose by Pathway Detail.....	9
Dose by Nuclide Detail.....	10
For time = 1.00E+00 yr	
Receptor-Source Dose Summary.....	12
Dose by Pathway Detail.....	13
Dose by Nuclide Detail.....	14

** RESRAD-BUILD Dose Program Output, Version 4.0 03/24/23 12:31:24 Page: 2 **
 Title : Limiting NC Surf Scenario Pb-210
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\Pb-210 DCGL 2023-03-22.bld

```

=====
=====
=====
RESRAD-BUILD Input Parameters
=====
=====
    
```

```

Number of Sources : 5
Number of Receptors: 1
Total Time : 3.650000E+02 days
Fraction Inside : 2.300000E-01
    
```

Transformations data from: ICRP107
 Cut off half life : 180.000000 days
 Library information in the Dose Coefficients and Slope Factors report

```

===== Receptor Information =====
    
```

Receptor	Room	x [m]	y [m]	z [m]	FracTime	Inhalation [m3/day]	Ingestion(Dust) [m2/hr]
1	1	5.000	5.000	1.000	1.000	3.36E+01	1.00E-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

** RESRAD-BUILD Dose Program Output, Version 4.0 03/24/23 12:31:24 Page: 3 **
 Title : Limiting NC Surf Scenario Pb-210
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\Pb-210 DCGL 2023-03-22.bld

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

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

Height[m]	Air Exchanges [m3/hr]	
Area [m2]		

	*	*
	*	*
	*	<=Q01: 0.00E+00
H1: 2.500	* Room 1	* Q10 : 0.00E+00
	* LAMBDA: 0.00E+00	*
Area 100.000	*	*
	*	*

Deposition velocity: 1.00E-02 [m/s] Resuspension Rate: 0.00E+00 [1/s]
 Deposition velocity: 5.00E-07 [m/s] Resuspension Rate:

** RESRAD-BUILD Dose Program Output, Version 4.0 03/24/23 12:31:24 Page: 4 **
 Title : Limiting NC Surf Scenario Pb-210
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\Pb-210 DCGL 2023-03-22.bld

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

Source: 1
 Location:: Room : 1 x: 5.00 y: 5.00 z: 0.00[m]
 Geometry:: Type: Area Length[m]:1.00E+01 Width[m]:1.00E+01
 Direction: z
 Pathway ::
 Direct Ingestion Rate: 0.000E+00 [1/hr]
 Fraction released to air: 7.000E-02
 Removable fraction: 2.000E-01
 Time to Remove: 1.000E+04 [day]

 Radon Release Fraction: 1.000E-01

 Contamination::
 Nuclide Concentration

	[pCi/m2]
Pb-210	1.000E+00

Source: 2
 Location:: Room : 1 x: 5.00 y: 10.00 z: 1.00[m]
 Geometry:: Type: Area Length[m]:1.00E+01 Width[m]:2.00E+00
 Direction: y
 Pathway ::
 Direct Ingestion Rate: 0.000E+00 [1/hr]
 Fraction released to air: 7.000E-02
 Removable fraction: 2.000E-01
 Time to Remove: 1.000E+04 [day]

 Radon Release Fraction: 1.000E-01

 Contamination::
 Nuclide Concentration

	[pCi/m2]
Pb-210	1.000E+00

** RESRAD-BUILD Dose Program Output, Version 4.0 03/24/23 12:31:24 Page: 5 **
Title : Limiting NC Surf Scenario Pb-210
Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\Pb-210 DCGL 2023-03-22.bld

Source: 3
Location:: Room : 1 x: 10.00 y: 5.00 z: 1.00[m]
Geometry:: Type: Area Length[m]:1.00E+01 Width[m]:2.00E+00
Direction: x
Pathway ::
Direct Ingestion Rate: 0.000E+00 [1/hr]
Fraction released to air: 7.000E-02
Removable fraction: 2.000E-01
Time to Remove: 1.000E+04 [day]

Radon Release Fraction: 1.000E-01

Contamination::
Nuclide Concentration

	[pCi/m2]
Pb-210	1.000E+00

Source: 4
Location:: Room : 1 x: 0.00 y: 5.00 z: 1.00[m]
Geometry:: Type: Area Length[m]:1.00E+01 Width[m]:2.00E+00
Direction: x
Pathway ::
Direct Ingestion Rate: 0.000E+00 [1/hr]
Fraction released to air: 7.000E-02
Removable fraction: 2.000E-01
Time to Remove: 1.000E+04 [day]

Radon Release Fraction: 1.000E-01

Contamination::
Nuclide Concentration

	[pCi/m2]
Pb-210	1.000E+00

** RESRAD-BUILD Dose Program Output, Version 4.0 03/24/23 12:31:24 Page: 6 **
Title : Limiting NC Surf Scenario Pb-210
Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\Pb-210 DCGL 2023-03-22.bld

Source: 5
Location:: Room : 1 x: 5.00 y: 0.00 z: 1.00[m]
Geometry:: Type: Area Length[m]:1.00E+01 Width[m]:2.00E+00
Direction: y
Pathway ::
Direct Ingestion Rate: 0.000E+00 [1/hr]
Fraction released to air: 7.000E-02
Removable fraction: 2.000E-01
Time to Remove: 1.000E+04 [day]

Radon Release Fraction: 1.000E-01

Contamination::
Nuclide Concentration

	[pCi/m2]
Pb-210	1.000E+00

** RESRAD-BUILD Dose Program Output, Version 4.0 03/24/23 12:31:24 Page: 7 **
 Title : Limiting NC Surf Scenario Pb-210
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\Pb-210 DCGL 2023-03-22.bld
 Temporal Summary

RESRAD-BUILD Temporal Dose Tables

Dose to Receptor over the Exposure Duration

(mrem)

Evaluation Time years	Receptor 1	Total
0.000000000	2.80E-06	2.80E-06
1.000000000	5.17E-06	5.17E-06

** RESRAD-BUILD Dose Program Output, Version 4.0 03/24/23 12:31:24 Page: 8 **
 Title : Limiting NC Surf Scenario Pb-210
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\Pb-210 DCGL 2023-03-22.bld
 Evaluation Time: 0.00000000E+00 years

RESRAD-BUILD Dose Tables

Source Contributions to Receptor Doses

[mrem]						
	Source 1	Source 2	Source 3	Source 4	Source 5	Total
Receptor 1	1.67E-06	2.83E-07	2.83E-07	2.83E-07	2.83E-07	2.80E-06
Total	1.67E-06	2.83E-07	2.83E-07	2.83E-07	2.83E-07	2.80E-06

** RESRAD-BUILD Dose Program Output, Version 4.0 03/24/23 12:31:24 Page: 9 **
 Title : Limiting NC Surf Scenario Pb-210
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\Pb-210 DCGL 2023-03-22.bld
 Evaluation Time: 0.00000000E+00 years

Pathway Detail of Doses [mrem]

Source: 1								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	3.44E-07	1.07E-06	6.47E-11	8.37E-14	2.61E-07	0.00E+00	0.00E+00	1.67E-06
Total	3.44E-07	1.07E-06	6.47E-11	8.37E-14	2.61E-07	0.00E+00	0.00E+00	1.67E-06
Source: 2								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	1.73E-08	2.13E-07	1.29E-11	1.67E-14	5.21E-08	0.00E+00	0.00E+00	2.83E-07
Total	1.73E-08	2.13E-07	1.29E-11	1.67E-14	5.21E-08	0.00E+00	0.00E+00	2.83E-07
Source: 3								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	1.73E-08	2.13E-07	1.29E-11	1.67E-14	5.21E-08	0.00E+00	0.00E+00	2.83E-07
Total	1.73E-08	2.13E-07	1.29E-11	1.67E-14	5.21E-08	0.00E+00	0.00E+00	2.83E-07
Source: 4								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	1.73E-08	2.13E-07	1.29E-11	1.67E-14	5.21E-08	0.00E+00	0.00E+00	2.83E-07
Total	1.73E-08	2.13E-07	1.29E-11	1.67E-14	5.21E-08	0.00E+00	0.00E+00	2.83E-07
Source: 5								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	1.73E-08	2.13E-07	1.29E-11	1.67E-14	5.21E-08	0.00E+00	0.00E+00	2.83E-07
Total	1.73E-08	2.13E-07	1.29E-11	1.67E-14	5.21E-08	0.00E+00	0.00E+00	2.83E-07

** RESRAD-BUILD Dose Program Output, Version 4.0 03/24/23 12:31:24 Page: 10 **
Title : Limiting NC Surf Scenario Pb-210
Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\Pb-210 DCGL 2023-03-22.bld
Evaluation Time: 0.00000000E+00 years

Nuclide Detail of Doses

[mrem]

Source: 1

Nuclide	Receptor	Total
	1	
Pb-210	1.67E-06	1.67E-06

Source: 2

Nuclide	Receptor	Total
	1	
Pb-210	2.83E-07	2.83E-07

Source: 3

Nuclide	Receptor	Total
	1	
Pb-210	2.83E-07	2.83E-07

Source: 4

Nuclide	Receptor	Total
	1	
Pb-210	2.83E-07	2.83E-07

** RESRAD-BUILD Dose Program Output, Version 4.0 03/24/23 12:31:24 Page: 11 **
Title : Limiting NC Surf Scenario Pb-210
Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\Pb-210 DCGL 2023-03-22.bld
Evaluation Time: 0.00000000E+00 years

Source: 5

Nuclide	Receptor	Total
	1	
Pb-210	2.83E-07	2.83E-07

RESRAD-BUILD Dose Tables

Source Contributions to Receptor Doses

```
[mrem]
```

		Source 1	Source 2	Source 3	Source 4	Source 5	Total
Receptor	1	2.98E-06	5.46E-07	5.46E-07	5.46E-07	5.46E-07	5.17E-06
Total		2.98E-06	5.46E-07	5.46E-07	5.46E-07	5.46E-07	5.17E-06

** RESRAD-BUILD Dose Program Output, Version 4.0 03/24/23 12:31:24 Page: 13 **
 Title : Limiting NC Surf Scenario Pb-210
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\Pb-210 DCGL 2023-03-22.bld
 Evaluation Time: 1.00000000 years

Pathway Detail of Doses [mrem]

Source: 1								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	3.31E-07	2.09E-06	1.38E-10	1.64E-13	5.57E-07	0.00E+00	0.00E+00	2.98E-06
Total	3.31E-07	2.09E-06	1.38E-10	1.64E-13	5.57E-07	0.00E+00	0.00E+00	2.98E-06
Source: 2								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	1.66E-08	4.19E-07	2.76E-11	3.29E-14	1.11E-07	0.00E+00	0.00E+00	5.46E-07
Total	1.66E-08	4.19E-07	2.76E-11	3.29E-14	1.11E-07	0.00E+00	0.00E+00	5.46E-07
Source: 3								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	1.66E-08	4.19E-07	2.76E-11	3.29E-14	1.11E-07	0.00E+00	0.00E+00	5.46E-07
Total	1.66E-08	4.19E-07	2.76E-11	3.29E-14	1.11E-07	0.00E+00	0.00E+00	5.46E-07
Source: 4								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	1.66E-08	4.19E-07	2.76E-11	3.29E-14	1.11E-07	0.00E+00	0.00E+00	5.46E-07
Total	1.66E-08	4.19E-07	2.76E-11	3.29E-14	1.11E-07	0.00E+00	0.00E+00	5.46E-07
Source: 5								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	1.66E-08	4.19E-07	2.76E-11	3.29E-14	1.11E-07	0.00E+00	0.00E+00	5.46E-07
Total	1.66E-08	4.19E-07	2.76E-11	3.29E-14	1.11E-07	0.00E+00	0.00E+00	5.46E-07

** RESRAD-BUILD Dose Program Output, Version 4.0 03/24/23 12:31:24 Page: 14 **
Title : Limiting NC Surf Scenario Pb-210
Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\Pb-210 DCGL 2023-03-22.bld
Evaluation Time: 1.00000000 years

Nuclide Detail of Doses

[mrem]

Source: 1

Nuclide	Receptor	Total
	1	
Pb-210	2.98E-06	2.98E-06

Source: 2

Nuclide	Receptor	Total
	1	
Pb-210	5.46E-07	5.46E-07

Source: 3

Nuclide	Receptor	Total
	1	
Pb-210	5.46E-07	5.46E-07

Source: 4

Nuclide	Receptor	Total
	1	
Pb-210	5.46E-07	5.46E-07

** RESRAD-BUILD Dose Program Output, Version 4.0 03/24/23 12:31:24 Page: 15 **
Title : Limiting NC Surf Scenario Pb-210
Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\Pb-210 DCGL 2023-03-22.bld
Evaluation Time: 1.00000000 years

Source: 5

Nuclide	Receptor	Total
	1	
Pb-210	5.46E-07	5.46E-07

THIS PAGE INTENTIONALLY LEFT BLANK

ATTACHMENT D-2

**SAMPLE IDENTIFIERS FOR THE DATASET USED TO CALCULATE
THE ACTIVITY FRACTIONS FOR HAZELWOOD PROPERTIES**

THIS PAGE INTENTIONALLY LEFT BLANK

Table D-2-1. Samples for the Dataset Used to Calculate the Activity Fractions for Hazelwood Properties

HTZ66293	HTZ68169	HTZ68170	HTZ69490	HTZ69491	HTZ69492	HTZ70827	HTZ75428	HTZ76688	HTZ76831
HTZ89021	HTZ89022	HTZ89044	HTR118469	HTR118471	HTZ113711	HTZ113714	HTZ113716	HTZ113717	HTZ113720
HTZ113722	HTZ113727	HTZ113728	HTZ115730	HTZ115769	HTZ115770	HTZ115771	HTZ115772	HTZ115773	HTZ115777
HTZ115790	HTZ115791	HTZ115792	HTZ115796	HTZ115798	HTZ115801	HTZ115802	HTZ115810	HTZ115812	HTZ115823
HTZ115824	HTZ115828	HTZ115832	HTZ115833	HTZ115838	HTZ115839	HTZ115840	HTZ115853	HTZ115857	HTZ115858
HTZ115859	HTZ115860	HTZ115861	HTZ115862	HTZ115864	HTZ115865	HTZ115874	HTZ115878	HTZ115895	HTZ115896
HTZ115897	HTZ115898	HTZ115918	HTZ115919	HTZ115944	HTZ115948	HTZ115949	HTZ119373	HTZ119380	HTZ119390
HTZ119396	HTZ124153	HTZ124285	HTZ124339	SVP72675	SVP83055	SVP83063	SVP83066	SVP83067	SVP83071
SVP83072	SVP83079	SVP83083	SVP88027	SVP88029	SVP88033	SVP88056	SVP88057	SVP88058	SVP88059
SVP88060	SVP88074	SVP88102	SVP88104	SVP88105	SVP88184	SVP88820	SVP89178	SVP89217	SVP89218
SVP89220	SVP89221	SVP89223	SVP89224	SVP91024	SVP107825	SVP108411	SVP108418	SVP108434	SVP108505
SVP108866	SVP108997	SVP109512	SVP109586	SVP109589	SVP110936	SVP110942	SVP110943	SVP110983	SVP117258
SVP117400	SVP117401	SVP117417	SVP117453	SVP117465	SVP117612	SVP117614	SVP117615	SVP118479	SVP118480
SVP118489	SVP118606	SVP118685	SVP118794	SVP118795	SVP118803				

THIS PAGE INTENTIONALLY LEFT BLANK

APPENDIX E

**DERIVED CONCENTRATION GUIDELINE LEVEL FOR STRUCTURES ON THE
ST. LOUIS DOWNTOWN SITE**

THIS PAGE INTENTIONALLY LEFT BLANK

DERIVED CONCENTRATION GUIDELINE LEVEL FOR STRUCTURES ON THE ST. LOUIS DOWNTOWN SITE

INTRODUCTION

The purpose of this appendix is to document the evaluation and the process used for calculating a health-conservative surrogate gross total alpha DCGL for structures¹ present on the SLDS that meet the dose and risk release criterion listed in the SLDS ROD for accessible soil (USACE 1998a). The surrogate total alpha DCGL developed in this appendix can then be consistently applied for any structure on any SLDS property where the structure is slated for demolition to access MED/AEC soil beneath the structure.

The DCGLs presented in this report are developed using the RESRAD-BUILD² computer code Version 4.0 to determine the DSR and RSR for individual radionuclides. The RSRs and DSRs are used to calculate individual radionuclide DCGLs equivalent to regulatory release criterion. The individual radionuclide DCGLs and site-specific AFs are used to calculate total activity surrogate DCGLs.

The health-conservative total alpha surrogate DCGL calculated using PDI data to enable field evaluation of structure surfaces for all SLDS properties is 8,700 dpm/100 cm². This DCGL is based on the suburban resident scenario (i.e., unrestricted use) meeting both dose and risk release criterion (e.g., 3×10^{-4} risk and 25 mrem/year dose).

A total beta DCGL was not developed because the health-conservative total alpha surrogate DCGL ensures beta activity remains within the release criterion for the consistent contaminant ratio at the SLDS. Additionally, the wide variability in background beta activity of structural materials prevents an effective use of the beta DCGL without substantial effort in finding similar non-impacted structural materials to establish reliable material background beta activity values. Nonetheless, a total beta DCGL based on other references may be selected with USACE concurrence as a conservative measure.

BACKGROUND

For the context of structures, the DCGL is simply a surface concentration activity level based on a site-specific mixture of nuclides that would result in a receptor receiving a dose or risk equivalent to a release criterion for a particular scenario. In other words, if a receptor (e.g., residential, etc.) spends time near the structure surfaces that had surface area concentrations below or equivalent to the DCGL, the receptor would not exceed a dose or risk-based regulatory limit. For the SLDS, the release criterion dose-based limit for a member of the public is 25 mrem/year and the risk-based limit is 3×10^{-4} risk. When conducting a MARSSIM-based survey, survey results are compared to the DCGL to identify potential compliance problem areas and to identify areas requiring further investigation.

Several different DCGLs/ILs have been used over time at the SLDS. After the SLDS ROD (USACE 1998a) was finalized, Regulatory Guide 1.86 (AEC 1974) and ANSI N13.12, *Surface and Volume Radioactivity Standards for Clearance* (ANSI/HPS 2013), were used. A total alpha DCGL of 3,900 dpm/100 cm² was introduced in the *Remedial Investigation Work Plan for the*

¹ The term “structures” includes consolidated materials, such as asphalt, concrete, and piping.

² Under the sponsorship of the DOE, the ANL developed the RESRAD family of computer codes to assess human health and environmental risk at sites contaminated with radioactive materials. Additional information on the RESRAD family of codes including RESRAD-BUILD is found on the Internet site <https://resrad.evs.anl.gov/>.

Inaccessible Soil Operable Unit at the St. Louis Downtown Site (ISOU RI WP) (USACE 2009). This DCGL related to an outdoor maintenance worker and equated to a dose of 25 mrem/year or a risk of 1×10^{-6} , whichever was the most restrictive. The ISOU RI WP DCGL was modified to 3,200 dpm/100 cm² in the *Remedial Investigation and Baseline Risk Assessment Report for the Inaccessible Soil Operable Unit at the St. Louis Downtown Site* (ISOU RI/BRA) (USACE 2012) and documented in the ISOU 1 ROD (USACE 2014). The ISOU RI WP DCGLs addressed only outdoor surfaces and were based upon limited historical AFs from radionuclide distributions listed in the BRA (DOE 1993); on outdated dose conversion factors, cancer slope factors, and dose modeling programs; and on the point of departure risk of 1×10^{-6} .

ST. LOUIS DOWNTOWN SITE STRUCTURE DERIVED CONCENTRATION GUIDELINE LEVEL PROCESS OVERVIEW

The process for developing SLDS structure DCGLs is broken into several components, each of which is described in the sections that follow:

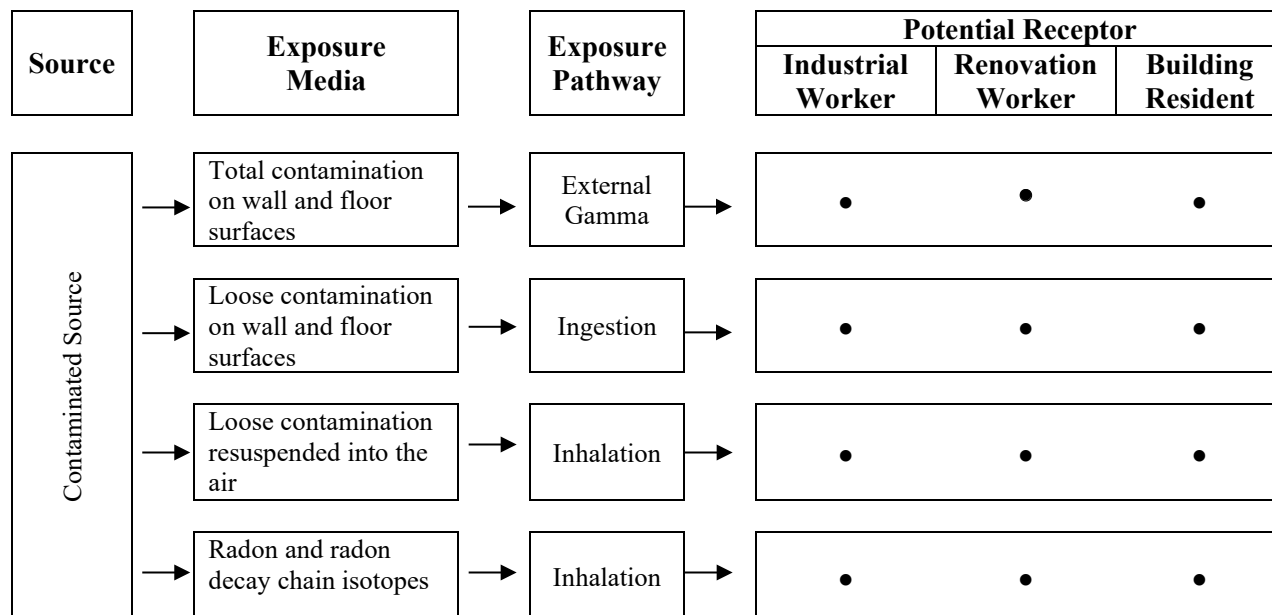
- Selecting regulatory release criterion (e.g., dose limit, risk limit, etc.),
- Developing the conceptual site model (CSM),
- Identifying potential exposure scenarios,
- Calculating radionuclide-specific DCGLs from RESRAD-BUILD output,
- Identifying the most limiting scenario,
- Determining site-specific AFs, and
- Calculating total activity DCGLs.

SELECTION OF REGULATORY RELEASE CRITERION

As listed in the SLDS ROD, the release criterion dose-based limit for a member of the public is 25 mrem/year and the risk-based limit is 3×10^{-4} risk (USACE 1998a). Depending on the specific radiological COC, dose or risk may be more limiting. Therefore, both dose and risk release criteria are evaluated for each COC.

CONCEPTUAL SITE MODEL

For an exposure to occur, a contaminated medium (i.e., source term), a receptor, and a complete pathway for the contaminant to reach the receptor must exist. The relationship between these three factors is described in the CSM. The CSM for SLDS structures is illustrated on Image E-1. The contaminated medium considered in this appendix, potential receptors, and the exposure pathways that could lead to a radiological dose (in mrem per year) to potential receptors are identified on Image E-1.

Image E-1. Conceptual Site Model for SLDS Structures

The CSM assumes that a potentially impacted building was intact and occupied. Three receptors³ were selected for comparison: (1) an industrial worker, (2) a renovation worker, and (3) a building resident. Considering the potential buildings that may be impacted at the SLDS, the industrial worker is considered the most likely long-term receptor for future use. The renovation worker is considered a conservative short-term receptor, assuming some remodeling is required to make the building suitable for future use. The building resident is not a likely receptor; however, to determine the most limiting scenario and ensure the DCGL is designed to meet unrestricted use criteria, a dose assessment for the building resident scenario was performed. Additional receptors associated with the renovation scenario (i.e., those listed in NUREG-1640 [NRC 2003], handling, transportation, disposal, etc.) were also considered. Determination of the most limiting scenario is presented in a subsequent section.

Although not shown on Image E-1, the CSM assumes receptors are exposed in a single room with a contaminated source. The ingestion pathway is also assumed to be completed through the re-deposition of suspended dust particles followed by inadvertent hand-to-mouth transfer. This approach represents the RESRAD-BUILD default pathway for ingestion. The direct ingestion pathway (without considering re-deposition) is assumed to be negligible for all scenarios.

The complete exposure pathways for all three scenarios follow:

- External gamma exposure,
- Indirect ingestion of re-deposited non-fixed contamination,
- Inhalation of re-suspended non-fixed contamination, and
- Inhalation of radon and radon decay chain isotopes.

The external gamma and radon pathways are independent of the contaminant nature (i.e., loose or fixed). However, the ingestion and inhalation pathways are subject to only the quantity of loose contamination that may be inadvertently transferred to the mouth or re-suspended into the air. The following section provides additional details regarding the potential exposure scenarios and presents the parameters used in exposure modeling.

³ Receptor scenarios are based primarily upon NRC guidance found in NUREG/CR-5512 (NRC 1999).

Although the CSM (consisting of three scenarios) assumed an intact and occupied building, an additional conceptual model was considered. The scenario for this model was the “onsite resident – post demolition.” This model assumed the contaminated structure was demolished and buried onsite, and a residence was established over the rubble. The “onsite resident – post demolition” model is not listed in this appendix and not carried forward because it was shown to be several orders of magnitude less restrictive than the other scenarios as documented in the *Derivation of Site-Specific DCGLs for North County Structures* (USACE 2004).

DEFINING THE SOURCE TERM

Depending on the structure’s location, date of construction, history of use, and history of the surrounding soil, the potential for surficial contamination may exist on the exterior only, the interior only, on or under the foundation only, or in any combination of these locations. Also, prior data indicates that contamination on potentially affected structures at the SLDS is usually spotty and tightly adherent to the structure surface. To determine an appropriate source term to be used in dose assessments, the following details were considered:

- Contamination of structure material not in direct contact with contaminated soil most likely occurred due to transport of contaminants through the air (e.g., dust), unless the structure was used in the MED/AEC material process (e.g., lab);
- Contamination of structure material by air transport would most likely result in higher levels of contamination on horizontal areas (e.g., floors, tops of equipment, structural I-beams, etc.) than on vertical areas;
- The potential volumetric contamination of materials (e.g., roofing material, insulation) was evaluated;
- Most affected SLDS structures are large industrial buildings (e.g., manufacturing facilities, warehouses); however, some of these structures have smaller office areas as well.
- Historical data that gives insight to the physical characteristics of the contamination (e.g., location, removal fraction); and
- Various characteristics of the COCs (e.g., AFs, ingrowth of decay chain isotopes, etc.) were used to model site conditions.

Empirical historical data indicates contamination found on the SLDS structures is spotty and tightly adherent (i.e., the average removal fraction is less than 5 percent). Additionally, office and warehouse areas have varying sizes, shapes, and features (e.g., drop ceilings, light fixtures, pipes, conduits, structural framework, window ledges, etc.). To develop generic parameters for a source term that fit each case, a single 100-m² room with 2.5-m high walls was selected. This size room was slightly larger than an office, yet smaller than a warehouse/manufacturing room. This size room was appropriate because the primary dose pathway was inhalation, and dose from inhalation is inversely proportional to the room volume for the same source term. The room size was also consistent with room sizes selected for dose assessments at other FUSRAP sites (e.g., North St. Louis County Sites, Missouri; and Windsor, Connecticut).

The area that may be potentially contaminated in a warehouse/manufacturing room is considerably larger than that of an office. However, as stated earlier, contamination found on the SLDS structures is likely to be spotty. Additionally, office areas are likely to be cleaner than warehouse rooms. Therefore, the contaminated portion of the selected room was assumed to be uniformly contaminated over the entire floor and the lower 2 m of all four walls. This source area

accounts for smaller offices that may have contamination in them and larger warehouse/manufacturing rooms that have more potentially contaminated surface areas. Because the contamination in the larger rooms is likely to be spotty and farther away from the receptor (e.g., horizontal structural roof supports, etc.), the source term is effectively distributed in close proximity to the receptor so that exposures are fully protective regardless of room size.

With regard to volumetric contamination, FUSRAP contaminants generally do not have the ability to penetrate surfaces such that they are volumetrically contaminated. Contamination found in roof components on other FUSRAP properties was removable surface contamination that was subsequently encased by application of additional roofing over a roof surface that exhibited concentrations of radionuclides exceeding background. Contamination of insulation, if present, should be present on the outer surface of the material and would represent the worst case with respect to potential for inhalation or ingestion of the associated contamination. Therefore, the source term was based upon surficial contamination.

NOTE: Although not a part of the DCGL development, implementation of MARSSIM surveys using these surface contamination structure DCGLs should evaluate the potential for hidden impacted surfaces on structures where MED/AEC processes occurred (e.g., layered/covered lab counters, floors, etc.).

An assessment (for years 0, 1, 3, 10, 30, 100, 300, and 1,000) using RESRAD-BUILD Version 4.0 with all radionuclide contaminants of concern at a uniform concentration of 1 pCi/m² was performed to determine when the maximum dose or risk would occur during the 1,000-year period. For all scenarios, the maximum dose or risk from the sum of all radionuclides occurred at year zero or year one. Although certain radionuclides (e.g., Th-232) had a maximum dose or risk at times other than year zero or year one, the prescribed DCGLs in this report are those from the year of maximum total dose or risk. Given that the surface contamination is removed in the first 10,000 days, the remaining pathway after 27 years is limited to external radiation and radon. Because the number of exposure pathways is reduced after the source term is no longer easily removable, doses after 10,000 days are not as significant as those in earlier years even when considering decay chain isotope ingrowth.

RESRAD-BUILD RECEPTOR EXPOSURE SCENARIOS

As shown in the CSM, three potential building occupancy (assuming the building was left intact and was occupied) exposure scenarios were considered: (1) industrial worker, (2) renovation worker, and (3) building resident. A fourth scenario, the onsite resident – post demolition, was also considered but is not carried forward in this evaluation.

The CSM assumed a simple, one-room configuration that is easy to conceptualize and can represent rooms in any SLDS building. Contamination was assumed to be distributed uniformly over the entire floor and all four walls from the floor up to 2 m. The CSM also assumed an area source. Table E-1 contains the non-default RESRAD-BUILD input parameter values used in the derivation of building DCGLs for the industrial worker, renovation worker, and building resident, respectively. The parameters were determined by using applicable guidance in the following priority:

1. Risk Assessment Guidance for Superfund,
2. NRC guidance (NUREGs, etc.),
3. ANSI guidance, and
4. RESRAD-BUILD default values.

The industrial worker scenario assumes that the critical receptor is a typical industrial worker who works 8 hours per day for 250 days per year for 25 years. The individual works in the building structure that is contaminated with surficial radioactive material. The radioactive material can be released into the indoor air by mechanisms such as mechanical removal (decontamination activities) or erosion (removal of surface contamination). The parameters of 250 days and 25 years are based on worker durations in Office of Solid Waste and Emergency Response (OSWER) Directive 9200.1-120, *Human Health Evaluation Manual, Supplemental Guidance, Update of Standard Default Exposure Factors* (USEPA 2014).

The renovation worker scenario assumes that the critical receptor is a typical renovation worker who works 8 hours per day for 90 days per year on a building renovation project. The individual works inside the building structure that is contaminated with surficial radioactive material. The radioactive material can be released into the indoor air by mechanisms such as mechanical removal (i.e., decontamination activities) or erosion (i.e., removal of surface contamination).

NOTE: a specific building renovation worker scenario was not presented in the SLDS ROD (USACE 1998a) or SLDS FS (USACE 1998b); however, the industrial/construction worker receptor is assumed to spend 400 hours per year in construction/excavation activities. In a related St. Louis FUSRAP Sites document, the renovation worker scenario spends 720 hours per year in construction/excavation activities. Therefore, the more limiting parameters from the same scenario presented in the *Derivation of Site-Specific DCGLs for North County Structures* (USACE 2004) document are used for this scenario.

The residential receptor is a composite of two residential periods of 0 to 6 years old and 24 years as an adult (DOE 1993). The residential receptor is indoors 16 hours per day for 350 days per year for 30 years. In Table 16-1 of the *Exposure Factors Handbook: 2011 Edition* (EFH), the average indoor time at home for children from ages 0 to 6 years is 16.7 hours per day, and the indoor time at home for adults is 15.8 hours per day (USEPA 2011).

The applicable pathways for all scenarios include the following:

- External exposure to penetrating radiation from surface sources,
- Inhalation of airborne radioactive particulates,
- Secondary ingestion of surface contamination, and
- Inhalation of radon and radon decay chain isotopes.

The receptor scenarios incorporate default modeling program input parameters, as well as parameters modified to reflect site-specific conditions. The non-default RESRAD-BUILD input parameters for the receptor scenarios are presented in Table E-1.

Table E-1. RESRAD-BUILD Non-Default Input Parameters

Parameter	Description	Value			Basis for Selected Value
		Industrial Worker	Renovation Worker	Suburban Resident	
Exposure Duration	Amount of time that exposure occurs	9,125 days	9,125 days	10,950 days	Industrial Worker: 25 years (USEPA 2014). Renovation Worker: 25 years (USEPA 2014). Suburban Resident: 30 years (6 years as child ages 0 to 6, 24 years as an adult) (USEPA 1991). Health-conservative value because the USEPA revised its guidance to 18 years as an adult (USEPA 2014).
Indoor Fraction	Fraction of the exposure duration spent inside the building or on/near the structure	0.243	0.08	0.639	Industrial Worker: 250 days/year (NUREG/CR-5512, Volume 3) (NRC 1999), 8 hours/day; 2,000 hours/year / 8,760 hours/year = 0.23. Renovation Worker: 90 days/year (USACE 2004), 8 hours/day; 720 hours/year / 8,760 hours/year = 0.08. Suburban Resident: An average, weighted by Exposure Durations, of the child and adult hours per day is calculated first: (16.7 hours/day * 6 years + 15.8 hours/day * 24 years) / 30 years = 16 hours/day. The indoor fraction is then calculated: (16 hours/day * 350 days/year) / 8,760 hours/year = 0.639.
Evaluation Times	Various times for which calculated results are reported	0, 1, 3, 10, 30, 100, 300, 1000 years			Evaluating receptor exposure over 1,000 years meets the requirement in 10 <i>CFR</i> 20.1401(d).
Room Area	Floor area of the room	100 m ²			100 m ² was selected as an average value somewhere between office room floor areas and manufacturing floor areas and equivalent to a MARSSIM Class 1 SU area for structures (DoD 2000).
Air Flow Rate	Flow rates of air passing through the room	200 m ³ /hour			In/Out Flow Rate = volume of room * air exchange rate. Interior flow rate: 100 m ² * 2.5 m * 0.8 hour ⁻¹ = 200 m ³ /hour. The air exchange rate of 0.8 hour ⁻¹ is the RESRAD-BUILD default value and is consistent with NUREG/CR-6697 (NRC 2000).
Breathing Rate	Inhalation rate of airborne material at this location	33.6 m ³ /day	33.6 m ³ /day	14.8 m ³ /day	Industrial Worker: Rate of 33.6 m ³ /day listed as the most likely value in NUREG/CR-6697 (NRC 2000). Renovation Worker: Rate of 33.6 m ³ /day listed as the most likely value in NUREG/CR-6697. Suburban Resident: For child ages 0 to 6, the assumed rate is 10.1 m ³ /day per Table 6-1 of the 2011 EFH (USEPA 2011). Weighted breathing rates are (10.1 m ³ /day x 6 years + 16 m ³ /day x 24 years) / 30 years = 14.8 m ³ /day. The breathing rate from ages 0 to 6 ranges from 3.5 to 10.1 m ³ /day, so using the highest rate is health-conservative.
Indirect Ingestion Rate	Ingestion rate of deposited dust transferred from structure surfaces to surfaces of hands, food, or other objects that contact the mouth	1 x 10 ⁻⁴ m ² /hour	2 x 10 ⁻⁴ m ² /hour	6.9 x 10 ⁻⁴ m ² /hour	Industrial Worker: Default indirect ingestion rate. Renovation Worker: Because this rate is expressed as the surface area contacted per unit time and renovation workers are likely to have more contact with contaminated surfaces than industrial workers, the default rate was doubled. This value is consistent with the max value of 2.9E-4 m ² /hour listed in NUREG/CR-6697 (NRC 2000). Suburban Resident: Weighted indirect ingestion rates are (3 x 10 ⁻³ m ² /hour x 6 years + 1.1 x 10 ⁻⁴ m ³ /hour x 24 years) / 30 years = 6.9 x 10 ⁻⁴ m ² /hour.
Receptor Location	Coordinates of the receptor	5, 5, 1 m			All: The receptor is located in the center of a square room with 100 m ² of floor area.

Table E-1. RESRAD-BUILD Non-Default Input Parameters (Continued)

Parameter	Description	Value			Basis for Selected Value
		Industrial Worker	Renovation Worker	Suburban Resident	
Number of Sources	1 floor and 4 walls	5			Floor and 4 walls.
Room Location	Sources are located in the scenario’s room number 1	1			Consistent with Room Number parameter.
Source Type	Surface of wall or floor	Area			The ‘Area’ parameter for Source Type reflects radioactivity on surfaces.
Source Direction	Axis perpendicular to the source wall or floor	Floor (z), 4 walls (x,y,x,y)			Establishes the axes for a three-dimensional room.
Source Location	Center point of the source wall or floor in the x, y, z direction	Floor: 5, 5, 0 m; Walls: 0, 5, 1 m; 5, 10, 1 m; 10, 5, 1 m; 5, 0, 1 m			Based on a square room with 100 m² of floor area with radioactivity on the lower 2 m of the walls.
Source Geometry: Area	Area of the exposed surface over which the radioactivity is evenly distributed	100, 20, 20, 20, 20 m²			Based on a square room with 100 m² of floor area with radioactivity on the lower 2 m of the walls.
Air Release Fraction	Fraction of the eroded material released into the air	0.07			Most likely value per NUREG/CR-6697 (NRC 2000).
Erosion Lifetime	Amount of time in which the Removable Fraction of the source is linearly eroded	10,000 days	1,825 days	10,000 days	Industrial Worker: Most likely value per NUREG/CR-6697 (NRC 2000). Renovation Worker: 1,825 days (5 years). This value was set to account for the increased removal rate of the source that would occur during a renovation. This value falls within the range of values listed in NUREG/CR-6697. This value as it relates to air release fraction, removable fraction, and resuspension rate was calculated at 3,280 and was subsequently reduced to 1,825 to provide conservatism to account for the air release fraction setpoint. Suburban Resident: Most likely value per NUREG/CR-6697 (NRC 2000).
EPC	The concentrations of radionuclides in the source	1 dpm/m²			All radionuclide concentrations were uniformly set at 1 dpm/m² to establish RSRs and DSRs that are used to calculate surface contamination levels equivalent to release criteria.
Slope/Conversion Factors Library	Library of multiplication factors that convert other input parameters into risk and dose estimates	Dose: DCFPAK3.02 (Adult) Risk: DCFPAK3.02 Morbidity	Dose: DCFPAK3.02 (Adult) Risk: DCFPAK3.02 Morbidity	Dose: DCFPAK3.02 (Age 10) Risk: DCFPAK3.02 Morbidity	All: DCFPAK 3.02 Morbidity reflects the most recent collection of risk multiplication factors for cancer occurring but not necessarily leading to death. Industrial Worker: DCFPAK 3.02 (Adult) reflects the age group for industrial workers. Renovation Worker: DCFPAK 3.02 (Age 5) reflects the age group for renovation workers. Suburban Resident: DCFPAK 3.02 (Age 10) reflects the most recent collection of dose multiplication factors for children at age 10. This age was selected to represent weighted factors for adults at age 24 and for children at ages 0 to 6.
Radionuclide Library	Library of radionuclide decay information	ICRP 107			Most recent collection of radionuclide decay chain and energy data.
Cut-Off Half-Life	Decay chain isotopes with this half-life or less are automatically included in the calculation	180 days			Selected so Po-210, with its 138-day half-life, is assumed to be in secular equilibrium with Pb-210.

CALCULATING DERIVED CONCENTRATION GUIDELINE LEVELS FROM RESRAD-BUILD OUTPUT

To derive the surficial contamination DCGL values that would be equivalent to the release criterion dose limit of 25 mrem/year and risk limit of 3×10^{-4} , a source term of 1 dpm/m² was put into the RESRAD-BUILD code for each SLDS radionuclide COC to determine a DSR and an RSR. The DSR and RSR are derived values, based upon the RESRAD modeling output (Attachment E-1), that can be used to convert the release criterion limits to units of surficial contamination (in pCi/m²).

Tables E-2 and E-3 list each radionuclide COC and then present the industrial worker derived DSR and RSR, respectively, for that radionuclide and its associated decay chain isotopes for each source in the building. The total DSR and RSR for a radionuclide COC is calculated by summing the respective DSRs and RSRs for each COC radionuclide and its decay chain isotopes. Tables E-4 and E-5 present this process for the renovation worker scenario. Tables E-6 and E-7 present this process for the suburban resident scenario.

It is important to note that the DCGLs, when implemented during surveys, are to be compared to residual contamination exceeding background. If background is not taken into consideration, the DCGLs remain fully protective.

Table E-2. Industrial Worker Total Dose-to-Source Ratio from All Sources

Radionuclide ^a / Decay Chain Isotopes		RESRAD-BUILD Dose Output per Source ^b (mrem/year per dpm/m ²)					Total ^c DSR (mrem/year)/(dpm/m ²)
		1	2	3	4	5	
Ac-227	Ac-227	1.33E-05	2.38E-06	2.38E-06	2.38E-06	2.38E-06	2.28E-05
Pa-231	Pa-231	1.60E-05	3.16E-06	3.16E-06	3.16E-06	3.16E-06	2.98E-05
	Ac-227	6.51E-07	1.16E-07	1.16E-07	1.16E-07	1.16E-07	
Pb-210	Pb-210	8.13E-07	1.40E-07	1.40E-07	1.40E-07	1.40E-07	1.37E-06
Ra-226	Ra-226	8.61E-06	8.14E-07	8.14E-07	8.14E-07	8.14E-07	8.79E-05
	Pb-210	3.89E-08	6.71E-09	6.71E-09	6.71E-09	6.71E-09	
Ra-228	Ra-228	3.63E-06	3.34E-07	3.34E-07	3.34E-07	3.34E-07	1.19E-05
	Th-228	4.67E-05	9.05E-06	9.05E-06	9.05E-06	9.05E-06	
Th-228	Th-228	7.23E-05	1.40E-05	1.40E-05	1.40E-05	1.40E-05	1.28E-04
Th-230	Th-230	6.97E-06	1.39E-06	1.39E-06	1.39E-06	1.39E-06	1.25E-05
	Ra-226	5.59E-09	5.29E-10	5.29E-10	5.29E-10	5.29E-10	
	Pb-210	1.32E-11	2.28E-12	2.28E-12	2.28E-12	2.28E-12	
Th-232	Th-232	7.55E-06	1.51E-06	1.51E-06	1.51E-06	1.51E-06	2.33E-05
	Th-228	7.16E-07	6.60E-08	6.60E-08	6.60E-08	6.60E-08	
	Ra-228	4.92E-06	9.54E-07	9.54E-07	9.54E-07	9.54E-07	
U-234	U-234	6.51E-07	1.29E-07	1.29E-07	1.29E-07	1.29E-07	1.17E-06
	Th-230	9.61E-11	1.92E-11	1.92E-11	1.92E-11	1.92E-11	
	Ra-226	4.00E-14	3.78E-15	3.78E-15	3.78E-15	3.78E-15	
	Pb-210	6.53E-17	1.13E-17	1.13E-17	1.13E-17	1.13E-17	
U-235	U-235	1.30E-06	1.49E-07	1.49E-07	1.49E-07	1.49E-07	1.90E-06
	Pa-231	5.07E-10	1.00E-10	1.00E-10	1.00E-10	1.00E-10	
	Ac-227	1.08E-11	1.93E-12	1.93E-12	1.93E-12	1.93E-12	
U-238	U-238	1.04E-06	1.37E-07	1.37E-07	1.37E-07	1.37E-07	1.59E-06
	U-234	2.76E-12	5.46E-13	5.46E-13	5.46E-13	5.46E-13	
	Th-230	2.11E-16	4.22E-17	4.22E-17	4.22E-17	4.22E-17	
	Ra-226	6.10E-20	5.58E-21	5.58E-21	5.58E-21	5.58E-21	
	Pb-210	1.04E-22	2.79E-23	2.79E-23	2.79E-23	2.79E-23	

^a Each parent COC radionuclide was set to 1 dpm/m².

^b Source 1 represents the floor; sources 2 through 5 represent each contaminated wall. The dose resulting from the parent radionuclide and the decay chain isotopes of each parent radionuclide are listed for each source.

^c Total DSR from each COC including dose from decay chain isotopes due to sources 1 through 5. Total DSR is calculated by summing all individual DSR values for each radionuclide and its decay chain isotopes from all sources.

Table E-3. Industrial Worker Total Risk-to-Source Ratio from All Sources

Radionuclide ^a / Decay Chain Isotopes		RESRAD-BUILD Risk Output per Source ^b (Risk per dpm/m ²)					Total ^c RSR Risk/(dpm/m ²)
		1	2	3	4	5	
Ac-227	Ac-227	9.09E-11	1.45E-11	1.45E-11	1.45E-11	1.45E-11	1.49E-10
Pa-231	Pa-231	3.95E-11	7.18E-12	7.18E-12	7.18E-12	7.18E-12	1.42E-10
	Ac-227	4.49E-11	7.18E-12	7.18E-12	7.18E-12	7.18E-12	
Pb-210	Pb-210	1.10E-11	2.00E-12	2.00E-12	2.00E-12	2.00E-12	1.90E-11
Ra-226	Ra-226	2.12E-10	2.50E-11	2.50E-11	2.50E-11	2.50E-11	3.21E-10
	Pb-210	5.33E-12	9.67E-13	9.67E-13	9.67E-13	9.67E-13	
Ra-228	Ra-228	2.34E-11	2.12E-12	2.12E-12	2.12E-12	2.12E-12	1.02E-09
	Th-228	5.61E-10	1.08E-10	1.08E-10	1.08E-10	1.08E-10	
Th-228	Th-228	1.45E-10	2.78E-11	2.78E-11	2.78E-11	2.78E-11	2.56E-10
Th-230	Th-230	1.59E-11	3.16E-12	3.16E-12	3.16E-12	3.16E-12	3.04E-11
	Ra-226	1.22E-12	1.45E-13	1.45E-13	1.45E-13	1.45E-13	
	Pb-210	2.13E-14	3.87E-15	3.87E-15	3.87E-15	3.87E-15	
Th-232	Th-232	2.01E-11	4.01E-12	4.01E-12	4.01E-12	4.01E-12	2.08E-09
	Th-228	5.89E-11	5.37E-12	5.37E-12	5.37E-12	5.37E-12	
	Ra-228	1.11E-09	2.14E-10	2.14E-10	2.14E-10	2.14E-10	
U-234	U-234	1.30E-11	2.58E-12	2.58E-12	2.58E-12	2.58E-12	2.33E-11
	Th-230	1.97E-15	3.92E-16	3.92E-16	3.92E-16	3.92E-16	
	Ra-226	9.69E-17	1.15E-17	1.15E-17	1.15E-17	1.15E-17	
	Pb-210	1.32E-18	2.40E-19	2.40E-19	2.40E-19	2.40E-19	
U-235	U-235	2.50E-11	2.93E-12	2.93E-12	2.93E-12	2.93E-12	3.68E-11
	Pa-231	1.13E-14	2.05E-15	2.05E-15	2.05E-15	2.05E-15	
	Ac-227	8.76E-15	1.40E-15	1.40E-15	1.40E-15	1.40E-15	
U-238	U-238	1.94E-11	2.65E-12	2.65E-12	2.65E-12	2.65E-12	3.00E-11
	U-234	4.95E-16	9.82E-17	9.82E-17	9.82E-17	9.82E-17	
	Th-230	4.83E-20	9.59E-21	9.59E-21	9.59E-21	9.59E-21	
	Ra-226	1.77E-21	2.09E-22	2.09E-22	2.09E-22	2.09E-22	
	Pb-210	1.99E-23	3.61E-24	3.61E-24	3.61E-24	3.61E-24	

^a Each parent COC radionuclide was set to 1 dpm/m².

^b Source 1 represents the floor; sources 2 through 5 represent each contaminated wall. The risk resulting from the parent radionuclide and the decay chain isotopes of each parent radionuclide are listed for each source.

^c Total RSR from each COC including risk from decay chain isotopes due to sources 1 through 5. Total RSR is calculated by summing all individual RSR values for each radionuclide and its decay chain isotopes from all sources.

Table E-4. Renovation Worker Total Dose-to-Source Ratio from All Sources

Radionuclide ^a / Decay Chain Isotopes		RESRAD-BUILD Dose Output per Source ^b (mrem/year per dpm/m ²)					Total ^c DSR (mrem/year)/(dpm/m ²)
		1	2	3	4	5	
Ac-227	Ac-227	1.18E-05	2.25E-06	2.25E-06	2.25E-06	2.25E-06	2.08E-05
Pa-231	Pa-231	1.49E-05	2.97E-06	2.97E-06	2.97E-06	2.97E-06	2.71E-05
	Ac-227	1.90E-07	3.64E-08	3.64E-08	3.64E-08	3.64E-08	
Pb-210	Pb-210	6.93E-07	1.31E-07	1.31E-07	1.31E-07	1.31E-07	1.22E-06
Ra-226	Ra-226	3.37E-06	3.60E-07	3.60E-07	3.60E-07	3.60E-07	4.83E-06
	Pb-210	1.10E-08	2.07E-09	2.07E-09	2.07E-09	2.07E-09	
Ra-228	Ra-228	2.03E-06	2.54E-07	2.54E-07	2.54E-07	2.54E-07	1.56E-05
	Th-228	7.05E-06	1.37E-06	1.37E-06	1.37E-06	1.37E-06	
Th-228	Th-228	3.83E-05	7.45E-06	7.45E-06	7.45E-06	7.45E-06	6.81E-05
Th-230	Th-230	6.55E-06	1.31E-06	1.31E-06	1.31E-06	1.31E-06	1.18E-05
	Ra-226	7.29E-10	7.80E-11	7.80E-11	7.80E-11	7.80E-11	
	Pb-210	1.59E-12	3.00E-13	3.00E-13	3.00E-13	3.00E-13	
Th-232	Th-232	7.09E-06	1.42E-06	1.42E-06	1.42E-06	1.42E-06	1.35E-05
	Th-228	1.26E-07	1.57E-08	1.57E-08	1.57E-08	1.57E-08	
	Ra-228	2.94E-07	5.72E-08	5.72E-08	5.72E-08	5.72E-08	
U-234	U-234	6.09E-07	1.21E-07	1.21E-07	1.21E-07	1.21E-07	1.09E-06
	Th-230	3.05E-11	6.09E-12	6.09E-12	6.09E-12	6.09E-12	
	Ra-226	2.23E-15	2.39E-16	2.39E-16	2.39E-16	2.39E-16	
	Pb-210	3.66E-18	6.91E-19	6.91E-19	6.91E-19	6.91E-19	
U-235	U-235	7.95E-07	1.20E-07	1.20E-07	1.20E-07	1.20E-07	1.28E-06
	Pa-231	1.59E-10	3.18E-11	3.18E-11	3.18E-11	3.18E-11	
	Ac-227	1.35E-12	2.58E-13	2.58E-13	2.58E-13	2.58E-13	
U-238	U-238	6.87E-07	1.13E-07	1.13E-07	1.13E-07	1.13E-07	1.14E-06
	U-234	8.69E-13	1.73E-13	1.73E-13	1.73E-13	1.73E-13	
	Th-230	2.87E-17	5.74E-18	5.74E-18	5.74E-18	5.74E-18	
	Ra-226	2.03E-21	1.33E-22	1.33E-22	1.33E-22	1.33E-22	
	Pb-210	1.71E-23	8.99E-24	8.99E-24	8.99E-24	8.99E-24	

^a Each parent COC radionuclide was set to 1 dpm/m².

^b Source 1 represents the floor; sources 2 through 5 represent each contaminated wall. The dose resulting from the parent radionuclide and the decay chain isotopes of each parent radionuclide are listed for each source.

^c Total DSR from each COC including dose from decay chain isotopes due to sources 1 through 5. Total DSR is calculated by summing all individual DSR values for each radionuclide and its decay chain isotopes from all sources.

Table E-5. Renovation Worker Total Risk-to-Source Ratio from All Sources

Radionuclide ^a / Decay Chain Isotopes		RESRAD-BUILD Risk Output per Source ^b (Risk per dpm/m ²)					Total ^c RSR Risk/(dpm/m ²)
		1	2	3	4	5	
Ac-227	Ac-227	2.59E-11	3.92E-12	3.92E-12	3.92E-12	3.92E-12	4.16E-11
Pa-231	Pa-231	8.13E-12	1.39E-12	1.39E-12	1.39E-12	1.39E-12	2.08E-11
	Ac-227	5.22E-12	4.81E-13	4.81E-13	4.81E-13	4.81E-13	
Pb-210	Pb-210	3.00E-12	5.28E-13	5.28E-13	5.28E-13	5.28E-13	5.11E-12
Ra-226	Ra-226	6.87E-11	7.97E-12	7.97E-12	7.97E-12	7.97E-12	1.01E-10
	Pb-210	4.06E-13	5.04E-14	5.04E-14	5.04E-14	5.04E-14	
Ra-228	Ra-228	9.53E-12	9.47E-13	9.47E-13	9.47E-13	9.47E-13	3.50E-10
	Th-228	1.90E-10	3.66E-11	3.66E-11	3.66E-11	3.66E-11	
Th-228	Th-228	7.53E-11	1.45E-11	1.45E-11	1.45E-11	1.45E-11	1.33E-10
Th-230	Th-230	3.05E-12	6.02E-13	6.02E-13	6.02E-13	6.02E-13	5.98E-12
	Ra-226	3.58E-13	4.07E-14	4.07E-14	4.07E-14	4.07E-14	
	Pb-210	9.25E-16	6.71E-17	6.71E-17	6.71E-17	6.71E-17	
Th-232	Th-232	3.85E-12	7.65E-13	7.65E-13	7.65E-13	7.65E-13	6.40E-10
	Th-228	1.50E-11	9.69E-13	9.69E-13	9.69E-13	9.69E-13	
	Ra-228	3.47E-10	6.67E-11	6.67E-11	6.67E-11	6.67E-11	
U-234	U-234	2.50E-12	4.92E-13	4.92E-13	4.92E-13	4.92E-13	4.47E-12
	Th-230	7.39E-17	1.40E-17	1.40E-17	1.40E-17	1.40E-17	
	Ra-226	2.73E-17	3.08E-18	3.08E-18	3.08E-18	3.08E-18	
	Pb-210	4.79E-20	2.57E-21	2.57E-21	2.57E-21	2.57E-21	
U-235	U-235	6.68E-12	6.45E-13	6.45E-13	6.45E-13	6.45E-13	9.26E-12
	Pa-231	7.24E-16	8.21E-17	8.21E-17	8.21E-17	8.21E-17	
	Ac-227	7.59E-16	4.67E-17	4.67E-17	4.67E-17	4.67E-17	
U-238	U-238	4.90E-12	5.69E-13	5.69E-13	5.69E-13	5.69E-13	7.18E-12
	U-234	1.88E-17	3.50E-18	3.50E-18	3.50E-18	3.50E-18	
	Th-230	4.32E-22	6.68E-23	6.68E-23	6.68E-23	6.68E-23	
	Ra-226	4.80E-22	5.42E-23	5.42E-23	5.42E-23	5.42E-23	
	Pb-210	6.73E-25	3.31E-26	3.31E-26	3.31E-26	3.31E-26	

^a Each radionuclide was set to 1 dpm/m².

^b Source 1 represents the floor; sources 2 through 5 represent each contaminated wall. The risk resulting from the parent radionuclide and the decay chain isotopes of each parent radionuclide are listed.

^c Total RSR from each COC including risk from decay chain isotopes due to sources 1 through 5. Total RSR is calculated by summing all individual RSR values for each radionuclide and its decay chain isotopes from all sources.

Table E-6. Suburban Resident Total Dose-to-Source Ratio from All Sources

Radionuclide ^a / Decay Chain Isotopes		RESRAD-BUILD Dose Output per Source ^b (mrem/year per dpm/m ²)					Total ^c DSR (mrem/year)/(dpm/m ²)
		1	2	3	4	5	
Ac-227	Ac-227	2.16E-05	3.53E-06	3.53E-06	3.53E-06	3.53E-06	3.57E-05
Pa-231	Pa-231	2.28E-05	4.46E-06	4.46E-06	4.46E-06	4.46E-06	4.24E-05
	Ac-227	1.05E-06	1.72E-07	1.72E-07	1.72E-07	1.72E-07	
Pb-210	Pb-210	1.79E-06	2.96E-07	2.96E-07	2.96E-07	2.96E-07	2.97E-06
Ra-226	Ra-226	2.32E-05	2.12E-06	2.12E-06	2.12E-06	2.12E-06	3.18E-05
	Pb-210	8.59E-08	1.42E-08	1.42E-08	1.42E-08	1.42E-08	
Ra-228	Ra-228	9.14E-06	7.40E-07	7.40E-07	7.40E-07	7.40E-07	2.40E-04
	Th-228	1.28E-04	2.49E-05	2.49E-05	2.49E-05	2.49E-05	
Th-228	Th-228	1.99E-04	3.86E-05	3.86E-05	3.86E-05	3.86E-05	3.53E-04
Th-230	Th-230	9.51E-06	1.90E-06	1.90E-06	1.90E-06	1.90E-06	1.71E-05
	Ra-226	1.51E-08	1.37E-09	1.37E-09	1.37E-09	1.37E-09	
	Pb-210	2.92E-11	4.82E-12	4.82E-12	4.82E-12	4.82E-12	
Th-232	Th-232	1.13E-05	2.25E-06	2.25E-06	2.25E-06	2.25E-06	4.67E-05
	Th-228	1.80E-06	1.46E-07	1.46E-07	1.46E-07	1.46E-07	
	Ra-228	1.35E-05	2.62E-06	2.62E-06	2.62E-06	2.62E-06	
U-234	U-234	1.04E-06	2.05E-07	2.05E-07	2.05E-07	2.05E-07	1.86E-06
	Th-230	1.31E-10	2.62E-11	2.62E-11	2.62E-11	2.62E-11	
	Ra-226	1.08E-13	9.83E-15	9.83E-15	9.83E-15	9.83E-15	
	Pb-210	1.44E-16	2.38E-17	2.38E-17	2.38E-17	2.38E-17	
U-235	U-235	2.92E-06	2.76E-07	2.76E-07	2.76E-07	2.76E-07	4.03E-06
	Pa-231	7.24E-10	1.42E-10	1.42E-10	1.42E-10	1.42E-10	
	Ac-227	1.75E-11	2.86E-12	2.86E-12	2.86E-12	2.86E-12	
U-238	U-238	2.23E-06	2.49E-07	2.49E-07	2.49E-07	2.49E-07	3.23E-06
	U-234	4.42E-12	8.69E-13	8.69E-13	8.69E-13	8.69E-13	
	Th-230	2.88E-16	5.75E-17	5.75E-17	5.75E-17	5.75E-17	
	Ra-226	1.64E-19	1.45E-20	1.45E-20	1.45E-20	1.45E-20	
	Pb-210	2.59E-22	5.41E-23	5.41E-23	5.41E-23	5.41E-23	

^a Each radionuclide was set to 1 dpm/m².

^b Source 1 represents the floor; sources 2 through 5 represent each contaminated wall. The dose resulting from the parent radionuclide and the decay chain isotopes of each parent radionuclide are listed.

^c Total DSR from each COC including dose from decay chain isotopes due to sources 1 through 5. Total DSR is calculated by summing all individual DSR values for each radionuclide and its decay chain isotopes from all sources.

Table E-7. Suburban Resident Total Risk-to-Source Ratio from All Sources

Radionuclide ^a / Decay Chain Isotopes		RESRAD-BUILD Risk Output per Source ^b (Risk per dpm/m ²)					Total ^c RSR Risk/(dpm/m ²)
		1	2	3	4	5	
Ac-227	Ac-227	1.61E-10	2.08E-11	2.08E-11	2.08E-11	2.08E-11	2.44E-10
Pa-231	Pa-231	5.97E-11	9.56E-12	9.56E-12	9.56E-12	9.56E-12	2.32E-10
	Ac-227	8.95E-11	1.12E-11	1.12E-11	1.12E-11	1.12E-11	
Pb-210	Pb-210	1.76E-11	2.88E-12	2.88E-12	2.88E-12	2.88E-12	2.91E-11
Ra-226	Ra-226	5.29E-10	4.86E-11	4.86E-11	4.86E-11	4.86E-11	7.39E-10
	Pb-210	9.30E-12	1.49E-12	1.49E-12	1.49E-12	1.49E-12	
Ra-228	Ra-228	5.75E-11	4.22E-12	4.22E-12	4.22E-12	4.22E-12	1.39E-09
	Th-228	7.55E-10	1.39E-10	1.39E-10	1.39E-10	1.39E-10	
Th-228	Th-228	1.89E-10	3.47E-11	3.47E-11	3.47E-11	3.47E-11	3.28E-10
Th-230	Th-230	2.09E-11	4.10E-12	4.10E-12	4.10E-12	4.10E-12	4.23E-11
	Ra-226	3.60E-12	3.29E-13	3.29E-13	3.29E-13	3.29E-13	
	Pb-210	4.07E-14	6.38E-15	6.38E-15	6.38E-15	6.38E-15	
Th-232	Th-232	2.63E-11	5.21E-12	5.21E-12	5.21E-12	5.21E-12	3.51E-09
	Th-228	1.74E-10	1.25E-11	1.25E-11	1.25E-11	1.25E-11	
	Ra-228	1.87E-09	3.43E-10	3.43E-10	3.43E-10	3.43E-10	
U-234	U-234	1.71E-11	3.35E-12	3.35E-12	3.35E-12	3.35E-12	3.05E-11
	Th-230	2.73E-15	5.36E-16	5.36E-16	5.36E-16	5.36E-16	
	Ra-226	3.38E-16	3.08E-17	3.08E-17	3.08E-17	3.08E-17	
	Pb-210	2.77E-18	4.23E-19	4.23E-19	4.23E-19	4.23E-19	
U-235	U-235	5.95E-11	5.03E-12	5.03E-12	5.03E-12	5.03E-12	7.97E-11
	Pa-231	1.84E-14	2.89E-15	2.89E-15	2.89E-15	2.89E-15	
	Ac-227	1.97E-14	2.37E-15	2.37E-15	2.37E-15	2.37E-15	
U-238	U-238	4.22E-11	4.35E-12	4.35E-12	4.35E-12	4.35E-12	5.96E-11
	U-234	6.88E-16	1.34E-16	1.34E-16	1.34E-16	1.34E-16	
	Th-230	7.08E-20	1.39E-20	1.39E-20	1.39E-20	1.39E-20	
	Ra-226	7.33E-21	6.67E-22	6.67E-22	6.67E-22	6.67E-22	
	Pb-210	4.58E-23	6.82E-24	6.82E-24	6.82E-24	6.82E-24	

^a Each radionuclide was set to 1 dpm/m².

^b Source 1 represents the floor; sources 2 through 5 represent each contaminated wall. The risk resulting from the parent radionuclide and the decay chain isotopes of each parent radionuclide are listed.

^c Total RSR from each COC including risk from decay chain isotopes due to sources 1 through 5. Total RSR is calculated by summing all individual RSR values for each radionuclide and its decay chain isotopes from all sources.

The limiting release criterion radionuclide-specific DCGL is highlighted in yellow for each scenario in Table E-8. The radionuclide-specific DCGL associated with risk was calculated by dividing the risk release criterion of 3×10^{-4} risk by the 1 dpm/m² RSR and 100 cm²/m² to result in units of dpm/100 cm². The radionuclide-specific DCGL associated with dose was calculated by dividing the dose release criterion of 25 mrem/year by the 1 dpm/m² DSR and 100 cm²/m² to result in units of dpm/100 cm².

Table E-8. Radionuclide-Specific Release Criterion Derived Concentration Guideline Levels per Scenario

Scenario	Industrial Worker				Renovation Worker				Suburban Resident			
Radionuclide	Total RSR ^a	Total DSR ^a	Risk DCGL ^b	Dose DCGL ^c	Total RSR ^a	Total DSR ^a	Risk DCGL ^b	Dose DCGL ^b	Total RSR ^a	Total DSR ^a	Risk DCGL ^b	Dose DCGL ^b
	(risk/dpm/m ²)	(mrem/year/dpm/m ²)	(dpm/100 cm ²)		(risk/dpm/m ²)	(mrem/year/dpm/m ²)	(dpm/100 cm ²)		(risk/dpm/m ²)	(mrem/year/dpm/m ²)	(dpm/100 cm ²)	
Ac-227	1.49E-10	2.28E-05	20,148	10,955	4.16E-11	2.08E-05	72,150	12,019	2.44E-10	3.57E-05	12,285	6,999
Pa-231	1.42E-10	2.98E-05	21,151	8,402	2.08E-11	2.71E-05	143,995	9,220	2.32E-10	4.24E-05	12,918	5,899
Pb-210	1.90E-11	1.37E-06	157,895	182,083	5.11E-12	1.22E-06	586,854	205,423	2.91E-11	2.97E-06	103,022	84,062
Ra-226	3.21E-10	1.19E-05	9,340	20,953	1.01E-10	4.83E-06	29,648	51,768	7.39E-10	3.18E-05	4,061	7,856
Ra-228	1.02E-09	8.79E-05	2,927	2,845	3.50E-10	1.56E-05	8,578	16,050	1.39E-09	2.40E-04	2,165	1,043
Th-228	2.56E-10	1.28E-04	11,710	1,949	1.33E-10	6.81E-05	22,506	3,671	3.28E-10	3.53E-04	9,152	707
Th-230	3.04E-11	1.25E-05	98,760	19,940	5.98E-12	1.18E-05	501,673	21,203	4.23E-11	1.71E-05	70,952	14,594
Th-232	2.08E-09	2.33E-05	1,441	10,727	6.40E-10	1.35E-05	4,691	18,544	3.51E-09	4.67E-05	854	5,357
U-234	2.33E-11	1.17E-06	128,625	214,193	4.47E-12	1.09E-06	671,416	228,717	3.05E-11	1.86E-06	98,343	134,392
U-235	3.68E-11	1.90E-06	81,624	131,792	9.26E-12	1.28E-06	323,904	196,034	7.97E-11	4.03E-06	37,651	62,107
U-238	3.00E-11	1.59E-06	99,997	157,430	7.18E-12	1.14E-06	418,058	219,490	5.96E-11	3.23E-06	50,335	77,495

^a Results from Total RSR or Total DSR column in Tables E-2 through E-7 for respective scenarios.

^b Risk DCGL = 3×10^{-4} risk / (Total RSR * 100).

^c Dose DCGL = 25 mrem/year / (Total DSR * 100).

Note:

The limiting release criterion radionuclide-specific DCGL is highlighted in yellow for each scenario.

Bold values indicate the limiting individual radionuclide DCGL.

IDENTIFYING THE MOST LIMITING SCENARIO

When comparing the limiting release criterion DCGL of all three scenarios, the suburban resident has the lowest or most limiting DCGL for each radionuclide. Therefore, the suburban resident is identified as the limiting scenario, and each limiting release criterion radionuclide-specific DCGL for the suburban resident scenario is rounded and presented in Table E-9 to be used in calculating the total alpha DCGLs.

Table E-9. SLDS Limiting Individual Radionuclide Derived Concentration Guideline Levels

Radionuclide	Derived Surface DCGL ^a	Rounded Surface DCGL ^b
	(dpm/100 cm ²)	
Ac-227	6,999	6,900
Pa-231	5,899	5,800
Pb-210	84,062	84,000
Ra-226	4,061	4,000
Ra-228	1,043	1,000
Th-228	707	700
Th-230	14,594	14,500
Th-232	854	850
U-234	98,343	98,000
U-235	37,651	37,000
U-238	50,335	50,000

^a Limiting DCGL from Table E-8.

^b Results rounded.

DETERMINATION OF SLDS ACTIVITY FRACTIONS

The SLDS property-specific data are used to calculate the total AFs necessary for developing surrogate DCGLs. SLDS non-historical (i.e., data collected by the USACE) PDI sample data collected through June 2023 with SOR_N values exceeding 1.0 provide an improved dataset for determining the AFs associated with MED/AEC radioactivity. This dataset is then used to calculate SLDS-specific total alpha and total beta DCGLs. The sample identifiers for the SLDS dataset are listed in Attachment E-2.

For the dataset, the average soil background concentration⁴ for each radionuclide is subtracted from each sample result to obtain the net sample result exceeding background. The net results are averaged for each radionuclide. Because sampling results are not available for Pb-210 and U-234, known relationships were documented in Table 2.15 of the BRA (DOE 1993) as follows: Pb-210 = 1.3 x Ra-226 and U-234 = U-238. These known relationships are applied to the average net results for Ra-226 and U-238 to obtain the net results for Pb-210 and U-234, respectively. The net average result for each radionuclide is then divided by the total net average concentration for all radionuclides to determine the site-specific AF for each radionuclide. Table E-10 contains the net results and AFs for the SLDS dataset. These AFs are for total radioactivity so both alpha and beta emissions are included.

⁴ The background sample dataset is documented in *Background Soils Characterization Report for the St. Louis Downtown Site* (USACE 1999g).

Table E-10. SLDS Activity Fractions

Radionuclide	Ac-227	Pa-231	Pb-210	Ra-226	Ra-228	Th-228	Th-230	Th-232	U-234	U-235	U-238
Average Background Data (pCi/g)	0.14	0.90	--	2.78	0.95	1.16	1.94	1.09	--	0.80	1.44
Net Result (pCi/g)	4.50	4.44	26.25	20.19	2.25	2.33	50.10	2.21	71.86	4.07	71.86
Total Net Result (pCi/g)	260.04										
AF	0.0173	0.0171	0.1009	0.0776	0.0086	0.0089	0.1926	0.0085	0.2763	0.0157	0.2763

CALCULATING TOTAL ACTIVITY DERIVED CONCENTRATION GUIDELEINE LEVELS

The MARSSIM equation for calculating a DCGL is based on total radioactivity (DoD 2000), as shown in the following equation:

$$Activity\ DCGL_{(Total)} = \frac{1}{\frac{AF_1}{DCGL_1} + \frac{AF_2}{DCGL_2} + \dots + \frac{AF_3}{DCGL_3}}$$

where:

AF_i = the site-specific AF for each radionuclide of interest

DCGL_i = the DCGL for each radionuclide of interest

For the SLDS properties, the total activity DCGL follows:

$$Activity\ DCGL_{(Total)} = \frac{1}{\frac{0.0173}{6,900} + \frac{0.0171}{5,800} + \frac{0.1009}{84,000} + \frac{0.0776}{4,000} + \frac{0.0086}{1,000} + \frac{0.0089}{700} + \frac{0.1926}{14,500} + \frac{0.0085}{850} + \frac{0.2763}{98,000} + \frac{0.0157}{37,000} + \frac{0.2763}{50,000}}$$

$$= 12,591\ dpm/100\ cm^2$$

TOTAL ALPHA ACTIVITY AND TOTAL BETA ACTIVITY SURROGATE DERIVED CONCENTRATION GUIDELEINE LEVELS

To obtain separate total DCGLs for alpha activity and for beta activity, the AFs are separated into alpha and beta portions. Separation involves the relative number of alpha and beta emissions for each radionuclide during decay to the next long-lived radionuclide in the decay chain. For the purposes of developing total surrogate DCGLs, the emissions from short-lived decay chain isotopes are counted with the emissions from their long-lived parent because the long-lived radionuclides have RGs. The short-lived decay chain isotopes are in secular equilibrium with these long-lived parent radionuclides. Table E-11 contains the decay chains and the decay emissions.

Table E-11. Decay Chain Emissions

U-238 Decay Chain	Decay Type with Average Beta keV	Th-232 Decay Chain	Decay Type with Average Beta keV	U-235 Decay Chain	Decay Type with Average Beta keV
U-238 ^a	Alpha	Th-232 ^a	Alpha	U-235 ^a	Alpha
Th-234	Beta, 47.9	Ra-228 ^a	Beta, 7.2 ^b	Th-231	Beta, 80
Pa-234	Beta, 811	Ac-228	Beta, 370	Pa-231 ^a	Alpha
U-234 ^a	Alpha	Th-228 ^a	Alpha	Ac-227 ^a	Beta, 9.9 ^b
Th-230 ^a	Alpha	Ra-224	Alpha	Th-227	Alpha
Ra-226 ^a	Alpha	Rn-220	Alpha	Ra-223	Alpha
Rn-222	Alpha	Po-216	Alpha	Rn-219	Alpha
Po-218	Alpha	Pb-212	Beta, 101	Po-215	Alpha
Pb-214	Beta, 224	Bi-212 ^c	64% Beta, 771 36% Alpha	Pb-211	Beta, 445
Bi-214	Beta, 641	64% Po-212 ^c	Alpha	Bi-211	Alpha
Po-214	Alpha	36% Tl-208 ^c	Beta, 560	Tl-207	Beta, 492
Pb-210 ^a	Beta, 6.1 ^b	Pb-208	STABLE	Pb-207	STABLE
Bi-210	Beta, 389				
Po-210	Alpha				
Pb-206	STABLE				

^a Long-lived parent radionuclide, which has an RG.

^b Energy is below the 25 keV threshold to penetrate the 1.2 mg/cm² mylar window of the Ludlum Model 43-89.

^c This decay branch effectively produces one alpha and one beta emission from the decay chain of Bi-212 to Pb-208.

The alpha and beta portions of the AFs are calculated for each long-lived radionuclide based upon the alpha and beta ratios of the parent radionuclide plus decay chain isotopes assumed to be in secular equilibrium. As an example, the following equation is used to calculate the alpha portion of the AF for Ac-227 for the SLDS.

$$\text{Alpha Portion of } AF_{Ac-227} = AF_{Ac-227} * \frac{\#Emissions_{Ac-227}^{Alpha}}{\#Emissions_{Ac-227}^{Alpha+Beta}} = 0.0173 * \frac{5}{8} = 0.0108$$

The alpha portions of each radionuclide are summed to obtain the total alpha portion of the AF; the equivalent summation provides the total beta portion of the AF. Table E-12 contains the values associated with these calculations for the SLDS. From the results in Table E-12, the alpha portion of the AF is approximately 70 percent of the AF.

Table E-12. Alpha Activity Fractions and Beta Activity Fractions

Radionuclide	Ac-227	Pa-231	Pb-210	Ra-226	Ra-228	Th-228	Th-230	Th-232	U-234	U-235	U-238
AF	0.0173	0.0171	0.1012	0.0779	0.0087	0.009	0.1932	0.0085	0.2771	0.0129	0.2771
Number of Alpha Emissions	5	1	1	4	0	5	1	1	1	1	1
Number of Beta Emissions	3	0	2	2	2	2	0	0	0	1	2
Total Number of Emissions	8	1	3	6	2	7	1	1	1	2	3
Alpha Portion of AF	0.0108	0.0171	0.0336	0.0517	0.0000	0.0064	0.1926	0.0085	0.2763	0.0079	0.0921
Total Alpha Portion of AF	0.697										
Beta Portion of AF	0.0065	0	0.0673	0.0259	0.0086	0.0025	0	0	0	0.0079	0.1842
Total Beta Portion of AF	0.303										

The total alpha surrogate DCGL is calculated by multiplying the total alpha portion of the AF by the total surrogate DCGL, which results in a total alpha surrogate DCGL of 12,591 dpm/100 cm² as shown in the following equation for the SLDS properties. For the purposes of implementation and as a health-conservative measure, the value is rounded down to 8,700 dpm/100 cm² for use as the alpha surrogate DCGL for structures on all SLDS properties.

$$\begin{aligned}
 \text{Total Activity DCGL}_{(\text{Alpha})} &= \text{Total Alpha Portion of AF} * \text{Activity DCGL}_{(\text{Total})} = 0.697 * 12,591 \\
 &= 8,776 \text{ dpm}/100 \text{ cm}^2
 \end{aligned}$$

A total beta surrogate DCGL can be developed using the same approach that was used in developing the total alpha surrogate DCGL. Because the DCGLs are based upon regulatory release criteria that exclude exposure to background radiation, and a wide variability in background beta activity for structural materials exists, substantial effort to establish reliable background beta activity values for each type of structural material being evaluated is required. Additionally, meeting the total alpha surrogate DCGL will ensure that beta activity remains within the release criterion because of the consistent contaminant ratio at the SLDS (i.e., meeting the 8,700 dpm/100 cm² alpha surrogate DCGL ensures the total activity DCGL of 12,591 dpm/100 cm² is not exceeded).

CONCLUSION

The health-conservative total alpha surrogate DCGL of 8,700 dpm/100 cm² calculated using PDI data to enable field evaluation of structure surfaces for all SLDS properties ensures the total activity DCGL is not exceeded and meets unrestricted use criteria for the suburban resident receptor based on the selected release criteria. A total beta DCGL was not developed because the health-conservative total alpha surrogate DCGL ensures beta activity remains within the release criterion for the consistent contaminant ratio at the SLDS. Additionally, the wide variability in background beta activity of structural materials precludes a reliable use of the beta DCGL without substantial effort in finding similar non-impacted structural materials to establish effective material background beta activity values. Nonetheless, a total beta DCGL based on other references may be selected with USACE concurrence as a conservative measure.

ATTACHMENT E-1
RESRAD-BUILD OUTPUT FILES

THIS PAGE INTENTIONALLY LEFT BLANK

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 09:03:03 Page: 1 **
Title : SLDS DCGL Industrial Worker
Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld

RESRAD-BUILD Table of Contents	

RESRAD-BUILD Input Parameters.....	2
Building Information.....	3
Source Information.....	4
Temporal Dose Summary.....	7
For time = 0.00E+00 yr	
Receptor-Source Dose Summary.....	8
Dose by Pathway Detail.....	9
Dose by Nuclide Detail.....	10
For time = 1.00E+00 yr	
Receptor-Source Dose Summary.....	14
Dose by Pathway Detail.....	15
Dose by Nuclide Detail.....	16
For time = 3.00E+00 yr	
Receptor-Source Dose Summary.....	20
Dose by Pathway Detail.....	21
Dose by Nuclide Detail.....	22
For time = 1.00E+01 yr	
Receptor-Source Dose Summary.....	26
Dose by Pathway Detail.....	27
Dose by Nuclide Detail.....	28
For time = 2.00E+01 yr	
Receptor-Source Dose Summary.....	32
Dose by Pathway Detail.....	33
Dose by Nuclide Detail.....	34
For time = 3.00E+01 yr	
Receptor-Source Dose Summary.....	38
Dose by Pathway Detail.....	39
Dose by Nuclide Detail.....	40
For time = 1.00E+02 yr	
Receptor-Source Dose Summary.....	44
Dose by Pathway Detail.....	45
Dose by Nuclide Detail.....	46
For time = 3.00E+02 yr	
Receptor-Source Dose Summary.....	50
Dose by Pathway Detail.....	51
Dose by Nuclide Detail.....	52
For time = 1.00E+03 yr	
Receptor-Source Dose Summary.....	56
Dose by Pathway Detail.....	57
Dose by Nuclide Detail.....	58

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 09:03:03 Page: 2 **
 Title : SLDS DCGL Industrial Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld

```

=====
=====
=====
RESRAD-BUILD Input Parameters
=====
=====
=====
    
```

```

Number of Sources : 5
Number of Receptors: 1
Total Time : 3.650000E+02 days
Fraction Inside : 2.300000E-01
    
```

```

Transformations data from: ICRP107
Cut off half life : 180.000000 days
Library information in the Dose Coefficients and Slope Factors report
    
```

```

===== Receptor Information =====
Receptor Room x y z FracTime Inhalation Ingestion(Dust)
           [m] [m] [m] [m3/day] [m2/hr]
1         1 5.000 5.000 1.000 1.000 3.36E+01 1.00E-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

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 09:03:03 Page: 3 **
Title : SLDS DCGL Industrial Worker
Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld

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

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

Height[m]	Air Exchanges [m3/hr]	
Area [m2]	*****	
	*	*
	*	*
	*	<=Q01: 0.00E+00
H1: 2.500	Room 1	Q10 : 0.00E+00
	LAMBDA: 0.00E+00	*
Area 100.000	*	*
	*	*

Deposition velocity: 3.90E-04 [m/s] Resuspension Rate: 0.00E+00 [1/s]
Deposition velocity: 5.00E-07 [m/s] Resuspension Rate:

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 09:03:03 Page: 4 **
 Title : SLDS DCGL Industrial Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld

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

Source: 1

Location:: Room : 1 x: 5.00 y: 5.00 z: 0.00[m]
 Geometry:: Type: Area Length[m]:1.00E+01 Width[m]:1.00E+01 Direction: z
 Pathway ::
 Direct Ingestion Rate: 0.000E+00 [1/hr]
 Fraction released to air: 7.000E-02
 Removable fraction: 1.000E-01
 Time to Remove: 1.000E+04 [day]

Radon Release Fraction: 1.000E-01

Contamination::

Nuclide Concentration

	[dpm/m2]
Ac-227	1.000E+00
Pa-231	1.000E+00
Pb-210	1.000E+00
Ra-226	1.000E+00
Ra-228	1.000E+00
Th-228	1.000E+00
Th-230	1.000E+00
Th-232	1.000E+00
U-234	1.000E+00
U-235	1.000E+00
U-238	1.000E+00

Source: 2

Location:: Room : 1 x: 10.00 y: 5.00 z: 1.00[m]
 Geometry:: Type: Area Length[m]:1.00E+01 Width[m]:2.00E+00 Direction: x
 Pathway ::
 Direct Ingestion Rate: 0.000E+00 [1/hr]
 Fraction released to air: 7.000E-02
 Removable fraction: 1.000E-01
 Time to Remove: 1.000E+04 [day]

Radon Release Fraction: 1.000E-01

Contamination::

Nuclide Concentration

	[dpm/m2]
Ac-227	1.000E+00
Pa-231	1.000E+00
Pb-210	1.000E+00
Ra-226	1.000E+00
Ra-228	1.000E+00
Th-228	1.000E+00
Th-230	1.000E+00
Th-232	1.000E+00
U-234	1.000E+00
U-235	1.000E+00
U-238	1.000E+00

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 09:03:03 Page: 5 **

Title : SLDS DCGL Industrial Worker

Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld

Source: 3

Location:: Room : 1 x: 5.00 y: 10.00 z: 1.00[m]
Geometry:: Type: Area Length[m]:1.00E+01 Width[m]:2.00E+00 Direction: y
Pathway ::
Direct Ingestion Rate: 0.000E+00 [1/hr]
Fraction released to air: 7.000E-02
Removable fraction: 1.000E-01
Time to Remove: 1.000E+04 [day]

Radon Release Fraction: 1.000E-01

Contamination::

Nuclide Concentration

	[dpm/m2]
Ac-227	1.000E+00
Pa-231	1.000E+00
Pb-210	1.000E+00
Ra-226	1.000E+00
Ra-228	1.000E+00
Th-228	1.000E+00
Th-230	1.000E+00
Th-232	1.000E+00
U-234	1.000E+00
U-235	1.000E+00
U-238	1.000E+00

Source: 4

Location:: Room : 1 x: 0.00 y: 5.00 z: 1.00[m]
Geometry:: Type: Area Length[m]:1.00E+01 Width[m]:2.00E+00 Direction: x
Pathway ::
Direct Ingestion Rate: 0.000E+00 [1/hr]
Fraction released to air: 7.000E-02
Removable fraction: 1.000E-01
Time to Remove: 1.000E+04 [day]

Radon Release Fraction: 1.000E-01

Contamination::

Nuclide Concentration

	[dpm/m2]
Ac-227	1.000E+00
Pa-231	1.000E+00
Pb-210	1.000E+00
Ra-226	1.000E+00
Ra-228	1.000E+00
Th-228	1.000E+00
Th-230	1.000E+00
Th-232	1.000E+00
U-234	1.000E+00
U-235	1.000E+00
U-238	1.000E+00

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 09:03:03 Page: 6 **
Title : SLDS DCGL Industrial Worker
Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld

Source: 5

Location:: Room : 1 x: 5.00 y: 0.00 z: 1.00[m]
Geometry:: Type: Area Length[m]:1.00E+01 Width[m]:2.00E+00 Direction: y
Pathway ::
Direct Ingestion Rate: 0.000E+00 [1/hr]
Fraction released to air: 7.000E-02
Removable fraction: 1.000E-01
Time to Remove: 1.000E+04 [day]

Radon Release Fraction: 1.000E-01

Contamination::

Nuclide Concentration

	[dpm/m2]
Ac-227	1.000E+00
Pa-231	1.000E+00
Pb-210	1.000E+00
Ra-226	1.000E+00
Ra-228	1.000E+00
Th-228	1.000E+00
Th-230	1.000E+00
Th-232	1.000E+00
U-234	1.000E+00
U-235	1.000E+00
U-238	1.000E+00

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 09:03:03 Page: 7 **
 Title : SLDS DCGL Industrial Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld
 Temporal Summary

RESRAD-BUILD Temporal Dose Tables

Dose to Receptor over the Exposure Duration

(mrem)

Evaluation Time years	Receptor 1	Total
0.000000000	3.20E-04	3.20E-04
1.000000000	3.23E-04	3.23E-04
3.000000000	3.21E-04	3.21E-04
10.00000000	3.15E-04	3.15E-04
20.00000000	3.06E-04	3.06E-04
30.00000000	2.11E-04	2.11E-04
100.0000080	2.11E-04	2.11E-04
300.0000310	2.11E-04	2.11E-04
1000.000000	2.11E-04	2.11E-04

RESRAD-BUILD Dose Tables

```
[mrem]
```

	Source 1	Source 2	Source 3	Source 4	Source 5	Total
Receptor 1	1.83E-04	3.40E-05	3.40E-05	3.40E-05	3.40E-05	3.20E-04
Total	1.83E-04	3.40E-05	3.40E-05	3.40E-05	3.40E-05	3.20E-04

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 09:03:03 Page: 9 **
 Title : SLDS DCGL Industrial Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld
 Evaluation Time: 0.00000000E+00 years

Pathway Detail of Doses

[mrem]

Source: 1								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	1.84E-05	4.72E-05	1.88E-10	3.80E-11	1.54E-08	1.18E-04	0.00E+00	1.83E-04
Total	1.84E-05	4.72E-05	1.88E-10	3.80E-11	1.54E-08	1.18E-04	0.00E+00	1.83E-04
Source: 2								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	1.00E-06	9.44E-06	3.75E-11	7.60E-12	3.09E-09	2.36E-05	0.00E+00	3.40E-05
Total	1.00E-06	9.44E-06	3.75E-11	7.60E-12	3.09E-09	2.36E-05	0.00E+00	3.40E-05
Source: 3								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	1.00E-06	9.44E-06	3.75E-11	7.60E-12	3.09E-09	2.36E-05	0.00E+00	3.40E-05
Total	1.00E-06	9.44E-06	3.75E-11	7.60E-12	3.09E-09	2.36E-05	0.00E+00	3.40E-05
Source: 4								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	1.00E-06	9.44E-06	3.75E-11	7.60E-12	3.09E-09	2.36E-05	0.00E+00	3.40E-05
Total	1.00E-06	9.44E-06	3.75E-11	7.60E-12	3.09E-09	2.36E-05	0.00E+00	3.40E-05
Source: 5								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	1.00E-06	9.44E-06	3.75E-11	7.60E-12	3.09E-09	2.36E-05	0.00E+00	3.40E-05
Total	1.00E-06	9.44E-06	3.75E-11	7.60E-12	3.09E-09	2.36E-05	0.00E+00	3.40E-05

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 09:03:03 Page: 10 **
 Title : SLDS DCGL Industrial Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld
 Evaluation Time: 0.00000000E+00 years

Nuclide Detail of Doses

[mrem]

Source: 1

Nuclide	Receptor 1	Total
Ac-227	1.32E-05	1.32E-05
Pa-231	1.53E-05	1.53E-05
Ac-227	2.18E-07	2.18E-07
Pb-210	8.08E-07	8.08E-07
Ra-226	8.61E-06	8.61E-06
Pb-210	1.30E-08	1.30E-08
Ra-228	4.06E-06	4.06E-06
Th-228	1.92E-05	1.92E-05
Th-228	1.04E-04	1.04E-04
Th-230	6.66E-06	6.66E-06
Ra-226	1.87E-09	1.87E-09
Pb-210	1.90E-12	1.90E-12
Th-232	7.21E-06	7.21E-06
Ra-228	2.51E-07	2.51E-07
Th-228	8.03E-07	8.03E-07
U-234	6.23E-07	6.23E-07
Th-230	3.17E-11	3.17E-11
Ra-226	5.72E-15	5.72E-15
Pb-210	4.37E-18	4.37E-18
U-235	1.28E-06	1.28E-06
Pa-231	1.67E-10	1.67E-10
Ac-227	1.55E-12	1.55E-12
U-238	1.02E-06	1.02E-06
U-234	9.10E-13	9.10E-13
Th-230	3.00E-17	3.00E-17
Ra-226	4.94E-21	4.94E-21
Pb-210	7.32E-23	7.32E-23

Source: 2

Nuclide	Receptor 1	Total
Ac-227	2.35E-06	2.35E-06
Pa-231	3.02E-06	3.02E-06
Ac-227	3.89E-08	3.89E-08
Pb-210	1.38E-07	1.38E-07
Ra-226	8.11E-07	8.11E-07
Pb-210	2.24E-09	2.24E-09

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 09:03:03 Page: 11 **
Title : SLDS DCGL Industrial Worker
Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld
Evaluation Time: 0.0000000E+00 years

Ra-228	3.68E-07	3.68E-07
Th-228	3.73E-06	3.73E-06
Th-228	2.02E-05	2.02E-05
Th-230	1.33E-06	1.33E-06
Ra-226	1.76E-10	1.76E-10
Pb-210	3.27E-13	3.27E-13
Th-232	1.44E-06	1.44E-06
Ra-228	2.31E-08	2.31E-08
Th-228	1.56E-07	1.56E-07
U-234	1.23E-07	1.23E-07
Th-230	6.34E-12	6.34E-12
Ra-226	5.41E-16	5.41E-16
Pb-210	7.53E-19	7.53E-19
U-235	1.44E-07	1.44E-07
Pa-231	3.31E-11	3.31E-11
Ac-227	2.77E-13	2.77E-13
U-238	1.32E-07	1.32E-07
U-234	1.80E-13	1.80E-13
Th-230	6.00E-18	6.00E-18
Ra-226	2.90E-22	2.90E-22
Pb-210	1.76E-24	1.76E-24

Source: 3

Nuclide	Receptor	Total
	1	
Ac-227	2.35E-06	2.35E-06
Pa-231	3.02E-06	3.02E-06
Ac-227	3.89E-08	3.89E-08
Pb-210	1.38E-07	1.38E-07
Ra-226	8.11E-07	8.11E-07
Pb-210	2.24E-09	2.24E-09
Ra-228	3.68E-07	3.68E-07
Th-228	3.73E-06	3.73E-06
Th-228	2.02E-05	2.02E-05
Th-230	1.33E-06	1.33E-06
Ra-226	1.76E-10	1.76E-10
Pb-210	3.27E-13	3.27E-13
Th-232	1.44E-06	1.44E-06
Ra-228	2.31E-08	2.31E-08
Th-228	1.56E-07	1.56E-07
U-234	1.23E-07	1.23E-07
Th-230	6.34E-12	6.34E-12
Ra-226	5.41E-16	5.41E-16
Pb-210	7.53E-19	7.53E-19
U-235	1.44E-07	1.44E-07
Pa-231	3.31E-11	3.31E-11
Ac-227	2.77E-13	2.77E-13
U-238	1.32E-07	1.32E-07
U-234	1.80E-13	1.80E-13

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 09:03:03 Page: 12 **
 Title : SLDS DCGL Industrial Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld
 Evaluation Time: 0.00000000E+00 years

Th-230	6.00E-18	6.00E-18
Ra-226	2.90E-22	2.90E-22
Pb-210	1.76E-24	1.76E-24

Source: 4

Nuclide	Receptor	Total
	1	
Ac-227	2.35E-06	2.35E-06
Pa-231	3.02E-06	3.02E-06
Ac-227	3.89E-08	3.89E-08
Pb-210	1.38E-07	1.38E-07
Ra-226	8.11E-07	8.11E-07
Pb-210	2.24E-09	2.24E-09
Ra-228	3.68E-07	3.68E-07
Th-228	3.73E-06	3.73E-06
Th-228	2.02E-05	2.02E-05
Th-230	1.33E-06	1.33E-06
Ra-226	1.76E-10	1.76E-10
Pb-210	3.27E-13	3.27E-13
Th-232	1.44E-06	1.44E-06
Ra-228	2.31E-08	2.31E-08
Th-228	1.56E-07	1.56E-07
U-234	1.23E-07	1.23E-07
Th-230	6.34E-12	6.34E-12
Ra-226	5.41E-16	5.41E-16
Pb-210	7.53E-19	7.53E-19
U-235	1.44E-07	1.44E-07
Pa-231	3.31E-11	3.31E-11
Ac-227	2.77E-13	2.77E-13
U-238	1.32E-07	1.32E-07
U-234	1.80E-13	1.80E-13
Th-230	6.00E-18	6.00E-18
Ra-226	2.90E-22	2.90E-22
Pb-210	1.76E-24	1.76E-24

Source: 5

Nuclide	Receptor	Total
	1	
Ac-227	2.35E-06	2.35E-06
Pa-231	3.02E-06	3.02E-06
Ac-227	3.89E-08	3.89E-08
Pb-210	1.38E-07	1.38E-07
Ra-226	8.11E-07	8.11E-07

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 09:03:03 Page: 13 **
Title : SLDS DCGL Industrial Worker
Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld
Evaluation Time: 0.00000000E+00 years

Pb-210	2.24E-09	2.24E-09
Ra-228	3.68E-07	3.68E-07
Th-228	3.73E-06	3.73E-06
Th-228	2.02E-05	2.02E-05
Th-230	1.33E-06	1.33E-06
Ra-226	1.76E-10	1.76E-10
Pb-210	3.27E-13	3.27E-13
Th-232	1.44E-06	1.44E-06
Ra-228	2.31E-08	2.31E-08
Th-228	1.56E-07	1.56E-07
U-234	1.23E-07	1.23E-07
Th-230	6.34E-12	6.34E-12
Ra-226	5.41E-16	5.41E-16
Pb-210	7.53E-19	7.53E-19
U-235	1.44E-07	1.44E-07
Pa-231	3.31E-11	3.31E-11
Ac-227	2.77E-13	2.77E-13
U-238	1.32E-07	1.32E-07
U-234	1.80E-13	1.80E-13
Th-230	6.00E-18	6.00E-18
Ra-226	2.90E-22	2.90E-22
Pb-210	1.76E-24	1.76E-24

RESRAD-BUILD Dose Tables

```
[mrem]
```

	Source 1	Source 2	Source 3	Source 4	Source 5	Total
Receptor 1	1.85E-04	3.44E-05	3.44E-05	3.44E-05	3.44E-05	3.23E-04
Total	1.85E-04	3.44E-05	3.44E-05	3.44E-05	3.44E-05	3.23E-04

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 09:03:03 Page: 15 **
 Title : SLDS DCGL Industrial Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld
 Evaluation Time: 1.00000000 years

Pathway Detail of Doses

[mrem]

Source: 1	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	1.83E-05	4.94E-05	2.10E-10	3.98E-11	1.73E-08	1.17E-04	0.00E+00	1.85E-04
Total	1.83E-05	4.94E-05	2.10E-10	3.98E-11	1.73E-08	1.17E-04	0.00E+00	1.85E-04

Source: 2	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	9.99E-07	9.88E-06	4.21E-11	7.95E-12	3.46E-09	2.35E-05	0.00E+00	3.44E-05
Total	9.99E-07	9.88E-06	4.21E-11	7.95E-12	3.46E-09	2.35E-05	0.00E+00	3.44E-05

Source: 3	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	9.99E-07	9.88E-06	4.21E-11	7.95E-12	3.46E-09	2.35E-05	0.00E+00	3.44E-05
Total	9.99E-07	9.88E-06	4.21E-11	7.95E-12	3.46E-09	2.35E-05	0.00E+00	3.44E-05

Source: 4	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	9.99E-07	9.88E-06	4.21E-11	7.95E-12	3.46E-09	2.35E-05	0.00E+00	3.44E-05
Total	9.99E-07	9.88E-06	4.21E-11	7.95E-12	3.46E-09	2.35E-05	0.00E+00	3.44E-05

Source: 5	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	9.99E-07	9.88E-06	4.21E-11	7.95E-12	3.46E-09	2.35E-05	0.00E+00	3.44E-05
Total	9.99E-07	9.88E-06	4.21E-11	7.95E-12	3.46E-09	2.35E-05	0.00E+00	3.44E-05

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 09:03:03 Page: 16 **
 Title : SLDS DCGL Industrial Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld
 Evaluation Time: 1.00000000 years

Nuclide Detail of Doses

[mrem]

Source: 1

Nuclide	Receptor 1	Total
Ac-227	1.33E-05	1.33E-05
Pa-231	1.60E-05	1.60E-05
Ac-227	6.51E-07	6.51E-07
Pb-210	8.13E-07	8.13E-07
Ra-226	8.61E-06	8.61E-06
Pb-210	3.89E-08	3.89E-08
Ra-228	3.63E-06	3.63E-06
Th-228	4.67E-05	4.67E-05
Th-228	7.23E-05	7.23E-05
Th-230	6.97E-06	6.97E-06
Ra-226	5.59E-09	5.59E-09
Pb-210	1.32E-11	1.32E-11
Th-232	7.55E-06	7.55E-06
Ra-228	7.16E-07	7.16E-07
Th-228	4.92E-06	4.92E-06
U-234	6.51E-07	6.51E-07
Th-230	9.61E-11	9.61E-11
Ra-226	4.00E-14	4.00E-14
Pb-210	6.53E-17	6.53E-17
U-235	1.30E-06	1.30E-06
Pa-231	5.07E-10	5.07E-10
Ac-227	1.08E-11	1.08E-11
U-238	1.04E-06	1.04E-06
U-234	2.76E-12	2.76E-12
Th-230	2.11E-16	2.11E-16
Ra-226	6.10E-20	6.10E-20
Pb-210	1.04E-22	1.04E-22

Source: 2

Nuclide	Receptor 1	Total
Ac-227	2.38E-06	2.38E-06
Pa-231	3.16E-06	3.16E-06
Ac-227	1.16E-07	1.16E-07
Pb-210	1.40E-07	1.40E-07
Ra-226	8.14E-07	8.14E-07
Pb-210	6.71E-09	6.71E-09

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 09:03:03 Page: 17 **
 Title : SLDS DCGL Industrial Worker
 Input File : C:\RESRAD Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld
 Evaluation Time: 1.00000000 years

Ra-228	3.34E-07	3.34E-07
Th-228	9.05E-06	9.05E-06
Th-228	1.40E-05	1.40E-05
Th-230	1.39E-06	1.39E-06
Ra-226	5.29E-10	5.29E-10
Pb-210	2.28E-12	2.28E-12
Th-232	1.51E-06	1.51E-06
Ra-228	6.60E-08	6.60E-08
Th-228	9.54E-07	9.54E-07
U-234	1.29E-07	1.29E-07
Th-230	1.92E-11	1.92E-11
Ra-226	3.78E-15	3.78E-15
Pb-210	1.13E-17	1.13E-17
U-235	1.49E-07	1.49E-07
Pa-231	1.00E-10	1.00E-10
Ac-227	1.93E-12	1.93E-12
U-238	1.37E-07	1.37E-07
U-234	5.46E-13	5.46E-13
Th-230	4.22E-17	4.22E-17
Ra-226	5.58E-21	5.58E-21
Pb-210	2.79E-23	2.79E-23

Source: 3

Nuclide	Receptor 1	Total
Ac-227	2.38E-06	2.38E-06
Pa-231	3.16E-06	3.16E-06
Ac-227	1.16E-07	1.16E-07
Pb-210	1.40E-07	1.40E-07
Ra-226	8.14E-07	8.14E-07
Pb-210	6.71E-09	6.71E-09
Ra-228	3.34E-07	3.34E-07
Th-228	9.05E-06	9.05E-06
Th-228	1.40E-05	1.40E-05
Th-230	1.39E-06	1.39E-06
Ra-226	5.29E-10	5.29E-10
Pb-210	2.28E-12	2.28E-12
Th-232	1.51E-06	1.51E-06
Ra-228	6.60E-08	6.60E-08
Th-228	9.54E-07	9.54E-07
U-234	1.29E-07	1.29E-07
Th-230	1.92E-11	1.92E-11
Ra-226	3.78E-15	3.78E-15
Pb-210	1.13E-17	1.13E-17
U-235	1.49E-07	1.49E-07
Pa-231	1.00E-10	1.00E-10
Ac-227	1.93E-12	1.93E-12
U-238	1.37E-07	1.37E-07
U-234	5.46E-13	5.46E-13

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 09:03:03 Page: 18 **
 Title : SLDS DCGL Industrial Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld
 Evaluation Time: 1.00000000 years

Th-230	4.22E-17	4.22E-17
Ra-226	5.58E-21	5.58E-21
Pb-210	2.79E-23	2.79E-23

Source: 4

Nuclide	Receptor 1	Total
Ac-227	2.38E-06	2.38E-06
Pa-231	3.16E-06	3.16E-06
Ac-227	1.16E-07	1.16E-07
Pb-210	1.40E-07	1.40E-07
Ra-226	8.14E-07	8.14E-07
Pb-210	6.71E-09	6.71E-09
Ra-228	3.34E-07	3.34E-07
Th-228	9.05E-06	9.05E-06
Th-228	1.40E-05	1.40E-05
Th-230	1.39E-06	1.39E-06
Ra-226	5.29E-10	5.29E-10
Pb-210	2.28E-12	2.28E-12
Th-232	1.51E-06	1.51E-06
Ra-228	6.60E-08	6.60E-08
Th-228	9.54E-07	9.54E-07
U-234	1.29E-07	1.29E-07
Th-230	1.92E-11	1.92E-11
Ra-226	3.78E-15	3.78E-15
Pb-210	1.13E-17	1.13E-17
U-235	1.49E-07	1.49E-07
Pa-231	1.00E-10	1.00E-10
Ac-227	1.93E-12	1.93E-12
U-238	1.37E-07	1.37E-07
U-234	5.46E-13	5.46E-13
Th-230	4.22E-17	4.22E-17
Ra-226	5.58E-21	5.58E-21
Pb-210	2.79E-23	2.79E-23

Source: 5

Nuclide	Receptor 1	Total
Ac-227	2.38E-06	2.38E-06
Pa-231	3.16E-06	3.16E-06
Ac-227	1.16E-07	1.16E-07
Pb-210	1.40E-07	1.40E-07
Ra-226	8.14E-07	8.14E-07

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 09:03:03 Page: 19 **
Title : SLDS DCGL Industrial Worker
Input File : C:\RESRAD Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld
Evaluation Time: 1.00000000 years

Pb-210	6.71E-09	6.71E-09
Ra-228	3.34E-07	3.34E-07
Th-228	9.05E-06	9.05E-06
Th-228	1.40E-05	1.40E-05
Th-230	1.39E-06	1.39E-06
Ra-226	5.29E-10	5.29E-10
Pb-210	2.28E-12	2.28E-12
Th-232	1.51E-06	1.51E-06
Ra-228	6.60E-08	6.60E-08
Th-228	9.54E-07	9.54E-07
U-234	1.29E-07	1.29E-07
Th-230	1.92E-11	1.92E-11
Ra-226	3.78E-15	3.78E-15
Pb-210	1.13E-17	1.13E-17
U-235	1.49E-07	1.49E-07
Pa-231	1.00E-10	1.00E-10
Ac-227	1.93E-12	1.93E-12
U-238	1.37E-07	1.37E-07
U-234	5.46E-13	5.46E-13
Th-230	4.22E-17	4.22E-17
Ra-226	5.58E-21	5.58E-21
Pb-210	2.79E-23	2.79E-23

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 09:03:03 Page: 20 **
 Title : SLDS DCGL Industrial Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld
 Evaluation Time: 3.00000000 years

RESRAD-BUILD Dose Tables

Source Contributions to Receptor Doses

[mrem]						
	Source 1	Source 2	Source 3	Source 4	Source 5	Total
Receptor 1	1.84E-04	3.42E-05	3.42E-05	3.42E-05	3.42E-05	3.21E-04
Total	1.84E-04	3.42E-05	3.42E-05	3.42E-05	3.42E-05	3.21E-04

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 09:03:03 Page: 21 **

Title : SLDS DCGL Industrial Worker

Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld

Evaluation Time: 3.00000000 years

Pathway Detail of Doses

[mrem]

Source: 1	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	1.82E-05	4.94E-05	2.10E-10	3.98E-11	1.73E-08	1.17E-04	0.00E+00	1.84E-04
Total	1.82E-05	4.94E-05	2.10E-10	3.98E-11	1.73E-08	1.17E-04	0.00E+00	1.84E-04

Source: 2	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	9.91E-07	9.88E-06	4.21E-11	7.95E-12	3.46E-09	2.33E-05	0.00E+00	3.42E-05
Total	9.91E-07	9.88E-06	4.21E-11	7.95E-12	3.46E-09	2.33E-05	0.00E+00	3.42E-05

Source: 3	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	9.91E-07	9.88E-06	4.21E-11	7.95E-12	3.46E-09	2.33E-05	0.00E+00	3.42E-05
Total	9.91E-07	9.88E-06	4.21E-11	7.95E-12	3.46E-09	2.33E-05	0.00E+00	3.42E-05

Source: 4	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	9.91E-07	9.88E-06	4.21E-11	7.95E-12	3.46E-09	2.33E-05	0.00E+00	3.42E-05
Total	9.91E-07	9.88E-06	4.21E-11	7.95E-12	3.46E-09	2.33E-05	0.00E+00	3.42E-05

Source: 5	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	9.91E-07	9.88E-06	4.21E-11	7.95E-12	3.46E-09	2.33E-05	0.00E+00	3.42E-05
Total	9.91E-07	9.88E-06	4.21E-11	7.95E-12	3.46E-09	2.33E-05	0.00E+00	3.42E-05

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 09:03:03 Page: 22 **
 Title : SLDS DCGL Industrial Worker
 Input File : C:\RESRAD Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld
 Evaluation Time: 3.00000000 years

Nuclide Detail of Doses

[mrem]

Source: 1

Nuclide	Receptor 1	Total
Ac-227	1.25E-05	1.25E-05
Pa-231	1.60E-05	1.60E-05
Ac-227	1.47E-06	1.47E-06
Pb-210	7.62E-07	7.62E-07
Ra-226	8.54E-06	8.54E-06
Pb-210	8.79E-08	8.79E-08
Ra-228	2.84E-06	2.84E-06
Th-228	6.88E-05	6.88E-05
Th-228	3.48E-05	3.48E-05
Th-230	6.97E-06	6.97E-06
Ra-226	1.30E-08	1.30E-08
Pb-210	6.83E-11	6.83E-11
Th-232	7.55E-06	7.55E-06
Ra-228	1.49E-06	1.49E-06
Th-228	1.94E-05	1.94E-05
U-234	6.51E-07	6.51E-07
Th-230	2.24E-10	2.24E-10
Ra-226	2.10E-13	2.10E-13
Pb-210	7.50E-16	7.50E-16
U-235	1.29E-06	1.29E-06
Pa-231	1.18E-09	1.18E-09
Ac-227	5.58E-11	5.58E-11
U-238	1.03E-06	1.03E-06
U-234	6.44E-12	6.44E-12
Th-230	1.12E-15	1.12E-15
Ra-226	7.01E-19	7.01E-19
Pb-210	1.96E-21	1.96E-21

Source: 2

Nuclide	Receptor 1	Total
Ac-227	2.23E-06	2.23E-06
Pa-231	3.16E-06	3.16E-06
Ac-227	2.63E-07	2.63E-07
Pb-210	1.32E-07	1.32E-07
Ra-226	8.08E-07	8.08E-07
Pb-210	1.52E-08	1.52E-08

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 09:03:03 Page: 23 **

Title : SLDS DCGL Industrial Worker

Input File : C:\RESRAD Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld

Evaluation Time: 3.00000000 years

Ra-228	2.62E-07	2.62E-07
Th-228	1.34E-05	1.34E-05
Th-228	6.75E-06	6.75E-06
Th-230	1.39E-06	1.39E-06
Ra-226	1.23E-09	1.23E-09
Pb-210	1.18E-11	1.18E-11
Th-232	1.51E-06	1.51E-06
Ra-228	1.37E-07	1.37E-07
Th-228	3.77E-06	3.77E-06
U-234	1.29E-07	1.29E-07
Th-230	4.48E-11	4.48E-11
Ra-226	1.99E-14	1.99E-14
Pb-210	1.29E-16	1.29E-16
U-235	1.48E-07	1.48E-07
Pa-231	2.34E-10	2.34E-10
Ac-227	9.99E-12	9.99E-12
U-238	1.36E-07	1.36E-07
U-234	1.28E-12	1.28E-12
Th-230	2.23E-16	2.23E-16
Ra-226	6.62E-20	6.62E-20
Pb-210	3.21E-22	3.21E-22

Source: 3

Nuclide	Receptor 1	Total
Ac-227	2.23E-06	2.23E-06
Pa-231	3.16E-06	3.16E-06
Ac-227	2.63E-07	2.63E-07
Pb-210	1.32E-07	1.32E-07
Ra-226	8.08E-07	8.08E-07
Pb-210	1.52E-08	1.52E-08
Ra-228	2.62E-07	2.62E-07
Th-228	1.34E-05	1.34E-05
Th-228	6.75E-06	6.75E-06
Th-230	1.39E-06	1.39E-06
Ra-226	1.23E-09	1.23E-09
Pb-210	1.18E-11	1.18E-11
Th-232	1.51E-06	1.51E-06
Ra-228	1.37E-07	1.37E-07
Th-228	3.77E-06	3.77E-06
U-234	1.29E-07	1.29E-07
Th-230	4.48E-11	4.48E-11
Ra-226	1.99E-14	1.99E-14
Pb-210	1.29E-16	1.29E-16
U-235	1.48E-07	1.48E-07
Pa-231	2.34E-10	2.34E-10
Ac-227	9.99E-12	9.99E-12
U-238	1.36E-07	1.36E-07
U-234	1.28E-12	1.28E-12

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 09:03:03 Page: 24 **
 Title : SLDS DCGL Industrial Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld
 Evaluation Time: 3.00000000 years

Th-230	2.23E-16	2.23E-16
Ra-226	6.62E-20	6.62E-20
Pb-210	3.21E-22	3.21E-22

Source: 4

Nuclide	Receptor	Total
	1	
Ac-227	2.23E-06	2.23E-06
Pa-231	3.16E-06	3.16E-06
Ac-227	2.63E-07	2.63E-07
Pb-210	1.32E-07	1.32E-07
Ra-226	8.08E-07	8.08E-07
Pb-210	1.52E-08	1.52E-08
Ra-228	2.62E-07	2.62E-07
Th-228	1.34E-05	1.34E-05
Th-228	6.75E-06	6.75E-06
Th-230	1.39E-06	1.39E-06
Ra-226	1.23E-09	1.23E-09
Pb-210	1.18E-11	1.18E-11
Th-232	1.51E-06	1.51E-06
Ra-228	1.37E-07	1.37E-07
Th-228	3.77E-06	3.77E-06
U-234	1.29E-07	1.29E-07
Th-230	4.48E-11	4.48E-11
Ra-226	1.99E-14	1.99E-14
Pb-210	1.29E-16	1.29E-16
U-235	1.48E-07	1.48E-07
Pa-231	2.34E-10	2.34E-10
Ac-227	9.99E-12	9.99E-12
U-238	1.36E-07	1.36E-07
U-234	1.28E-12	1.28E-12
Th-230	2.23E-16	2.23E-16
Ra-226	6.62E-20	6.62E-20
Pb-210	3.21E-22	3.21E-22

Source: 5

Nuclide	Receptor	Total
	1	
Ac-227	2.23E-06	2.23E-06
Pa-231	3.16E-06	3.16E-06
Ac-227	2.63E-07	2.63E-07
Pb-210	1.32E-07	1.32E-07
Ra-226	8.08E-07	8.08E-07

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 09:03:03 Page: 25 **
Title : SLDS DCGL Industrial Worker
Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld
Evaluation Time: 3.00000000 years

Pb-210	1.52E-08	1.52E-08
Ra-228	2.62E-07	2.62E-07
Th-228	1.34E-05	1.34E-05
Th-228	6.75E-06	6.75E-06
Th-230	1.39E-06	1.39E-06
Ra-226	1.23E-09	1.23E-09
Pb-210	1.18E-11	1.18E-11
Th-232	1.51E-06	1.51E-06
Ra-228	1.37E-07	1.37E-07
Th-228	3.77E-06	3.77E-06
U-234	1.29E-07	1.29E-07
Th-230	4.48E-11	4.48E-11
Ra-226	1.99E-14	1.99E-14
Pb-210	1.29E-16	1.29E-16
U-235	1.48E-07	1.48E-07
Pa-231	2.34E-10	2.34E-10
Ac-227	9.99E-12	9.99E-12
U-238	1.36E-07	1.36E-07
U-234	1.28E-12	1.28E-12
Th-230	2.23E-16	2.23E-16
Ra-226	6.62E-20	6.62E-20
Pb-210	3.21E-22	3.21E-22

RESRAD-BUILD Dose Tables

```
[mrem]
```

	Source 1	Source 2	Source 3	Source 4	Source 5	Total
Receptor 1	1.81E-04	3.36E-05	3.36E-05	3.36E-05	3.36E-05	3.15E-04
Total	1.81E-04	3.36E-05	3.36E-05	3.36E-05	3.36E-05	3.15E-04

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 09:03:03 Page: 27 **

Title : SLDS DCGL Industrial Worker

Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld

Evaluation Time: 10.0000000 years

Pathway Detail of Doses

[mrem]

Source: 1	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	1.77E-05	4.94E-05	2.10E-10	3.98E-11	1.73E-08	1.14E-04	0.00E+00	1.81E-04
Total	1.77E-05	4.94E-05	2.10E-10	3.98E-11	1.73E-08	1.14E-04	0.00E+00	1.81E-04
Source: 2	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	9.66E-07	9.88E-06	4.21E-11	7.95E-12	3.46E-09	2.27E-05	0.00E+00	3.36E-05
Total	9.66E-07	9.88E-06	4.21E-11	7.95E-12	3.46E-09	2.27E-05	0.00E+00	3.36E-05
Source: 3	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	9.66E-07	9.88E-06	4.21E-11	7.95E-12	3.46E-09	2.27E-05	0.00E+00	3.36E-05
Total	9.66E-07	9.88E-06	4.21E-11	7.95E-12	3.46E-09	2.27E-05	0.00E+00	3.36E-05
Source: 4	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	9.66E-07	9.88E-06	4.21E-11	7.95E-12	3.46E-09	2.27E-05	0.00E+00	3.36E-05
Total	9.66E-07	9.88E-06	4.21E-11	7.95E-12	3.46E-09	2.27E-05	0.00E+00	3.36E-05
Source: 5	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	9.66E-07	9.88E-06	4.21E-11	7.95E-12	3.46E-09	2.27E-05	0.00E+00	3.36E-05
Total	9.66E-07	9.88E-06	4.21E-11	7.95E-12	3.46E-09	2.27E-05	0.00E+00	3.36E-05

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 09:03:03 Page: 28 **
 Title : SLDS DCGL Industrial Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld
 Evaluation Time: 10.0000000 years

Nuclide Detail of Doses

[mrem]

Source: 1

Nuclide	Receptor 1	Total
Ac-227	9.95E-06	9.95E-06
Pa-231	1.60E-05	1.60E-05
Ac-227	3.95E-06	3.95E-06
Pb-210	6.10E-07	6.10E-07
Ra-226	8.31E-06	8.31E-06
Pb-210	2.36E-07	2.36E-07
Ra-228	1.20E-06	1.20E-06
Th-228	4.67E-05	4.67E-05
Th-228	2.68E-06	2.68E-06
Th-230	6.97E-06	6.97E-06
Ra-226	3.79E-08	3.79E-08
Pb-210	5.67E-10	5.67E-10
Th-232	7.55E-06	7.55E-06
Ra-228	3.04E-06	3.04E-06
Th-228	7.06E-05	7.06E-05
U-234	6.51E-07	6.51E-07
Th-230	6.73E-10	6.73E-10
Ra-226	1.83E-12	1.83E-12
Pb-210	1.88E-14	1.88E-14
U-235	1.28E-06	1.28E-06
Pa-231	3.55E-09	3.55E-09
Ac-227	4.63E-10	4.63E-10
U-238	1.02E-06	1.02E-06
U-234	1.93E-11	1.93E-11
Th-230	9.98E-15	9.98E-15
Ra-226	1.81E-17	1.81E-17
Pb-210	1.42E-19	1.42E-19

Source: 2

Nuclide	Receptor 1	Total
Ac-227	1.79E-06	1.79E-06
Pa-231	3.16E-06	3.16E-06
Ac-227	7.08E-07	7.08E-07
Pb-210	1.06E-07	1.06E-07
Ra-226	7.88E-07	7.88E-07
Pb-210	4.08E-08	4.08E-08

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 09:03:03 Page: 29 **

Title : SLDS DCGL Industrial Worker
 Input File : C:\RESRAD Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld
 Evaluation Time: 10.0000000 years

Ra-228	1.11E-07	1.11E-07
Th-228	9.06E-06	9.06E-06
Th-228	5.20E-07	5.20E-07
Th-230	1.39E-06	1.39E-06
Ra-226	3.59E-09	3.59E-09
Pb-210	9.81E-11	9.81E-11
Th-232	1.51E-06	1.51E-06
Ra-228	2.83E-07	2.83E-07
Th-228	1.37E-05	1.37E-05
U-234	1.29E-07	1.29E-07
Th-230	1.35E-10	1.35E-10
Ra-226	1.74E-13	1.74E-13
Pb-210	3.25E-15	3.25E-15
U-235	1.48E-07	1.48E-07
Pa-231	7.02E-10	7.02E-10
Ac-227	8.31E-11	8.31E-11
U-238	1.36E-07	1.36E-07
U-234	3.83E-12	3.83E-12
Th-230	2.00E-15	2.00E-15
Ra-226	1.72E-18	1.72E-18
Pb-210	2.46E-20	2.46E-20

Source: 3

Nuclide	Receptor 1	Total
Ac-227	1.79E-06	1.79E-06
Pa-231	3.16E-06	3.16E-06
Ac-227	7.08E-07	7.08E-07
Pb-210	1.06E-07	1.06E-07
Ra-226	7.88E-07	7.88E-07
Pb-210	4.08E-08	4.08E-08
Ra-228	1.11E-07	1.11E-07
Th-228	9.06E-06	9.06E-06
Th-228	5.20E-07	5.20E-07
Th-230	1.39E-06	1.39E-06
Ra-226	3.59E-09	3.59E-09
Pb-210	9.81E-11	9.81E-11
Th-232	1.51E-06	1.51E-06
Ra-228	2.83E-07	2.83E-07
Th-228	1.37E-05	1.37E-05
U-234	1.29E-07	1.29E-07
Th-230	1.35E-10	1.35E-10
Ra-226	1.74E-13	1.74E-13
Pb-210	3.25E-15	3.25E-15
U-235	1.48E-07	1.48E-07
Pa-231	7.02E-10	7.02E-10
Ac-227	8.31E-11	8.31E-11
U-238	1.36E-07	1.36E-07
U-234	3.83E-12	3.83E-12

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 09:03:03 Page: 30 **
 Title : SLDS DCGL Industrial Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld
 Evaluation Time: 10.0000000 years

Th-230	2.00E-15	2.00E-15
Ra-226	1.72E-18	1.72E-18
Pb-210	2.46E-20	2.46E-20

Source: 4

Nuclide	Receptor 1	Total
Ac-227	1.79E-06	1.79E-06
Pa-231	3.16E-06	3.16E-06
Ac-227	7.08E-07	7.08E-07
Pb-210	1.06E-07	1.06E-07
Ra-226	7.88E-07	7.88E-07
Pb-210	4.08E-08	4.08E-08
Ra-228	1.11E-07	1.11E-07
Th-228	9.06E-06	9.06E-06
Th-228	5.20E-07	5.20E-07
Th-230	1.39E-06	1.39E-06
Ra-226	3.59E-09	3.59E-09
Pb-210	9.81E-11	9.81E-11
Th-232	1.51E-06	1.51E-06
Ra-228	2.83E-07	2.83E-07
Th-228	1.37E-05	1.37E-05
U-234	1.29E-07	1.29E-07
Th-230	1.35E-10	1.35E-10
Ra-226	1.74E-13	1.74E-13
Pb-210	3.25E-15	3.25E-15
U-235	1.48E-07	1.48E-07
Pa-231	7.02E-10	7.02E-10
Ac-227	8.31E-11	8.31E-11
U-238	1.36E-07	1.36E-07
U-234	3.83E-12	3.83E-12
Th-230	2.00E-15	2.00E-15
Ra-226	1.72E-18	1.72E-18
Pb-210	2.46E-20	2.46E-20

Source: 5

Nuclide	Receptor 1	Total
Ac-227	1.79E-06	1.79E-06
Pa-231	3.16E-06	3.16E-06
Ac-227	7.08E-07	7.08E-07
Pb-210	1.06E-07	1.06E-07
Ra-226	7.88E-07	7.88E-07

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 09:03:03 Page: 31 **
Title : SLDS DCGL Industrial Worker
Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld
Evaluation Time: 10.0000000 years

Pb-210	4.08E-08	4.08E-08
Ra-228	1.11E-07	1.11E-07
Th-228	9.06E-06	9.06E-06
Th-228	5.20E-07	5.20E-07
Th-230	1.39E-06	1.39E-06
Ra-226	3.59E-09	3.59E-09
Pb-210	9.81E-11	9.81E-11
Th-232	1.51E-06	1.51E-06
Ra-228	2.83E-07	2.83E-07
Th-228	1.37E-05	1.37E-05
U-234	1.29E-07	1.29E-07
Th-230	1.35E-10	1.35E-10
Ra-226	1.74E-13	1.74E-13
Pb-210	3.25E-15	3.25E-15
U-235	1.48E-07	1.48E-07
Pa-231	7.02E-10	7.02E-10
Ac-227	8.31E-11	8.31E-11
U-238	1.36E-07	1.36E-07
U-234	3.83E-12	3.83E-12
Th-230	2.00E-15	2.00E-15
Ra-226	1.72E-18	1.72E-18
Pb-210	2.46E-20	2.46E-20

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 09:03:03 Page: 32 **
 Title : SLDS DCGL Industrial Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld
 Evaluation Time: 20.0000000 years

RESRAD-BUILD Dose Tables

Source Contributions to Receptor Doses

[mrem]						
	Source 1	Source 2	Source 3	Source 4	Source 5	Total
Receptor 1	1.76E-04	3.27E-05	3.27E-05	3.27E-05	3.27E-05	3.06E-04
Total	1.76E-04	3.27E-05	3.27E-05	3.27E-05	3.27E-05	3.06E-04

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 09:03:03 Page: 33 **

Title : SLDS DCGL Industrial Worker

Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld

Evaluation Time: 20.0000000 years

Pathway Detail of Doses

[mrem]

Source: 1	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	1.70E-05	4.94E-05	2.10E-10	3.98E-11	1.73E-08	1.09E-04	0.00E+00	1.76E-04
Total	1.70E-05	4.94E-05	2.10E-10	3.98E-11	1.73E-08	1.09E-04	0.00E+00	1.76E-04
Source: 2	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	9.29E-07	9.88E-06	4.21E-11	7.95E-12	3.46E-09	2.19E-05	0.00E+00	3.27E-05
Total	9.29E-07	9.88E-06	4.21E-11	7.95E-12	3.46E-09	2.19E-05	0.00E+00	3.27E-05
Source: 3	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	9.29E-07	9.88E-06	4.21E-11	7.95E-12	3.46E-09	2.19E-05	0.00E+00	3.27E-05
Total	9.29E-07	9.88E-06	4.21E-11	7.95E-12	3.46E-09	2.19E-05	0.00E+00	3.27E-05
Source: 4	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	9.29E-07	9.88E-06	4.21E-11	7.95E-12	3.46E-09	2.19E-05	0.00E+00	3.27E-05
Total	9.29E-07	9.88E-06	4.21E-11	7.95E-12	3.46E-09	2.19E-05	0.00E+00	3.27E-05
Source: 5	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	9.29E-07	9.88E-06	4.21E-11	7.95E-12	3.46E-09	2.19E-05	0.00E+00	3.27E-05
Total	9.29E-07	9.88E-06	4.21E-11	7.95E-12	3.46E-09	2.19E-05	0.00E+00	3.27E-05

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 09:03:03 Page: 34 **
 Title : SLDS DCGL Industrial Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld
 Evaluation Time: 20.0000000 years

Nuclide Detail of Doses

[mrem]

Source: 1

Nuclide	Receptor 1	Total
Ac-227	7.20E-06	7.20E-06
Pa-231	1.60E-05	1.60E-05
Ac-227	6.63E-06	6.63E-06
Pb-210	4.43E-07	4.43E-07
Ra-226	7.99E-06	7.99E-06
Pb-210	3.95E-07	3.95E-07
Ra-228	3.48E-07	3.48E-07
Th-228	1.45E-05	1.45E-05
Th-228	6.87E-08	6.87E-08
Th-230	6.97E-06	6.97E-06
Ra-226	7.12E-08	7.12E-08
Pb-210	1.95E-09	1.95E-09
Th-232	7.55E-06	7.55E-06
Ra-228	3.77E-06	3.77E-06
Th-228	1.01E-04	1.01E-04
U-234	6.51E-07	6.51E-07
Th-230	1.31E-09	1.31E-09
Ra-226	6.73E-12	6.73E-12
Pb-210	1.29E-13	1.29E-13
U-235	1.25E-06	1.25E-06
Pa-231	6.92E-09	6.92E-09
Ac-227	1.59E-09	1.59E-09
U-238	1.00E-06	1.00E-06
U-234	3.77E-11	3.77E-11
Th-230	3.80E-14	3.80E-14
Ra-226	1.30E-16	1.30E-16
Pb-210	1.92E-18	1.92E-18

Source: 2

Nuclide	Receptor 1	Total
Ac-227	1.30E-06	1.30E-06
Pa-231	3.16E-06	3.16E-06
Ac-227	1.19E-06	1.19E-06
Pb-210	7.71E-08	7.71E-08
Ra-226	7.60E-07	7.60E-07
Pb-210	6.88E-08	6.88E-08

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 09:03:03 Page: 35 **

Title : SLDS DCGL Industrial Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld
 Evaluation Time: 20.0000000 years

Ra-228	3.28E-08	3.28E-08
Th-228	2.82E-06	2.82E-06
Th-228	1.33E-08	1.33E-08
Th-230	1.39E-06	1.39E-06
Ra-226	6.78E-09	6.78E-09
Pb-210	3.38E-10	3.38E-10
Th-232	1.51E-06	1.51E-06
Ra-228	3.55E-07	3.55E-07
Th-228	1.96E-05	1.96E-05
U-234	1.29E-07	1.29E-07
Th-230	2.63E-10	2.63E-10
Ra-226	6.40E-13	6.40E-13
Pb-210	2.24E-14	2.24E-14
U-235	1.46E-07	1.46E-07
Pa-231	1.37E-09	1.37E-09
Ac-227	2.87E-10	2.87E-10
U-238	1.35E-07	1.35E-07
U-234	7.47E-12	7.47E-12
Th-230	7.60E-15	7.60E-15
Ra-226	1.24E-17	1.24E-17
Pb-210	3.34E-19	3.34E-19

Source: 3

Nuclide	Receptor 1	Total
Ac-227	1.30E-06	1.30E-06
Pa-231	3.16E-06	3.16E-06
Ac-227	1.19E-06	1.19E-06
Pb-210	7.71E-08	7.71E-08
Ra-226	7.60E-07	7.60E-07
Pb-210	6.88E-08	6.88E-08
Ra-228	3.28E-08	3.28E-08
Th-228	2.82E-06	2.82E-06
Th-228	1.33E-08	1.33E-08
Th-230	1.39E-06	1.39E-06
Ra-226	6.78E-09	6.78E-09
Pb-210	3.38E-10	3.38E-10
Th-232	1.51E-06	1.51E-06
Ra-228	3.55E-07	3.55E-07
Th-228	1.96E-05	1.96E-05
U-234	1.29E-07	1.29E-07
Th-230	2.63E-10	2.63E-10
Ra-226	6.40E-13	6.40E-13
Pb-210	2.24E-14	2.24E-14
U-235	1.46E-07	1.46E-07
Pa-231	1.37E-09	1.37E-09
Ac-227	2.87E-10	2.87E-10
U-238	1.35E-07	1.35E-07
U-234	7.47E-12	7.47E-12

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 09:03:03 Page: 36 **
 Title : SLDS DCGL Industrial Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld
 Evaluation Time: 20.0000000 years

Th-230	7.60E-15	7.60E-15
Ra-226	1.24E-17	1.24E-17
Pb-210	3.34E-19	3.34E-19

Source: 4

Nuclide	Receptor 1	Total
Ac-227	1.30E-06	1.30E-06
Pa-231	3.16E-06	3.16E-06
Ac-227	1.19E-06	1.19E-06
Pb-210	7.71E-08	7.71E-08
Ra-226	7.60E-07	7.60E-07
Pb-210	6.88E-08	6.88E-08
Ra-228	3.28E-08	3.28E-08
Th-228	2.82E-06	2.82E-06
Th-228	1.33E-08	1.33E-08
Th-230	1.39E-06	1.39E-06
Ra-226	6.78E-09	6.78E-09
Pb-210	3.38E-10	3.38E-10
Th-232	1.51E-06	1.51E-06
Ra-228	3.55E-07	3.55E-07
Th-228	1.96E-05	1.96E-05
U-234	1.29E-07	1.29E-07
Th-230	2.63E-10	2.63E-10
Ra-226	6.40E-13	6.40E-13
Pb-210	2.24E-14	2.24E-14
U-235	1.46E-07	1.46E-07
Pa-231	1.37E-09	1.37E-09
Ac-227	2.87E-10	2.87E-10
U-238	1.35E-07	1.35E-07
U-234	7.47E-12	7.47E-12
Th-230	7.60E-15	7.60E-15
Ra-226	1.24E-17	1.24E-17
Pb-210	3.34E-19	3.34E-19

Source: 5

Nuclide	Receptor 1	Total
Ac-227	1.30E-06	1.30E-06
Pa-231	3.16E-06	3.16E-06
Ac-227	1.19E-06	1.19E-06
Pb-210	7.71E-08	7.71E-08
Ra-226	7.60E-07	7.60E-07

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 09:03:03 Page: 37 **
Title : SLDS DCGL Industrial Worker
Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld
Evaluation Time: 20.0000000 years

Pb-210	6.88E-08	6.88E-08
Ra-228	3.28E-08	3.28E-08
Th-228	2.82E-06	2.82E-06
Th-228	1.33E-08	1.33E-08
Th-230	1.39E-06	1.39E-06
Ra-226	6.78E-09	6.78E-09
Pb-210	3.38E-10	3.38E-10
Th-232	1.51E-06	1.51E-06
Ra-228	3.55E-07	3.55E-07
Th-228	1.96E-05	1.96E-05
U-234	1.29E-07	1.29E-07
Th-230	2.63E-10	2.63E-10
Ra-226	6.40E-13	6.40E-13
Pb-210	2.24E-14	2.24E-14
U-235	1.46E-07	1.46E-07
Pa-231	1.37E-09	1.37E-09
Ac-227	2.87E-10	2.87E-10
U-238	1.35E-07	1.35E-07
U-234	7.47E-12	7.47E-12
Th-230	7.60E-15	7.60E-15
Ra-226	1.24E-17	1.24E-17
Pb-210	3.34E-19	3.34E-19

RESRAD-BUILD Dose Tables

```
[mrem]
```

	Source 1	Source 2	Source 3	Source 4	Source 5	Total
Receptor 1	1.23E-04	2.22E-05	2.22E-05	2.22E-05	2.22E-05	2.11E-04
Total	1.23E-04	2.22E-05	2.22E-05	2.22E-05	2.22E-05	2.11E-04

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 09:03:03 Page: 39 **
 Title : SLDS DCGL Industrial Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld
 Evaluation Time: 30.0000000 years

Pathway Detail of Doses

[mrem]

Source: 1								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	1.65E-05	6.23E-17	6.42E-22	5.01E-23	5.28E-20	1.06E-04	0.00E+00	1.23E-04
Total	1.65E-05	6.23E-17	6.42E-22	5.01E-23	5.28E-20	1.06E-04	0.00E+00	1.23E-04
Source: 2								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	9.04E-07	1.25E-17	1.28E-22	1.00E-23	1.06E-20	2.13E-05	0.00E+00	2.22E-05
Total	9.04E-07	1.25E-17	1.28E-22	1.00E-23	1.06E-20	2.13E-05	0.00E+00	2.22E-05
Source: 3								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	9.04E-07	1.25E-17	1.28E-22	1.00E-23	1.06E-20	2.13E-05	0.00E+00	2.22E-05
Total	9.04E-07	1.25E-17	1.28E-22	1.00E-23	1.06E-20	2.13E-05	0.00E+00	2.22E-05
Source: 4								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	9.04E-07	1.25E-17	1.28E-22	1.00E-23	1.06E-20	2.13E-05	0.00E+00	2.22E-05
Total	9.04E-07	1.25E-17	1.28E-22	1.00E-23	1.06E-20	2.13E-05	0.00E+00	2.22E-05
Source: 5								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	9.04E-07	1.25E-17	1.28E-22	1.00E-23	1.06E-20	2.13E-05	0.00E+00	2.22E-05
Total	9.04E-07	1.25E-17	1.28E-22	1.00E-23	1.06E-20	2.13E-05	0.00E+00	2.22E-05

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 09:03:03 Page: 40 **
 Title : SLDS DCGL Industrial Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld
 Evaluation Time: 30.0000000 years

Nuclide Detail of Doses

[mrem]

Source: 1

Nuclide	Receptor 1	Total
Ac-227	6.85E-07	6.85E-07
Pa-231	2.01E-07	2.01E-07
Ac-227	1.12E-06	1.12E-06
Pb-210	5.49E-08	5.49E-08
Ra-226	7.11E-06	7.11E-06
Pb-210	8.67E-08	8.67E-08
Ra-228	7.43E-08	7.43E-08
Th-228	4.15E-06	4.15E-06
Th-228	1.73E-09	1.73E-09
Th-230	5.80E-09	5.80E-09
Ra-226	9.45E-08	9.45E-08
Pb-210	6.64E-10	6.64E-10
Th-232	4.61E-09	4.61E-09
Ra-228	2.86E-06	2.86E-06
Th-228	1.05E-04	1.05E-04
U-234	6.04E-09	6.04E-09
Th-230	1.63E-12	1.63E-12
Ra-226	1.33E-11	1.33E-11
Pb-210	6.68E-14	6.68E-14
U-235	6.50E-07	6.50E-07
Pa-231	1.30E-10	1.30E-10
Ac-227	4.20E-10	4.20E-10
U-238	4.41E-07	4.41E-07
U-234	5.20E-13	5.20E-13
Th-230	7.01E-17	7.01E-17
Ra-226	3.82E-16	3.82E-16
Pb-210	1.50E-18	1.50E-18

Source: 2

Nuclide	Receptor 1	Total
Ac-227	3.53E-08	3.53E-08
Pa-231	5.83E-09	5.83E-09
Ac-227	5.80E-08	5.80E-08
Pb-210	2.76E-09	2.76E-09
Ra-226	6.10E-07	6.10E-07
Pb-210	4.35E-09	4.35E-09

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 09:03:03 Page: 41 **

Title : SLDS DCGL Industrial Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld
 Evaluation Time: 30.0000000 years

Ra-228	4.11E-09	4.11E-09
Th-228	8.05E-07	8.05E-07
Th-228	3.36E-10	3.36E-10
Th-230	7.35E-11	7.35E-11
Ra-226	8.11E-09	8.11E-09
Pb-210	3.34E-11	3.34E-11
Th-232	6.56E-11	6.56E-11
Ra-228	1.58E-07	1.58E-07
Th-228	2.04E-05	2.04E-05
U-234	7.12E-11	7.12E-11
Th-230	2.06E-14	2.06E-14
Ra-226	1.14E-12	1.14E-12
Pb-210	3.35E-15	3.35E-15
U-235	2.95E-08	2.95E-08
Pa-231	3.76E-12	3.76E-12
Ac-227	2.17E-11	2.17E-11
U-238	2.37E-08	2.37E-08
U-234	6.13E-15	6.13E-15
Th-230	8.87E-19	8.87E-19
Ra-226	3.28E-17	3.28E-17
Pb-210	7.54E-20	7.54E-20

Source: 3

Nuclide	Receptor 1	Total
Ac-227	3.53E-08	3.53E-08
Pa-231	5.83E-09	5.83E-09
Ac-227	5.80E-08	5.80E-08
Pb-210	2.76E-09	2.76E-09
Ra-226	6.10E-07	6.10E-07
Pb-210	4.35E-09	4.35E-09
Ra-228	4.11E-09	4.11E-09
Th-228	8.05E-07	8.05E-07
Th-228	3.36E-10	3.36E-10
Th-230	7.35E-11	7.35E-11
Ra-226	8.11E-09	8.11E-09
Pb-210	3.34E-11	3.34E-11
Th-232	6.56E-11	6.56E-11
Ra-228	1.58E-07	1.58E-07
Th-228	2.04E-05	2.04E-05
U-234	7.12E-11	7.12E-11
Th-230	2.06E-14	2.06E-14
Ra-226	1.14E-12	1.14E-12
Pb-210	3.35E-15	3.35E-15
U-235	2.95E-08	2.95E-08
Pa-231	3.76E-12	3.76E-12
Ac-227	2.17E-11	2.17E-11
U-238	2.37E-08	2.37E-08
U-234	6.13E-15	6.13E-15

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 09:03:03 Page: 42 **
 Title : SLDS DCGL Industrial Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld
 Evaluation Time: 30.0000000 years

Th-230	8.87E-19	8.87E-19
Ra-226	3.28E-17	3.28E-17
Pb-210	7.54E-20	7.54E-20

Source: 4

Nuclide	Receptor 1	Total
Ac-227	3.53E-08	3.53E-08
Pa-231	5.83E-09	5.83E-09
Ac-227	5.80E-08	5.80E-08
Pb-210	2.76E-09	2.76E-09
Ra-226	6.10E-07	6.10E-07
Pb-210	4.35E-09	4.35E-09
Ra-228	4.11E-09	4.11E-09
Th-228	8.05E-07	8.05E-07
Th-228	3.36E-10	3.36E-10
Th-230	7.35E-11	7.35E-11
Ra-226	8.11E-09	8.11E-09
Pb-210	3.34E-11	3.34E-11
Th-232	6.56E-11	6.56E-11
Ra-228	1.58E-07	1.58E-07
Th-228	2.04E-05	2.04E-05
U-234	7.12E-11	7.12E-11
Th-230	2.06E-14	2.06E-14
Ra-226	1.14E-12	1.14E-12
Pb-210	3.35E-15	3.35E-15
U-235	2.95E-08	2.95E-08
Pa-231	3.76E-12	3.76E-12
Ac-227	2.17E-11	2.17E-11
U-238	2.37E-08	2.37E-08
U-234	6.13E-15	6.13E-15
Th-230	8.87E-19	8.87E-19
Ra-226	3.28E-17	3.28E-17
Pb-210	7.54E-20	7.54E-20

Source: 5

Nuclide	Receptor 1	Total
Ac-227	3.53E-08	3.53E-08
Pa-231	5.83E-09	5.83E-09
Ac-227	5.80E-08	5.80E-08
Pb-210	2.76E-09	2.76E-09
Ra-226	6.10E-07	6.10E-07

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 09:03:03 Page: 43 **
Title : SLDS DCGL Industrial Worker
Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld
Evaluation Time: 30.0000000 years

Pb-210	4.35E-09	4.35E-09
Ra-228	4.11E-09	4.11E-09
Th-228	8.05E-07	8.05E-07
Th-228	3.36E-10	3.36E-10
Th-230	7.35E-11	7.35E-11
Ra-226	8.11E-09	8.11E-09
Pb-210	3.34E-11	3.34E-11
Th-232	6.56E-11	6.56E-11
Ra-228	1.58E-07	1.58E-07
Th-228	2.04E-05	2.04E-05
U-234	7.12E-11	7.12E-11
Th-230	2.06E-14	2.06E-14
Ra-226	1.14E-12	1.14E-12
Pb-210	3.35E-15	3.35E-15
U-235	2.95E-08	2.95E-08
Pa-231	3.76E-12	3.76E-12
Ac-227	2.17E-11	2.17E-11
U-238	2.37E-08	2.37E-08
U-234	6.13E-15	6.13E-15
Th-230	8.87E-19	8.87E-19
Ra-226	3.28E-17	3.28E-17
Pb-210	7.54E-20	7.54E-20

RESRAD-BUILD Dose Tables

Source Contributions to Receptor Doses

```
[mrem]
```

	Source 1	Source 2	Source 3	Source 4	Source 5	Total
Receptor 1	1.23E-04	2.22E-05	2.22E-05	2.22E-05	2.22E-05	2.11E-04
Total	1.23E-04	2.22E-05	2.22E-05	2.22E-05	2.22E-05	2.11E-04

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 09:03:03 Page: 45 **

Title : SLDS DCGL Industrial Worker

Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld

Evaluation Time: 100.000008 years

Pathway Detail of Doses

[mrem]

Source: 1	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	1.65E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.06E-04	0.00E+00	1.23E-04
Total	1.65E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.06E-04	0.00E+00	1.23E-04
Source: 2	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	9.04E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.13E-05	0.00E+00	2.22E-05
Total	9.04E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.13E-05	0.00E+00	2.22E-05
Source: 3	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	9.04E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.13E-05	0.00E+00	2.22E-05
Total	9.04E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.13E-05	0.00E+00	2.22E-05
Source: 4	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	9.04E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.13E-05	0.00E+00	2.22E-05
Total	9.04E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.13E-05	0.00E+00	2.22E-05
Source: 5	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	9.04E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.13E-05	0.00E+00	2.22E-05
Total	9.04E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.13E-05	0.00E+00	2.22E-05

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 09:03:03 Page: 46 **
 Title : SLDS DCGL Industrial Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld
 Evaluation Time: 100.000008 years

Nuclide Detail of Doses

[mrem]

Source: 1

Nuclide	Receptor 1	Total
Ac-227	7.37E-08	7.37E-08
Pa-231	2.01E-07	2.01E-07
Ac-227	1.73E-06	1.73E-06
Pb-210	6.17E-09	6.17E-09
Ra-226	6.90E-06	6.90E-06
Pb-210	1.32E-07	1.32E-07
Ra-228	1.61E-11	1.61E-11
Th-228	8.98E-10	8.98E-10
Th-228	1.64E-20	1.64E-20
Th-230	5.80E-09	5.80E-09
Ra-226	3.07E-07	3.07E-07
Pb-210	4.23E-09	4.23E-09
Th-232	4.61E-09	4.61E-09
Ra-228	2.93E-06	2.93E-06
Th-228	1.09E-04	1.09E-04
U-234	6.04E-09	6.04E-09
Th-230	5.36E-12	5.36E-12
Ra-226	1.43E-10	1.43E-10
Pb-210	1.57E-12	1.57E-12
U-235	6.50E-07	6.50E-07
Pa-231	4.27E-10	4.27E-10
Ac-227	2.69E-09	2.69E-09
U-238	4.41E-07	4.41E-07
U-234	1.71E-12	1.71E-12
Th-230	7.61E-16	7.61E-16
Ra-226	1.36E-14	1.36E-14
Pb-210	1.25E-16	1.25E-16

Source: 2

Nuclide	Receptor 1	Total
Ac-227	3.81E-09	3.81E-09
Pa-231	5.82E-09	5.82E-09
Ac-227	8.94E-08	8.94E-08
Pb-210	3.10E-10	3.10E-10
Ra-226	5.92E-07	5.92E-07
Pb-210	6.62E-09	6.62E-09

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 09:03:03 Page: 47 **

Title : SLDS DCGL Industrial Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld
 Evaluation Time: 100.000008 years

Ra-228	8.90E-13	8.90E-13
Th-228	1.74E-10	1.74E-10
Th-228	3.18E-21	3.18E-21
Th-230	7.34E-11	7.34E-11
Ra-226	2.63E-08	2.63E-08
Pb-210	2.12E-10	2.12E-10
Th-232	6.56E-11	6.56E-11
Ra-228	1.62E-07	1.62E-07
Th-228	2.12E-05	2.12E-05
U-234	7.12E-11	7.12E-11
Th-230	6.79E-14	6.79E-14
Ra-226	1.23E-11	1.23E-11
Pb-210	7.90E-14	7.90E-14
U-235	2.95E-08	2.95E-08
Pa-231	1.24E-11	1.24E-11
Ac-227	1.39E-10	1.39E-10
U-238	2.37E-08	2.37E-08
U-234	2.02E-14	2.02E-14
Th-230	9.63E-18	9.63E-18
Ra-226	1.16E-15	1.16E-15
Pb-210	6.29E-18	6.29E-18

Source: 3

Nuclide	Receptor 1	Total
Ac-227	3.81E-09	3.81E-09
Pa-231	5.82E-09	5.82E-09
Ac-227	8.94E-08	8.94E-08
Pb-210	3.10E-10	3.10E-10
Ra-226	5.92E-07	5.92E-07
Pb-210	6.62E-09	6.62E-09
Ra-228	8.90E-13	8.90E-13
Th-228	1.74E-10	1.74E-10
Th-228	3.18E-21	3.18E-21
Th-230	7.34E-11	7.34E-11
Ra-226	2.63E-08	2.63E-08
Pb-210	2.12E-10	2.12E-10
Th-232	6.56E-11	6.56E-11
Ra-228	1.62E-07	1.62E-07
Th-228	2.12E-05	2.12E-05
U-234	7.12E-11	7.12E-11
Th-230	6.79E-14	6.79E-14
Ra-226	1.23E-11	1.23E-11
Pb-210	7.90E-14	7.90E-14
U-235	2.95E-08	2.95E-08
Pa-231	1.24E-11	1.24E-11
Ac-227	1.39E-10	1.39E-10
U-238	2.37E-08	2.37E-08
U-234	2.02E-14	2.02E-14

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 09:03:03 Page: 48 **
 Title : SLDS DCGL Industrial Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld
 Evaluation Time: 100.000008 years

Th-230	9.63E-18	9.63E-18
Ra-226	1.16E-15	1.16E-15
Pb-210	6.29E-18	6.29E-18

Source: 4

Nuclide	Receptor 1	Total
Ac-227	3.81E-09	3.81E-09
Pa-231	5.82E-09	5.82E-09
Ac-227	8.94E-08	8.94E-08
Pb-210	3.10E-10	3.10E-10
Ra-226	5.92E-07	5.92E-07
Pb-210	6.62E-09	6.62E-09
Ra-228	8.90E-13	8.90E-13
Th-228	1.74E-10	1.74E-10
Th-228	3.18E-21	3.18E-21
Th-230	7.34E-11	7.34E-11
Ra-226	2.63E-08	2.63E-08
Pb-210	2.12E-10	2.12E-10
Th-232	6.56E-11	6.56E-11
Ra-228	1.62E-07	1.62E-07
Th-228	2.12E-05	2.12E-05
U-234	7.12E-11	7.12E-11
Th-230	6.79E-14	6.79E-14
Ra-226	1.23E-11	1.23E-11
Pb-210	7.90E-14	7.90E-14
U-235	2.95E-08	2.95E-08
Pa-231	1.24E-11	1.24E-11
Ac-227	1.39E-10	1.39E-10
U-238	2.37E-08	2.37E-08
U-234	2.02E-14	2.02E-14
Th-230	9.63E-18	9.63E-18
Ra-226	1.16E-15	1.16E-15
Pb-210	6.29E-18	6.29E-18

Source: 5

Nuclide	Receptor 1	Total
Ac-227	3.81E-09	3.81E-09
Pa-231	5.82E-09	5.82E-09
Ac-227	8.94E-08	8.94E-08
Pb-210	3.10E-10	3.10E-10
Ra-226	5.92E-07	5.92E-07

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 09:03:03 Page: 49 **
Title : SLDS DCGL Industrial Worker
Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld
Evaluation Time: 100.000008 years

Pb-210	6.62E-09	6.62E-09
Ra-228	8.90E-13	8.90E-13
Th-228	1.74E-10	1.74E-10
Th-228	3.18E-21	3.18E-21
Th-230	7.34E-11	7.34E-11
Ra-226	2.63E-08	2.63E-08
Pb-210	2.12E-10	2.12E-10
Th-232	6.56E-11	6.56E-11
Ra-228	1.62E-07	1.62E-07
Th-228	2.12E-05	2.12E-05
U-234	7.12E-11	7.12E-11
Th-230	6.79E-14	6.79E-14
Ra-226	1.23E-11	1.23E-11
Pb-210	7.90E-14	7.90E-14
U-235	2.95E-08	2.95E-08
Pa-231	1.24E-11	1.24E-11
Ac-227	1.39E-10	1.39E-10
U-238	2.37E-08	2.37E-08
U-234	2.02E-14	2.02E-14
Th-230	9.63E-18	9.63E-18
Ra-226	1.16E-15	1.16E-15
Pb-210	6.29E-18	6.29E-18

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 09:03:03 Page: 50 **
 Title : SLDS DCGL Industrial Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld
 Evaluation Time: 300.000031 years

RESRAD-BUILD Dose Tables

Source Contributions to Receptor Doses

[mrem]						
	Source 1	Source 2	Source 3	Source 4	Source 5	Total
Receptor 1	1.23E-04	2.22E-05	2.22E-05	2.22E-05	2.22E-05	2.11E-04
Total	1.23E-04	2.22E-05	2.22E-05	2.22E-05	2.22E-05	2.11E-04

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 09:03:03 Page: 51 **
 Title : SLDS DCGL Industrial Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld
 Evaluation Time: 300.000031 years

Pathway Detail of Doses

[mrem]

Source: 1								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	1.65E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.06E-04	0.00E+00	1.23E-04
Total	1.65E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.06E-04	0.00E+00	1.23E-04
Source: 2								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	9.04E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.13E-05	0.00E+00	2.22E-05
Total	9.04E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.13E-05	0.00E+00	2.22E-05
Source: 3								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	9.04E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.13E-05	0.00E+00	2.22E-05
Total	9.04E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.13E-05	0.00E+00	2.22E-05
Source: 4								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	9.04E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.13E-05	0.00E+00	2.22E-05
Total	9.04E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.13E-05	0.00E+00	2.22E-05
Source: 5								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	9.04E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.13E-05	0.00E+00	2.22E-05
Total	9.04E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.13E-05	0.00E+00	2.22E-05

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 09:03:03 Page: 52 **
 Title : SLDS DCGL Industrial Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld
 Evaluation Time: 300.000031 years

Nuclide Detail of Doses

[mrem]

Source: 1

Nuclide	Receptor 1	Total
Ac-227	1.27E-10	1.27E-10
Pa-231	2.00E-07	2.00E-07
Ac-227	1.80E-06	1.80E-06
Pb-210	1.20E-11	1.20E-11
Ra-226	6.32E-06	6.32E-06
Pb-210	1.27E-07	1.27E-07
Ra-228	5.44E-22	5.44E-22
Th-228	3.04E-20	3.04E-20
Th-228	0.00E+00	0.00E+00
Th-230	5.79E-09	5.79E-09
Ra-226	8.78E-07	8.78E-07
Pb-210	1.56E-08	1.56E-08
Th-232	4.61E-09	4.61E-09
Ra-228	2.93E-06	2.93E-06
Th-228	1.09E-04	1.09E-04
U-234	6.03E-09	6.03E-09
Th-230	1.60E-11	1.60E-11
Ra-226	1.24E-09	1.24E-09
Pb-210	1.99E-11	1.99E-11
U-235	6.50E-07	6.50E-07
Pa-231	1.27E-09	1.27E-09
Ac-227	1.03E-08	1.03E-08
U-238	4.41E-07	4.41E-07
U-234	5.12E-12	5.12E-12
Th-230	6.79E-15	6.79E-15
Ra-226	3.54E-13	3.54E-13
Pb-210	5.20E-15	5.20E-15

Source: 2

Nuclide	Receptor 1	Total
Ac-227	6.53E-12	6.53E-12
Pa-231	5.79E-09	5.79E-09
Ac-227	9.28E-08	9.28E-08
Pb-210	6.01E-13	6.01E-13
Ra-226	5.43E-07	5.43E-07
Pb-210	6.36E-09	6.36E-09

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 09:03:03 Page: 53 **

Title : SLDS DCGL Industrial Worker

Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld

Evaluation Time: 300.000031 years

Ra-228	3.01E-23	3.01E-23
Th-228	5.89E-21	5.89E-21
Th-228	0.00E+00	0.00E+00
Th-230	7.33E-11	7.33E-11
Ra-226	7.54E-08	7.54E-08
Pb-210	7.83E-10	7.83E-10
Th-232	6.56E-11	6.56E-11
Ra-228	1.62E-07	1.62E-07
Th-228	2.12E-05	2.12E-05
U-234	7.11E-11	7.11E-11
Th-230	2.03E-13	2.03E-13
Ra-226	1.06E-10	1.06E-10
Pb-210	9.99E-13	9.99E-13
U-235	2.95E-08	2.95E-08
Pa-231	3.69E-11	3.69E-11
Ac-227	5.30E-10	5.30E-10
U-238	2.37E-08	2.37E-08
U-234	6.04E-14	6.04E-14
Th-230	8.61E-17	8.61E-17
Ra-226	3.04E-14	3.04E-14
Pb-210	2.61E-16	2.61E-16

Source: 3

Nuclide	Receptor 1	Total
Ac-227	6.53E-12	6.53E-12
Pa-231	5.79E-09	5.79E-09
Ac-227	9.28E-08	9.28E-08
Pb-210	6.01E-13	6.01E-13
Ra-226	5.43E-07	5.43E-07
Pb-210	6.36E-09	6.36E-09
Ra-228	3.01E-23	3.01E-23
Th-228	5.89E-21	5.89E-21
Th-228	0.00E+00	0.00E+00
Th-230	7.33E-11	7.33E-11
Ra-226	7.54E-08	7.54E-08
Pb-210	7.83E-10	7.83E-10
Th-232	6.56E-11	6.56E-11
Ra-228	1.62E-07	1.62E-07
Th-228	2.12E-05	2.12E-05
U-234	7.11E-11	7.11E-11
Th-230	2.03E-13	2.03E-13
Ra-226	1.06E-10	1.06E-10
Pb-210	9.99E-13	9.99E-13
U-235	2.95E-08	2.95E-08
Pa-231	3.69E-11	3.69E-11
Ac-227	5.30E-10	5.30E-10
U-238	2.37E-08	2.37E-08
U-234	6.04E-14	6.04E-14

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 09:03:03 Page: 54 **
 Title : SLDS DCGL Industrial Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld
 Evaluation Time: 300.000031 years

Th-230	8.61E-17	8.61E-17
Ra-226	3.04E-14	3.04E-14
Pb-210	2.61E-16	2.61E-16

Source: 4

Nuclide	Receptor 1	Total
Ac-227	6.53E-12	6.53E-12
Pa-231	5.79E-09	5.79E-09
Ac-227	9.28E-08	9.28E-08
Pb-210	6.01E-13	6.01E-13
Ra-226	5.43E-07	5.43E-07
Pb-210	6.36E-09	6.36E-09
Ra-228	3.01E-23	3.01E-23
Th-228	5.89E-21	5.89E-21
Th-228	0.00E+00	0.00E+00
Th-230	7.33E-11	7.33E-11
Ra-226	7.54E-08	7.54E-08
Pb-210	7.83E-10	7.83E-10
Th-232	6.56E-11	6.56E-11
Ra-228	1.62E-07	1.62E-07
Th-228	2.12E-05	2.12E-05
U-234	7.11E-11	7.11E-11
Th-230	2.03E-13	2.03E-13
Ra-226	1.06E-10	1.06E-10
Pb-210	9.99E-13	9.99E-13
U-235	2.95E-08	2.95E-08
Pa-231	3.69E-11	3.69E-11
Ac-227	5.30E-10	5.30E-10
U-238	2.37E-08	2.37E-08
U-234	6.04E-14	6.04E-14
Th-230	8.61E-17	8.61E-17
Ra-226	3.04E-14	3.04E-14
Pb-210	2.61E-16	2.61E-16

Source: 5

Nuclide	Receptor 1	Total
Ac-227	6.53E-12	6.53E-12
Pa-231	5.79E-09	5.79E-09
Ac-227	9.28E-08	9.28E-08
Pb-210	6.01E-13	6.01E-13
Ra-226	5.43E-07	5.43E-07

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 09:03:03 Page: 55 **
Title : SLDS DCGL Industrial Worker
Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld
Evaluation Time: 300.000031 years

Pb-210	6.36E-09	6.36E-09
Ra-228	3.01E-23	3.01E-23
Th-228	5.89E-21	5.89E-21
Th-228	0.00E+00	0.00E+00
Th-230	7.33E-11	7.33E-11
Ra-226	7.54E-08	7.54E-08
Pb-210	7.83E-10	7.83E-10
Th-232	6.56E-11	6.56E-11
Ra-228	1.62E-07	1.62E-07
Th-228	2.12E-05	2.12E-05
U-234	7.11E-11	7.11E-11
Th-230	2.03E-13	2.03E-13
Ra-226	1.06E-10	1.06E-10
Pb-210	9.99E-13	9.99E-13
U-235	2.95E-08	2.95E-08
Pa-231	3.69E-11	3.69E-11
Ac-227	5.30E-10	5.30E-10
U-238	2.37E-08	2.37E-08
U-234	6.04E-14	6.04E-14
Th-230	8.61E-17	8.61E-17
Ra-226	3.04E-14	3.04E-14
Pb-210	2.61E-16	2.61E-16

RESRAD-BUILD Dose Tables

```
[mrem]
```

	Source 1	Source 2	Source 3	Source 4	Source 5	Total
Receptor 1	1.23E-04	2.22E-05	2.22E-05	2.22E-05	2.22E-05	2.11E-04
Total	1.23E-04	2.22E-05	2.22E-05	2.22E-05	2.22E-05	2.11E-04

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 09:03:03 Page: 57 **
 Title : SLDS DCGL Industrial Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld
 Evaluation Time: 1000.00000 years

Pathway Detail of Doses

[mrem]

Source: 1								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	1.65E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.06E-04	0.00E+00	1.23E-04
Total	1.65E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.06E-04	0.00E+00	1.23E-04
Source: 2								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	9.04E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.13E-05	0.00E+00	2.22E-05
Total	9.04E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.13E-05	0.00E+00	2.22E-05
Source: 3								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	9.04E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.13E-05	0.00E+00	2.22E-05
Total	9.04E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.13E-05	0.00E+00	2.22E-05
Source: 4								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	9.04E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.13E-05	0.00E+00	2.22E-05
Total	9.04E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.13E-05	0.00E+00	2.22E-05
Source: 5								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	9.04E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.13E-05	0.00E+00	2.22E-05
Total	9.04E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.13E-05	0.00E+00	2.22E-05

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 09:03:03 Page: 58 **
 Title : SLDS DCGL Industrial Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld
 Evaluation Time: 1000.00000 years

Nuclide Detail of Doses

[mrem]

Source: 1

Nuclide	Receptor 1	Total
Ac-227	2.65E-20	2.65E-20
Pa-231	1.97E-07	1.97E-07
Ac-227	1.77E-06	1.77E-06
Pb-210	3.86E-21	3.86E-21
Ra-226	4.67E-06	4.67E-06
Pb-210	9.35E-08	9.35E-08
Ra-228	0.00E+00	0.00E+00
Th-228	0.00E+00	0.00E+00
Th-228	0.00E+00	0.00E+00
Th-230	5.75E-09	5.75E-09
Ra-226	2.52E-06	2.52E-06
Pb-210	4.85E-08	4.85E-08
Th-232	4.61E-09	4.61E-09
Ra-228	2.93E-06	2.93E-06
Th-228	1.09E-04	1.09E-04
U-234	6.02E-09	6.02E-09
Th-230	5.31E-11	5.31E-11
Ra-226	1.24E-08	1.24E-08
Pb-210	2.31E-10	2.31E-10
U-235	6.50E-07	6.50E-07
Pa-231	4.21E-09	4.21E-09
Ac-227	3.67E-08	3.67E-08
U-238	4.41E-07	4.41E-07
U-234	1.70E-11	1.70E-11
Th-230	7.51E-14	7.51E-14
Ra-226	1.21E-11	1.21E-11
Pb-210	2.19E-13	2.19E-13

Source: 2

Nuclide	Receptor 1	Total
Ac-227	1.37E-21	1.37E-21
Pa-231	5.71E-09	5.71E-09
Ac-227	9.14E-08	9.14E-08
Pb-210	1.94E-22	1.94E-22
Ra-226	4.01E-07	4.01E-07
Pb-210	4.70E-09	4.70E-09

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 09:03:03 Page: 59 **

Title : SLDS DCGL Industrial Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld
 Evaluation Time: 1000.00000 years

Ra-228	0.00E+00	0.00E+00
Th-228	0.00E+00	0.00E+00
Th-228	0.00E+00	0.00E+00
Th-230	7.28E-11	7.28E-11
Ra-226	2.16E-07	2.16E-07
Pb-210	2.44E-09	2.44E-09
Th-232	6.56E-11	6.56E-11
Ra-228	1.62E-07	1.62E-07
Th-228	2.12E-05	2.12E-05
U-234	7.10E-11	7.10E-11
Th-230	6.72E-13	6.72E-13
Ra-226	1.07E-09	1.07E-09
Pb-210	1.16E-11	1.16E-11
U-235	2.95E-08	2.95E-08
Pa-231	1.22E-10	1.22E-10
Ac-227	1.89E-09	1.89E-09
U-238	2.37E-08	2.37E-08
U-234	2.01E-13	2.01E-13
Th-230	9.51E-16	9.51E-16
Ra-226	1.04E-12	1.04E-12
Pb-210	1.10E-14	1.10E-14

Source: 3

Nuclide	Receptor 1	Total
Ac-227	1.37E-21	1.37E-21
Pa-231	5.71E-09	5.71E-09
Ac-227	9.14E-08	9.14E-08
Pb-210	1.94E-22	1.94E-22
Ra-226	4.01E-07	4.01E-07
Pb-210	4.70E-09	4.70E-09
Ra-228	0.00E+00	0.00E+00
Th-228	0.00E+00	0.00E+00
Th-228	0.00E+00	0.00E+00
Th-230	7.28E-11	7.28E-11
Ra-226	2.16E-07	2.16E-07
Pb-210	2.44E-09	2.44E-09
Th-232	6.56E-11	6.56E-11
Ra-228	1.62E-07	1.62E-07
Th-228	2.12E-05	2.12E-05
U-234	7.10E-11	7.10E-11
Th-230	6.72E-13	6.72E-13
Ra-226	1.07E-09	1.07E-09
Pb-210	1.16E-11	1.16E-11
U-235	2.95E-08	2.95E-08
Pa-231	1.22E-10	1.22E-10
Ac-227	1.89E-09	1.89E-09
U-238	2.37E-08	2.37E-08
U-234	2.01E-13	2.01E-13

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 09:03:03 Page: 60 **
 Title : SLDS DCGL Industrial Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld
 Evaluation Time: 1000.00000 years

Th-230	9.51E-16	9.51E-16
Ra-226	1.04E-12	1.04E-12
Pb-210	1.10E-14	1.10E-14

Source: 4

Nuclide	Receptor 1	Total
Ac-227	1.37E-21	1.37E-21
Pa-231	5.71E-09	5.71E-09
Ac-227	9.14E-08	9.14E-08
Pb-210	1.94E-22	1.94E-22
Ra-226	4.01E-07	4.01E-07
Pb-210	4.70E-09	4.70E-09
Ra-228	0.00E+00	0.00E+00
Th-228	0.00E+00	0.00E+00
Th-228	0.00E+00	0.00E+00
Th-230	7.28E-11	7.28E-11
Ra-226	2.16E-07	2.16E-07
Pb-210	2.44E-09	2.44E-09
Th-232	6.56E-11	6.56E-11
Ra-228	1.62E-07	1.62E-07
Th-228	2.12E-05	2.12E-05
U-234	7.10E-11	7.10E-11
Th-230	6.72E-13	6.72E-13
Ra-226	1.07E-09	1.07E-09
Pb-210	1.16E-11	1.16E-11
U-235	2.95E-08	2.95E-08
Pa-231	1.22E-10	1.22E-10
Ac-227	1.89E-09	1.89E-09
U-238	2.37E-08	2.37E-08
U-234	2.01E-13	2.01E-13
Th-230	9.51E-16	9.51E-16
Ra-226	1.04E-12	1.04E-12
Pb-210	1.10E-14	1.10E-14

Source: 5

Nuclide	Receptor 1	Total
Ac-227	1.37E-21	1.37E-21
Pa-231	5.71E-09	5.71E-09
Ac-227	9.14E-08	9.14E-08
Pb-210	1.94E-22	1.94E-22
Ra-226	4.01E-07	4.01E-07

** RESRAD-BUILD Dose Program Output, Version 4.0 02/15/24 09:03:03 Page: 61 **
Title : SLDS DCGL Industrial Worker
Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld
Evaluation Time: 1000.00000 years

Pb-210	4.70E-09	4.70E-09
Ra-228	0.00E+00	0.00E+00
Th-228	0.00E+00	0.00E+00
Th-228	0.00E+00	0.00E+00
Th-230	7.28E-11	7.28E-11
Ra-226	2.16E-07	2.16E-07
Pb-210	2.44E-09	2.44E-09
Th-232	6.56E-11	6.56E-11
Ra-228	1.62E-07	1.62E-07
Th-228	2.12E-05	2.12E-05
U-234	7.10E-11	7.10E-11
Th-230	6.72E-13	6.72E-13
Ra-226	1.07E-09	1.07E-09
Pb-210	1.16E-11	1.16E-11
U-235	2.95E-08	2.95E-08
Pa-231	1.22E-10	1.22E-10
Ac-227	1.89E-09	1.89E-09
U-238	2.37E-08	2.37E-08
U-234	2.01E-13	2.01E-13
Th-230	9.51E-16	9.51E-16
Ra-226	1.04E-12	1.04E-12
Pb-210	1.10E-14	1.10E-14

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:22:29 Page: 1 **
 Title : SLDS DCGL Industrial Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld

=====	
=====	
=====	=====
RESRAD-BUILD Table of Contents	=====
=====	=====
=====	

RESRAD-BUILD Input Parameters.....	2
Building Information.....	3
Source Information.....	4
Temporal Risk Summary.....	7
For time = 0.00E+00 yr	
Receptor-Source Risk Summary.....	8
Risk by Pathway Detail.....	9
Risk by Nuclide Detail.....	10
For time = 1.00E+00 yr	
Receptor-Source Risk Summary.....	14
Risk by Pathway Detail.....	15
Risk by Nuclide Detail.....	16
For time = 3.00E+00 yr	
Receptor-Source Risk Summary.....	20
Risk by Pathway Detail.....	21
Risk by Nuclide Detail.....	22
For time = 1.00E+01 yr	
Receptor-Source Risk Summary.....	26
Risk by Pathway Detail.....	27
Risk by Nuclide Detail.....	28
For time = 2.00E+01 yr	
Receptor-Source Risk Summary.....	32
Risk by Pathway Detail.....	33
Risk by Nuclide Detail.....	34
For time = 3.00E+01 yr	
Receptor-Source Risk Summary.....	38
Risk by Pathway Detail.....	39
Risk by Nuclide Detail.....	40
For time = 1.00E+02 yr	
Receptor-Source Risk Summary.....	44
Risk by Pathway Detail.....	45
Risk by Nuclide Detail.....	46
For time = 3.00E+02 yr	
Receptor-Source Risk Summary.....	50
Risk by Pathway Detail.....	51
Risk by Nuclide Detail.....	52
For time = 1.00E+03 yr	
Receptor-Source Risk Summary.....	56
Risk by Pathway Detail.....	57
Risk by Nuclide Detail.....	58

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:22:29 Page: 2 **
 Title : SLDS DCGL Industrial Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld

```

=====
=====
=====
RESRAD-BUILD Input Parameters
=====
=====
=====
    
```

```

Number of Sources : 5
Number of Receptors: 1
Total Time : 9.125000E+03 days
Fraction Inside : 2.300000E-01
    
```

```

Transformations data from: ICRP107
Cut off half life : 180.000000 days
Library information in the Dose Coefficients and Slope Factors report
    
```

```

===== Receptor Information =====
Receptor  Room      x      y      z  FracTime Inhalation Ingestion(Dust)
           [m]      [m]      [m]      [m3/day] [m2/hr]
1          1    5.000    5.000    1.000  1.000    3.36E+01  1.00E-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

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:22:29 Page: 3 **
Title : SLDS DCGL Industrial Worker
Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld

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

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

Height[m]	Air Exchanges [m3/hr]	
Area [m2]	*****	
	*	*
	*	*
	*	<=Q01: 0.00E+00
H1: 2.500	Room 1	Q10 : 0.00E+00
	LAMBDA: 0.00E+00	*
Area 100.000	*	*
	*	*

Deposition velocity: 3.90E-04 [m/s] Resuspension Rate: 0.00E+00 [1/s]
Deposition velocity: 5.00E-07 [m/s] Resuspension Rate:

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:22:29 Page: 4 **
 Title : SLDS DCGL Industrial Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld

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

Source: 1

Location:: Room : 1 x: 5.00 y: 5.00 z: 0.00[m]
 Geometry:: Type: Area Length[m]:1.00E+01 Width[m]:1.00E+01 Direction: z
 Pathway ::
 Direct Ingestion Rate: 0.000E+00 [1/hr]
 Fraction released to air: 7.000E-02
 Removable fraction: 1.000E-01
 Time to Remove: 1.000E+04 [day]

Radon Release Fraction: 1.000E-01

Contamination::

Nuclide Concentration

	[dpm/m2]
Ac-227	1.000E+00
Pa-231	1.000E+00
Pb-210	1.000E+00
Ra-226	1.000E+00
Ra-228	1.000E+00
Th-228	1.000E+00
Th-230	1.000E+00
Th-232	1.000E+00
U-234	1.000E+00
U-235	1.000E+00
U-238	1.000E+00

Source: 2

Location:: Room : 1 x: 10.00 y: 5.00 z: 1.00[m]
 Geometry:: Type: Area Length[m]:1.00E+01 Width[m]:2.00E+00 Direction: x
 Pathway ::
 Direct Ingestion Rate: 0.000E+00 [1/hr]
 Fraction released to air: 7.000E-02
 Removable fraction: 1.000E-01
 Time to Remove: 1.000E+04 [day]

Radon Release Fraction: 1.000E-01

Contamination::

Nuclide Concentration

	[dpm/m2]
Ac-227	1.000E+00
Pa-231	1.000E+00
Pb-210	1.000E+00
Ra-226	1.000E+00
Ra-228	1.000E+00
Th-228	1.000E+00
Th-230	1.000E+00
Th-232	1.000E+00
U-234	1.000E+00
U-235	1.000E+00
U-238	1.000E+00

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:22:29 Page: 5 **
 Title : SLDS DCGL Industrial Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld

Source: 3

Location:: Room : 1 x: 5.00 y: 10.00 z: 1.00[m]
 Geometry:: Type: Area Length[m]:1.00E+01 Width[m]:2.00E+00 Direction: y
 Pathway ::
 Direct Ingestion Rate: 0.000E+00 [1/hr]
 Fraction released to air: 7.000E-02
 Removable fraction: 1.000E-01
 Time to Remove: 1.000E+04 [day]

 Radon Release Fraction: 1.000E-01

Contamination::

Nuclide Concentration

	[dpm/m2]
Ac-227	1.000E+00
Pa-231	1.000E+00
Pb-210	1.000E+00
Ra-226	1.000E+00
Ra-228	1.000E+00
Th-228	1.000E+00
Th-230	1.000E+00
Th-232	1.000E+00
U-234	1.000E+00
U-235	1.000E+00
U-238	1.000E+00

Source: 4

Location:: Room : 1 x: 0.00 y: 5.00 z: 1.00[m]
 Geometry:: Type: Area Length[m]:1.00E+01 Width[m]:2.00E+00 Direction: x
 Pathway ::
 Direct Ingestion Rate: 0.000E+00 [1/hr]
 Fraction released to air: 7.000E-02
 Removable fraction: 1.000E-01
 Time to Remove: 1.000E+04 [day]

 Radon Release Fraction: 1.000E-01

Contamination::

Nuclide Concentration

	[dpm/m2]
Ac-227	1.000E+00
Pa-231	1.000E+00
Pb-210	1.000E+00
Ra-226	1.000E+00
Ra-228	1.000E+00
Th-228	1.000E+00
Th-230	1.000E+00
Th-232	1.000E+00
U-234	1.000E+00
U-235	1.000E+00
U-238	1.000E+00

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:22:29 Page: 6 **
Title : SLDS DCGL Industrial Worker
Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld

Source: 5

Location:: Room : 1 x: 5.00 y: 0.00 z: 1.00[m]
Geometry:: Type: Area Length[m]:1.00E+01 Width[m]:2.00E+00 Direction: y
Pathway ::
Direct Ingestion Rate: 0.000E+00 [1/hr]
Fraction released to air: 7.000E-02
Removable fraction: 1.000E-01
Time to Remove: 1.000E+04 [day]

Radon Release Fraction: 1.000E-01

Contamination::

Nuclide Concentration

	[dpm/m2]
Ac-227	1.000E+00
Pa-231	1.000E+00
Pb-210	1.000E+00
Ra-226	1.000E+00
Ra-228	1.000E+00
Th-228	1.000E+00
Th-230	1.000E+00
Th-232	1.000E+00
U-234	1.000E+00
U-235	1.000E+00
U-238	1.000E+00

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:22:29 Page: 7 **
 Title : SLDS DCGL Industrial Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld
 Temporal Summary

RESRAD-BUILD Temporal Risk Tables

Risk to Receptor over the Exposure Duration

(Risk)		
Evaluation Time years	Receptor 1	Total
0.000000000	4.13E-09	4.13E-09
1.000000000	4.12E-09	4.12E-09
3.000000000	4.08E-09	4.08E-09
10.00000000	3.83E-09	3.83E-09
20.00000000	3.54E-09	3.54E-09
30.00000000	3.35E-09	3.35E-09
100.0000080	3.35E-09	3.35E-09
300.0000310	3.35E-09	3.35E-09
1000.000000	3.35E-09	3.35E-09

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:22:29 Page: 8 **
 Title : SLDS DCGL Industrial Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld
 Evaluation Time: 0.00000000E+00 years

RESRAD-BUILD Risk Tables

Source Contributions to Receptor Risks

		[Risk]					
		Source 1	Source 2	Source 3	Source 4	Source 5	Total
Receptor	1	2.41E-09	4.31E-10	4.31E-10	4.31E-10	4.31E-10	4.13E-09
Total		2.41E-09	4.31E-10	4.31E-10	4.31E-10	4.31E-10	4.13E-09

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:22:29 Page: 9 **
 Title : SLDS DCGL Industrial Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld
 Evaluation Time: 0.00000000E+00 years

Pathway Detail of Risks

[Risk]

Source: 1								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	3.48E-10	3.19E-10	4.16E-15	7.91E-16	1.86E-13	1.74E-09	0.00E+00	2.41E-09
Total	3.48E-10	3.19E-10	4.16E-15	7.91E-16	1.86E-13	1.74E-09	0.00E+00	2.41E-09
Source: 2								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	1.90E-11	6.39E-11	8.32E-16	1.58E-16	3.73E-14	3.48E-10	0.00E+00	4.31E-10
Total	1.90E-11	6.39E-11	8.32E-16	1.58E-16	3.73E-14	3.48E-10	0.00E+00	4.31E-10
Source: 3								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	1.90E-11	6.39E-11	8.32E-16	1.58E-16	3.73E-14	3.48E-10	0.00E+00	4.31E-10
Total	1.90E-11	6.39E-11	8.32E-16	1.58E-16	3.73E-14	3.48E-10	0.00E+00	4.31E-10
Source: 4								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	1.90E-11	6.39E-11	8.32E-16	1.58E-16	3.73E-14	3.48E-10	0.00E+00	4.31E-10
Total	1.90E-11	6.39E-11	8.32E-16	1.58E-16	3.73E-14	3.48E-10	0.00E+00	4.31E-10
Source: 5								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	1.90E-11	6.39E-11	8.32E-16	1.58E-16	3.73E-14	3.48E-10	0.00E+00	4.31E-10
Total	1.90E-11	6.39E-11	8.32E-16	1.58E-16	3.73E-14	3.48E-10	0.00E+00	4.31E-10

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:22:29 Page: 10 **
 Title : SLDS DCGL Industrial Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld
 Evaluation Time: 0.00000000E+00 years

Nuclide Detail of Risks

[Risk]

Source: 1

Nuclide	Receptor	Total
	1	
Ac-227	9.37E-11	9.37E-11
Pa-231	3.95E-11	3.95E-11
Ac-227	4.20E-11	4.20E-11
Pb-210	1.14E-11	1.14E-11
Ra-226	2.13E-10	2.13E-10
Pb-210	4.98E-12	4.98E-12
Ra-228	2.64E-11	2.64E-11
Th-228	5.68E-10	5.68E-10
Th-228	2.09E-10	2.09E-10
Th-230	1.59E-11	1.59E-11
Ra-226	1.14E-12	1.14E-12
Pb-210	1.91E-14	1.91E-14
Th-232	2.01E-11	2.01E-11
Ra-228	5.60E-11	5.60E-11
Th-228	1.05E-09	1.05E-09
U-234	1.30E-11	1.30E-11
Th-230	1.83E-15	1.83E-15
Ra-226	8.63E-17	8.63E-17
Pb-210	1.14E-18	1.14E-18
U-235	2.51E-11	2.51E-11
Pa-231	1.04E-14	1.04E-14
Ac-227	7.85E-15	7.85E-15
U-238	1.94E-11	1.94E-11
U-234	4.59E-16	4.59E-16
Th-230	4.29E-20	4.29E-20
Ra-226	1.52E-21	1.52E-21
Pb-210	1.64E-23	1.64E-23

Source: 2

Nuclide	Receptor	Total
	1	
Ac-227	1.49E-11	1.49E-11
Pa-231	7.17E-12	7.17E-12
Ac-227	6.71E-12	6.71E-12
Pb-210	2.06E-12	2.06E-12
Ra-226	2.51E-11	2.51E-11
Pb-210	9.04E-13	9.04E-13

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:22:29 Page: 11 **
 Title : SLDS DCGL Industrial Worker
 Input File : C:\RESRAD Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld
 Evaluation Time: 0.0000000E+00 years

Ra-228	2.38E-12	2.38E-12
Th-228	1.09E-10	1.09E-10
Th-228	4.01E-11	4.01E-11
Th-230	3.15E-12	3.15E-12
Ra-226	1.34E-13	1.34E-13
Pb-210	3.47E-15	3.47E-15
Th-232	4.01E-12	4.01E-12
Ra-228	5.11E-12	5.11E-12
Th-228	2.01E-10	2.01E-10
U-234	2.57E-12	2.57E-12
Th-230	3.63E-16	3.63E-16
Ra-226	1.02E-17	1.02E-17
Pb-210	2.06E-19	2.06E-19
U-235	2.93E-12	2.93E-12
Pa-231	1.90E-15	1.90E-15
Ac-227	1.26E-15	1.26E-15
U-238	2.65E-12	2.65E-12
U-234	9.10E-17	9.10E-17
Th-230	8.53E-21	8.53E-21
Ra-226	1.80E-22	1.80E-22
Pb-210	2.98E-24	2.98E-24

Source: 3

Nuclide	Receptor	Total
	1	
Ac-227	1.49E-11	1.49E-11
Pa-231	7.17E-12	7.17E-12
Ac-227	6.71E-12	6.71E-12
Pb-210	2.06E-12	2.06E-12
Ra-226	2.51E-11	2.51E-11
Pb-210	9.04E-13	9.04E-13
Ra-228	2.38E-12	2.38E-12
Th-228	1.09E-10	1.09E-10
Th-228	4.01E-11	4.01E-11
Th-230	3.15E-12	3.15E-12
Ra-226	1.34E-13	1.34E-13
Pb-210	3.47E-15	3.47E-15
Th-232	4.01E-12	4.01E-12
Ra-228	5.11E-12	5.11E-12
Th-228	2.01E-10	2.01E-10
U-234	2.57E-12	2.57E-12
Th-230	3.63E-16	3.63E-16
Ra-226	1.02E-17	1.02E-17
Pb-210	2.06E-19	2.06E-19
U-235	2.93E-12	2.93E-12
Pa-231	1.90E-15	1.90E-15
Ac-227	1.26E-15	1.26E-15
U-238	2.65E-12	2.65E-12
U-234	9.10E-17	9.10E-17

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:22:29 Page: 12 **
 Title : SLDS DCGL Industrial Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld
 Evaluation Time: 0.0000000E+00 years

Th-230	8.53E-21	8.53E-21
Ra-226	1.80E-22	1.80E-22
Pb-210	2.98E-24	2.98E-24

Source: 4

Nuclide	Receptor	Total
	1	
Ac-227	1.49E-11	1.49E-11
Pa-231	7.17E-12	7.17E-12
Ac-227	6.71E-12	6.71E-12
Pb-210	2.06E-12	2.06E-12
Ra-226	2.51E-11	2.51E-11
Pb-210	9.04E-13	9.04E-13
Ra-228	2.38E-12	2.38E-12
Th-228	1.09E-10	1.09E-10
Th-228	4.01E-11	4.01E-11
Th-230	3.15E-12	3.15E-12
Ra-226	1.34E-13	1.34E-13
Pb-210	3.47E-15	3.47E-15
Th-232	4.01E-12	4.01E-12
Ra-228	5.11E-12	5.11E-12
Th-228	2.01E-10	2.01E-10
U-234	2.57E-12	2.57E-12
Th-230	3.63E-16	3.63E-16
Ra-226	1.02E-17	1.02E-17
Pb-210	2.06E-19	2.06E-19
U-235	2.93E-12	2.93E-12
Pa-231	1.90E-15	1.90E-15
Ac-227	1.26E-15	1.26E-15
U-238	2.65E-12	2.65E-12
U-234	9.10E-17	9.10E-17
Th-230	8.53E-21	8.53E-21
Ra-226	1.80E-22	1.80E-22
Pb-210	2.98E-24	2.98E-24

Source: 5

Nuclide	Receptor	Total
	1	
Ac-227	1.49E-11	1.49E-11
Pa-231	7.17E-12	7.17E-12
Ac-227	6.71E-12	6.71E-12
Pb-210	2.06E-12	2.06E-12
Ra-226	2.51E-11	2.51E-11

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:22:29 Page: 13 **
Title : SLDS DCGL Industrial Worker
Input File : C:\RESRAD Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld
Evaluation Time: 0.0000000E+00 years

Pb-210	9.04E-13	9.04E-13
Ra-228	2.38E-12	2.38E-12
Th-228	1.09E-10	1.09E-10
Th-228	4.01E-11	4.01E-11
Th-230	3.15E-12	3.15E-12
Ra-226	1.34E-13	1.34E-13
Pb-210	3.47E-15	3.47E-15
Th-232	4.01E-12	4.01E-12
Ra-228	5.11E-12	5.11E-12
Th-228	2.01E-10	2.01E-10
U-234	2.57E-12	2.57E-12
Th-230	3.63E-16	3.63E-16
Ra-226	1.02E-17	1.02E-17
Pb-210	2.06E-19	2.06E-19
U-235	2.93E-12	2.93E-12
Pa-231	1.90E-15	1.90E-15
Ac-227	1.26E-15	1.26E-15
U-238	2.65E-12	2.65E-12
U-234	9.10E-17	9.10E-17
Th-230	8.53E-21	8.53E-21
Ra-226	1.80E-22	1.80E-22
Pb-210	2.98E-24	2.98E-24

RESRAD-BUILD Risk Tables

[Risk]

	Source 1	Source 2	Source 3	Source 4	Source 5	Total
Receptor 1	2.40E-09	4.29E-10	4.29E-10	4.29E-10	4.29E-10	4.12E-09
Total	2.40E-09	4.29E-10	4.29E-10	4.29E-10	4.29E-10	4.12E-09

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:22:29 Page: 15 **

Title : SLDS DCGL Industrial Worker

Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld

Evaluation Time: 1.00000000 years

Pathway Detail of Risks

[Risk]								
Source: 1	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	3.47E-10	3.20E-10	4.18E-15	7.92E-16	1.87E-13	1.73E-09	0.00E+00	2.40E-09
Total	3.47E-10	3.20E-10	4.18E-15	7.92E-16	1.87E-13	1.73E-09	0.00E+00	2.40E-09
Source: 2	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	1.90E-11	6.40E-11	8.35E-16	1.58E-16	3.74E-14	3.46E-10	0.00E+00	4.29E-10
Total	1.90E-11	6.40E-11	8.35E-16	1.58E-16	3.74E-14	3.46E-10	0.00E+00	4.29E-10
Source: 3	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	1.90E-11	6.40E-11	8.35E-16	1.58E-16	3.74E-14	3.46E-10	0.00E+00	4.29E-10
Total	1.90E-11	6.40E-11	8.35E-16	1.58E-16	3.74E-14	3.46E-10	0.00E+00	4.29E-10
Source: 4	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	1.90E-11	6.40E-11	8.35E-16	1.58E-16	3.74E-14	3.46E-10	0.00E+00	4.29E-10
Total	1.90E-11	6.40E-11	8.35E-16	1.58E-16	3.74E-14	3.46E-10	0.00E+00	4.29E-10
Source: 5	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	1.90E-11	6.40E-11	8.35E-16	1.58E-16	3.74E-14	3.46E-10	0.00E+00	4.29E-10
Total	1.90E-11	6.40E-11	8.35E-16	1.58E-16	3.74E-14	3.46E-10	0.00E+00	4.29E-10

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:22:29 Page: 16 **
 Title : SLDS DCGL Industrial Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld
 Evaluation Time: 1.00000000 years

Nuclide Detail of Risks

[Risk]

Source: 1

Nuclide	Receptor 1	Total
Ac-227	9.09E-11	9.09E-11
Pa-231	3.95E-11	3.95E-11
Ac-227	4.49E-11	4.49E-11
Pb-210	1.10E-11	1.10E-11
Ra-226	2.12E-10	2.12E-10
Pb-210	5.33E-12	5.33E-12
Ra-228	2.34E-11	2.34E-11
Th-228	5.61E-10	5.61E-10
Th-228	1.45E-10	1.45E-10
Th-230	1.59E-11	1.59E-11
Ra-226	1.22E-12	1.22E-12
Pb-210	2.13E-14	2.13E-14
Th-232	2.01E-11	2.01E-11
Ra-228	5.89E-11	5.89E-11
Th-228	1.11E-09	1.11E-09
U-234	1.30E-11	1.30E-11
Th-230	1.97E-15	1.97E-15
Ra-226	9.69E-17	9.69E-17
Pb-210	1.32E-18	1.32E-18
U-235	2.50E-11	2.50E-11
Pa-231	1.13E-14	1.13E-14
Ac-227	8.76E-15	8.76E-15
U-238	1.94E-11	1.94E-11
U-234	4.95E-16	4.95E-16
Th-230	4.83E-20	4.83E-20
Ra-226	1.77E-21	1.77E-21
Pb-210	1.99E-23	1.99E-23

Source: 2

Nuclide	Receptor 1	Total
Ac-227	1.45E-11	1.45E-11
Pa-231	7.18E-12	7.18E-12
Ac-227	7.18E-12	7.18E-12
Pb-210	2.00E-12	2.00E-12
Ra-226	2.50E-11	2.50E-11
Pb-210	9.67E-13	9.67E-13

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:22:29 Page: 17 **

Title : SLDS DCGL Industrial Worker
 Input File : C:\RESRAD Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld
 Evaluation Time: 1.00000000 years

Ra-228	2.12E-12	2.12E-12
Th-228	1.08E-10	1.08E-10
Th-228	2.78E-11	2.78E-11
Th-230	3.16E-12	3.16E-12
Ra-226	1.45E-13	1.45E-13
Pb-210	3.87E-15	3.87E-15
Th-232	4.01E-12	4.01E-12
Ra-228	5.37E-12	5.37E-12
Th-228	2.14E-10	2.14E-10
U-234	2.58E-12	2.58E-12
Th-230	3.92E-16	3.92E-16
Ra-226	1.15E-17	1.15E-17
Pb-210	2.40E-19	2.40E-19
U-235	2.93E-12	2.93E-12
Pa-231	2.05E-15	2.05E-15
Ac-227	1.40E-15	1.40E-15
U-238	2.65E-12	2.65E-12
U-234	9.82E-17	9.82E-17
Th-230	9.59E-21	9.59E-21
Ra-226	2.09E-22	2.09E-22
Pb-210	3.61E-24	3.61E-24

Source: 3

Nuclide	Receptor	Total
	1	
Ac-227	1.45E-11	1.45E-11
Pa-231	7.18E-12	7.18E-12
Ac-227	7.18E-12	7.18E-12
Pb-210	2.00E-12	2.00E-12
Ra-226	2.50E-11	2.50E-11
Pb-210	9.67E-13	9.67E-13
Ra-228	2.12E-12	2.12E-12
Th-228	1.08E-10	1.08E-10
Th-228	2.78E-11	2.78E-11
Th-230	3.16E-12	3.16E-12
Ra-226	1.45E-13	1.45E-13
Pb-210	3.87E-15	3.87E-15
Th-232	4.01E-12	4.01E-12
Ra-228	5.37E-12	5.37E-12
Th-228	2.14E-10	2.14E-10
U-234	2.58E-12	2.58E-12
Th-230	3.92E-16	3.92E-16
Ra-226	1.15E-17	1.15E-17
Pb-210	2.40E-19	2.40E-19
U-235	2.93E-12	2.93E-12
Pa-231	2.05E-15	2.05E-15
Ac-227	1.40E-15	1.40E-15
U-238	2.65E-12	2.65E-12
U-234	9.82E-17	9.82E-17

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:22:29 Page: 18 **
 Title : SLDS DCGL Industrial Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld
 Evaluation Time: 1.00000000 years

Th-230	9.59E-21	9.59E-21
Ra-226	2.09E-22	2.09E-22
Pb-210	3.61E-24	3.61E-24

Source: 4

Nuclide	Receptor	Total
	1	
Ac-227	1.45E-11	1.45E-11
Pa-231	7.18E-12	7.18E-12
Ac-227	7.18E-12	7.18E-12
Pb-210	2.00E-12	2.00E-12
Ra-226	2.50E-11	2.50E-11
Pb-210	9.67E-13	9.67E-13
Ra-228	2.12E-12	2.12E-12
Th-228	1.08E-10	1.08E-10
Th-228	2.78E-11	2.78E-11
Th-230	3.16E-12	3.16E-12
Ra-226	1.45E-13	1.45E-13
Pb-210	3.87E-15	3.87E-15
Th-232	4.01E-12	4.01E-12
Ra-228	5.37E-12	5.37E-12
Th-228	2.14E-10	2.14E-10
U-234	2.58E-12	2.58E-12
Th-230	3.92E-16	3.92E-16
Ra-226	1.15E-17	1.15E-17
Pb-210	2.40E-19	2.40E-19
U-235	2.93E-12	2.93E-12
Pa-231	2.05E-15	2.05E-15
Ac-227	1.40E-15	1.40E-15
U-238	2.65E-12	2.65E-12
U-234	9.82E-17	9.82E-17
Th-230	9.59E-21	9.59E-21
Ra-226	2.09E-22	2.09E-22
Pb-210	3.61E-24	3.61E-24

Source: 5

Nuclide	Receptor	Total
	1	
Ac-227	1.45E-11	1.45E-11
Pa-231	7.18E-12	7.18E-12
Ac-227	7.18E-12	7.18E-12
Pb-210	2.00E-12	2.00E-12
Ra-226	2.50E-11	2.50E-11

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:22:29 Page: 19 **
Title : SLDS DCGL Industrial Worker
Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld
Evaluation Time: 1.00000000 years

Pb-210	9.67E-13	9.67E-13
Ra-228	2.12E-12	2.12E-12
Th-228	1.08E-10	1.08E-10
Th-228	2.78E-11	2.78E-11
Th-230	3.16E-12	3.16E-12
Ra-226	1.45E-13	1.45E-13
Pb-210	3.87E-15	3.87E-15
Th-232	4.01E-12	4.01E-12
Ra-228	5.37E-12	5.37E-12
Th-228	2.14E-10	2.14E-10
U-234	2.58E-12	2.58E-12
Th-230	3.92E-16	3.92E-16
Ra-226	1.15E-17	1.15E-17
Pb-210	2.40E-19	2.40E-19
U-235	2.93E-12	2.93E-12
Pa-231	2.05E-15	2.05E-15
Ac-227	1.40E-15	1.40E-15
U-238	2.65E-12	2.65E-12
U-234	9.82E-17	9.82E-17
Th-230	9.59E-21	9.59E-21
Ra-226	2.09E-22	2.09E-22
Pb-210	3.61E-24	3.61E-24

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:22:29 Page: 20 **
 Title : SLDS DCGL Industrial Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld
 Evaluation Time: 3.00000000 years

RESRAD-BUILD Risk Tables

Source Contributions to Receptor Risks

[Risk]						
	Source 1	Source 2	Source 3	Source 4	Source 5	Total
Receptor 1	2.38E-09	4.25E-10	4.25E-10	4.25E-10	4.25E-10	4.08E-09
Total	2.38E-09	4.25E-10	4.25E-10	4.25E-10	4.25E-10	4.08E-09

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:22:29 Page: 21 **
 Title : SLDS DCGL Industrial Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld
 Evaluation Time: 3.00000000 years

Pathway Detail of Risks

[Risk]								
Source: 1	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	3.44E-10	3.13E-10	4.09E-15	7.75E-16	1.83E-13	1.72E-09	0.00E+00	2.38E-09
Total	3.44E-10	3.13E-10	4.09E-15	7.75E-16	1.83E-13	1.72E-09	0.00E+00	2.38E-09
Source: 2	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	1.88E-11	6.25E-11	8.19E-16	1.55E-16	3.67E-14	3.44E-10	0.00E+00	4.25E-10
Total	1.88E-11	6.25E-11	8.19E-16	1.55E-16	3.67E-14	3.44E-10	0.00E+00	4.25E-10
Source: 3	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	1.88E-11	6.25E-11	8.19E-16	1.55E-16	3.67E-14	3.44E-10	0.00E+00	4.25E-10
Total	1.88E-11	6.25E-11	8.19E-16	1.55E-16	3.67E-14	3.44E-10	0.00E+00	4.25E-10
Source: 4	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	1.88E-11	6.25E-11	8.19E-16	1.55E-16	3.67E-14	3.44E-10	0.00E+00	4.25E-10
Total	1.88E-11	6.25E-11	8.19E-16	1.55E-16	3.67E-14	3.44E-10	0.00E+00	4.25E-10
Source: 5	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	1.88E-11	6.25E-11	8.19E-16	1.55E-16	3.67E-14	3.44E-10	0.00E+00	4.25E-10
Total	1.88E-11	6.25E-11	8.19E-16	1.55E-16	3.67E-14	3.44E-10	0.00E+00	4.25E-10

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:22:29 Page: 22 **
 Title : SLDS DCGL Industrial Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld
 Evaluation Time: 3.00000000 years

Nuclide Detail of Risks

[Risk]

Source: 1

Nuclide	Receptor	Total
	1	
Ac-227	8.42E-11	8.42E-11
Pa-231	3.87E-11	3.87E-11
Ac-227	4.91E-11	4.91E-11
Pb-210	1.02E-11	1.02E-11
Ra-226	2.10E-10	2.10E-10
Pb-210	5.80E-12	5.80E-12
Ra-228	1.83E-11	1.83E-11
Th-228	5.02E-10	5.02E-10
Th-228	6.96E-11	6.96E-11
Th-230	1.55E-11	1.55E-11
Ra-226	1.39E-12	1.39E-12
Pb-210	2.49E-14	2.49E-14
Th-232	1.97E-11	1.97E-11
Ra-228	6.31E-11	6.31E-11
Th-228	1.23E-09	1.23E-09
U-234	1.27E-11	1.27E-11
Th-230	2.17E-15	2.17E-15
Ra-226	1.20E-16	1.20E-16
Pb-210	1.64E-18	1.64E-18
U-235	2.47E-11	2.47E-11
Pa-231	1.25E-14	1.25E-14
Ac-227	1.03E-14	1.03E-14
U-238	1.91E-11	1.91E-11
U-234	5.46E-16	5.46E-16
Th-230	5.67E-20	5.67E-20
Ra-226	2.35E-21	2.35E-21
Pb-210	2.61E-23	2.61E-23

Source: 2

Nuclide	Receptor	Total
	1	
Ac-227	1.34E-11	1.34E-11
Pa-231	7.02E-12	7.02E-12
Ac-227	7.81E-12	7.81E-12
Pb-210	1.85E-12	1.85E-12
Ra-226	2.48E-11	2.48E-11
Pb-210	1.05E-12	1.05E-12

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:22:29 Page: 23 **

Title : SLDS DCGL Industrial Worker

Input File : C:\RESRAD Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld

Evaluation Time: 3.00000000 years

Ra-228	1.65E-12	1.65E-12
Th-228	9.66E-11	9.66E-11
Th-228	1.34E-11	1.34E-11
Th-230	3.09E-12	3.09E-12
Ra-226	1.65E-13	1.65E-13
Pb-210	4.51E-15	4.51E-15
Th-232	3.92E-12	3.92E-12
Ra-228	5.72E-12	5.72E-12
Th-228	2.37E-10	2.37E-10
U-234	2.52E-12	2.52E-12
Th-230	4.32E-16	4.32E-16
Ra-226	1.41E-17	1.41E-17
Pb-210	2.96E-19	2.96E-19
U-235	2.87E-12	2.87E-12
Pa-231	2.26E-15	2.26E-15
Ac-227	1.64E-15	1.64E-15
U-238	2.60E-12	2.60E-12
U-234	1.08E-16	1.08E-16
Th-230	1.13E-20	1.13E-20
Ra-226	2.78E-22	2.78E-22
Pb-210	4.71E-24	4.71E-24

Source: 3

Nuclide	Receptor	Total
	1	
Ac-227	1.34E-11	1.34E-11
Pa-231	7.02E-12	7.02E-12
Ac-227	7.81E-12	7.81E-12
Pb-210	1.85E-12	1.85E-12
Ra-226	2.48E-11	2.48E-11
Pb-210	1.05E-12	1.05E-12
Ra-228	1.65E-12	1.65E-12
Th-228	9.66E-11	9.66E-11
Th-228	1.34E-11	1.34E-11
Th-230	3.09E-12	3.09E-12
Ra-226	1.65E-13	1.65E-13
Pb-210	4.51E-15	4.51E-15
Th-232	3.92E-12	3.92E-12
Ra-228	5.72E-12	5.72E-12
Th-228	2.37E-10	2.37E-10
U-234	2.52E-12	2.52E-12
Th-230	4.32E-16	4.32E-16
Ra-226	1.41E-17	1.41E-17
Pb-210	2.96E-19	2.96E-19
U-235	2.87E-12	2.87E-12
Pa-231	2.26E-15	2.26E-15
Ac-227	1.64E-15	1.64E-15
U-238	2.60E-12	2.60E-12
U-234	1.08E-16	1.08E-16

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:22:29 Page: 24 **
 Title : SLDS DCGL Industrial Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld
 Evaluation Time: 3.00000000 years

Th-230	1.13E-20	1.13E-20
Ra-226	2.78E-22	2.78E-22
Pb-210	4.71E-24	4.71E-24

Source: 4

Nuclide	Receptor	Total
	1	
Ac-227	1.34E-11	1.34E-11
Pa-231	7.02E-12	7.02E-12
Ac-227	7.81E-12	7.81E-12
Pb-210	1.85E-12	1.85E-12
Ra-226	2.48E-11	2.48E-11
Pb-210	1.05E-12	1.05E-12
Ra-228	1.65E-12	1.65E-12
Th-228	9.66E-11	9.66E-11
Th-228	1.34E-11	1.34E-11
Th-230	3.09E-12	3.09E-12
Ra-226	1.65E-13	1.65E-13
Pb-210	4.51E-15	4.51E-15
Th-232	3.92E-12	3.92E-12
Ra-228	5.72E-12	5.72E-12
Th-228	2.37E-10	2.37E-10
U-234	2.52E-12	2.52E-12
Th-230	4.32E-16	4.32E-16
Ra-226	1.41E-17	1.41E-17
Pb-210	2.96E-19	2.96E-19
U-235	2.87E-12	2.87E-12
Pa-231	2.26E-15	2.26E-15
Ac-227	1.64E-15	1.64E-15
U-238	2.60E-12	2.60E-12
U-234	1.08E-16	1.08E-16
Th-230	1.13E-20	1.13E-20
Ra-226	2.78E-22	2.78E-22
Pb-210	4.71E-24	4.71E-24

Source: 5

Nuclide	Receptor	Total
	1	
Ac-227	1.34E-11	1.34E-11
Pa-231	7.02E-12	7.02E-12
Ac-227	7.81E-12	7.81E-12
Pb-210	1.85E-12	1.85E-12
Ra-226	2.48E-11	2.48E-11

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:22:29 Page: 25 **
Title : SLDS DCGL Industrial Worker
Input File : C:\RESRAD Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld
Evaluation Time: 3.00000000 years

Pb-210	1.05E-12	1.05E-12
Ra-228	1.65E-12	1.65E-12
Th-228	9.66E-11	9.66E-11
Th-228	1.34E-11	1.34E-11
Th-230	3.09E-12	3.09E-12
Ra-226	1.65E-13	1.65E-13
Pb-210	4.51E-15	4.51E-15
Th-232	3.92E-12	3.92E-12
Ra-228	5.72E-12	5.72E-12
Th-228	2.37E-10	2.37E-10
U-234	2.52E-12	2.52E-12
Th-230	4.32E-16	4.32E-16
Ra-226	1.41E-17	1.41E-17
Pb-210	2.96E-19	2.96E-19
U-235	2.87E-12	2.87E-12
Pa-231	2.26E-15	2.26E-15
Ac-227	1.64E-15	1.64E-15
U-238	2.60E-12	2.60E-12
U-234	1.08E-16	1.08E-16
Th-230	1.13E-20	1.13E-20
Ra-226	2.78E-22	2.78E-22
Pb-210	4.71E-24	4.71E-24

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:22:29 Page: 26 **
 Title : SLDS DCGL Industrial Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld
 Evaluation Time: 10.0000000 years

RESRAD-BUILD Risk Tables

Source Contributions to Receptor Risks

[Risk]						
	Source 1	Source 2	Source 3	Source 4	Source 5	Total
Receptor 1	2.24E-09	3.99E-10	3.99E-10	3.99E-10	3.99E-10	3.83E-09
Total	2.24E-09	3.99E-10	3.99E-10	3.99E-10	3.99E-10	3.83E-09

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:22:29 Page: 27 **

Title : SLDS DCGL Industrial Worker

Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld

Evaluation Time: 10.0000000 years

Pathway Detail of Risks

[Risk]

Source: 1								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	3.37E-10	2.23E-10	2.92E-15	5.53E-16	1.31E-13	1.68E-09	0.00E+00	2.24E-09
Total	3.37E-10	2.23E-10	2.92E-15	5.53E-16	1.31E-13	1.68E-09	0.00E+00	2.24E-09
Source: 2								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	1.84E-11	4.46E-11	5.85E-16	1.11E-16	2.62E-14	3.36E-10	0.00E+00	3.99E-10
Total	1.84E-11	4.46E-11	5.85E-16	1.11E-16	2.62E-14	3.36E-10	0.00E+00	3.99E-10
Source: 3								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	1.84E-11	4.46E-11	5.85E-16	1.11E-16	2.62E-14	3.36E-10	0.00E+00	3.99E-10
Total	1.84E-11	4.46E-11	5.85E-16	1.11E-16	2.62E-14	3.36E-10	0.00E+00	3.99E-10
Source: 4								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	1.84E-11	4.46E-11	5.85E-16	1.11E-16	2.62E-14	3.36E-10	0.00E+00	3.99E-10
Total	1.84E-11	4.46E-11	5.85E-16	1.11E-16	2.62E-14	3.36E-10	0.00E+00	3.99E-10
Source: 5								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	1.84E-11	4.46E-11	5.85E-16	1.11E-16	2.62E-14	3.36E-10	0.00E+00	3.99E-10
Total	1.84E-11	4.46E-11	5.85E-16	1.11E-16	2.62E-14	3.36E-10	0.00E+00	3.99E-10

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:22:29 Page: 28 **
 Title : SLDS DCGL Industrial Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld
 Evaluation Time: 10.0000000 years

Nuclide Detail of Risks

[Risk]

Source: 1

Nuclide	Receptor 1	Total
Ac-227	5.66E-11	5.66E-11
Pa-231	2.87E-11	2.87E-11
Ac-227	4.82E-11	4.82E-11
Pb-210	6.66E-12	6.66E-12
Ra-226	2.01E-10	2.01E-10
Pb-210	5.30E-12	5.30E-12
Ra-228	7.56E-12	7.56E-12
Th-228	2.46E-10	2.46E-10
Th-228	5.36E-12	5.36E-12
Th-230	1.11E-11	1.11E-11
Ra-226	1.94E-12	1.94E-12
Pb-210	2.62E-14	2.62E-14
Th-232	1.41E-11	1.41E-11
Ra-228	6.67E-11	6.67E-11
Th-228	1.49E-09	1.49E-09
U-234	9.10E-12	9.10E-12
Th-230	1.92E-15	1.92E-15
Ra-226	2.19E-16	2.19E-16
Pb-210	1.89E-18	1.89E-18
U-235	2.11E-11	2.11E-11
Pa-231	1.17E-14	1.17E-14
Ac-227	1.22E-14	1.22E-14
U-238	1.58E-11	1.58E-11
U-234	4.82E-16	4.82E-16
Th-230	5.45E-20	5.45E-20
Ra-226	5.44E-21	5.44E-21
Pb-210	3.25E-23	3.25E-23

Source: 2

Nuclide	Receptor 1	Total
Ac-227	8.62E-12	8.62E-12
Pa-231	5.04E-12	5.04E-12
Ac-227	7.00E-12	7.00E-12
Pb-210	1.18E-12	1.18E-12
Ra-226	2.35E-11	2.35E-11
Pb-210	9.15E-13	9.15E-13

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:22:29 Page: 29 **

Title : SLDS DCGL Industrial Worker

Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld

Evaluation Time: 10.0000000 years

Ra-228	6.75E-13	6.75E-13
Th-228	4.72E-11	4.72E-11

Th-228	1.03E-12	1.03E-12

Th-230	2.20E-12	2.20E-12
Ra-226	2.25E-13	2.25E-13
Pb-210	4.39E-15	4.39E-15

Th-232	2.80E-12	2.80E-12
Ra-228	5.48E-12	5.48E-12
Th-228	2.87E-10	2.87E-10

U-234	1.80E-12	1.80E-12
Th-230	3.79E-16	3.79E-16
Ra-226	2.53E-17	2.53E-17
Pb-210	3.04E-19	3.04E-19

U-235	2.21E-12	2.21E-12
Pa-231	2.01E-15	2.01E-15
Ac-227	1.67E-15	1.67E-15

U-238	1.97E-12	1.97E-12
U-234	9.51E-17	9.51E-17
Th-230	1.07E-20	1.07E-20
Ra-226	6.26E-22	6.26E-22
Pb-210	4.99E-24	4.99E-24

Source: 3

Nuclide	Receptor	Total
	1	

Ac-227	8.62E-12	8.62E-12

Pa-231	5.04E-12	5.04E-12
Ac-227	7.00E-12	7.00E-12

Pb-210	1.18E-12	1.18E-12

Ra-226	2.35E-11	2.35E-11
Pb-210	9.15E-13	9.15E-13

Ra-228	6.75E-13	6.75E-13
Th-228	4.72E-11	4.72E-11

Th-228	1.03E-12	1.03E-12

Th-230	2.20E-12	2.20E-12
Ra-226	2.25E-13	2.25E-13
Pb-210	4.39E-15	4.39E-15

Th-232	2.80E-12	2.80E-12
Ra-228	5.48E-12	5.48E-12
Th-228	2.87E-10	2.87E-10

U-234	1.80E-12	1.80E-12
Th-230	3.79E-16	3.79E-16
Ra-226	2.53E-17	2.53E-17
Pb-210	3.04E-19	3.04E-19

U-235	2.21E-12	2.21E-12
Pa-231	2.01E-15	2.01E-15
Ac-227	1.67E-15	1.67E-15

U-238	1.97E-12	1.97E-12
U-234	9.51E-17	9.51E-17

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:22:29 Page: 30 **
 Title : SLDS DCGL Industrial Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld
 Evaluation Time: 10.0000000 years

Th-230	1.07E-20	1.07E-20
Ra-226	6.26E-22	6.26E-22
Pb-210	4.99E-24	4.99E-24

Source: 4

Nuclide	Receptor	Total
	1	
Ac-227	8.62E-12	8.62E-12
Pa-231	5.04E-12	5.04E-12
Ac-227	7.00E-12	7.00E-12
Pb-210	1.18E-12	1.18E-12
Ra-226	2.35E-11	2.35E-11
Pb-210	9.15E-13	9.15E-13
Ra-228	6.75E-13	6.75E-13
Th-228	4.72E-11	4.72E-11
Th-228	1.03E-12	1.03E-12
Th-230	2.20E-12	2.20E-12
Ra-226	2.25E-13	2.25E-13
Pb-210	4.39E-15	4.39E-15
Th-232	2.80E-12	2.80E-12
Ra-228	5.48E-12	5.48E-12
Th-228	2.87E-10	2.87E-10
U-234	1.80E-12	1.80E-12
Th-230	3.79E-16	3.79E-16
Ra-226	2.53E-17	2.53E-17
Pb-210	3.04E-19	3.04E-19
U-235	2.21E-12	2.21E-12
Pa-231	2.01E-15	2.01E-15
Ac-227	1.67E-15	1.67E-15
U-238	1.97E-12	1.97E-12
U-234	9.51E-17	9.51E-17
Th-230	1.07E-20	1.07E-20
Ra-226	6.26E-22	6.26E-22
Pb-210	4.99E-24	4.99E-24

Source: 5

Nuclide	Receptor	Total
	1	
Ac-227	8.62E-12	8.62E-12
Pa-231	5.04E-12	5.04E-12
Ac-227	7.00E-12	7.00E-12
Pb-210	1.18E-12	1.18E-12
Ra-226	2.35E-11	2.35E-11

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:22:29 Page: 31 **
Title : SLDS DCGL Industrial Worker
Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld
Evaluation Time: 10.0000000 years

Pb-210	9.15E-13	9.15E-13
Ra-228	6.75E-13	6.75E-13
Th-228	4.72E-11	4.72E-11
Th-228	1.03E-12	1.03E-12
Th-230	2.20E-12	2.20E-12
Ra-226	2.25E-13	2.25E-13
Pb-210	4.39E-15	4.39E-15
Th-232	2.80E-12	2.80E-12
Ra-228	5.48E-12	5.48E-12
Th-228	2.87E-10	2.87E-10
U-234	1.80E-12	1.80E-12
Th-230	3.79E-16	3.79E-16
Ra-226	2.53E-17	2.53E-17
Pb-210	3.04E-19	3.04E-19
U-235	2.21E-12	2.21E-12
Pa-231	2.01E-15	2.01E-15
Ac-227	1.67E-15	1.67E-15
U-238	1.97E-12	1.97E-12
U-234	9.51E-17	9.51E-17
Th-230	1.07E-20	1.07E-20
Ra-226	6.26E-22	6.26E-22
Pb-210	4.99E-24	4.99E-24

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:22:29 Page: 32 **
 Title : SLDS DCGL Industrial Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld
 Evaluation Time: 20.0000000 years

RESRAD-BUILD Risk Tables

Source Contributions to Receptor Risks

		[Risk]					
		Source 1	Source 2	Source 3	Source 4	Source 5	Total
Receptor	1	2.07E-09	3.66E-10	3.66E-10	3.66E-10	3.66E-10	3.54E-09
Total		2.07E-09	3.66E-10	3.66E-10	3.66E-10	3.66E-10	3.54E-09

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:22:29 Page: 33 **

Title : SLDS DCGL Industrial Worker

Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld

Evaluation Time: 20.0000000 years

Pathway Detail of Risks

[Risk]

Source: 1		External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor	1	3.30E-10	9.50E-11	1.25E-15	2.35E-16	5.61E-14	1.65E-09	0.00E+00	2.07E-09
Total		3.30E-10	9.50E-11	1.25E-15	2.35E-16	5.61E-14	1.65E-09	0.00E+00	2.07E-09
Source: 2		External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor	1	1.80E-11	1.90E-11	2.50E-16	4.71E-17	1.12E-14	3.29E-10	0.00E+00	3.66E-10
Total		1.80E-11	1.90E-11	2.50E-16	4.71E-17	1.12E-14	3.29E-10	0.00E+00	3.66E-10
Source: 3		External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor	1	1.80E-11	1.90E-11	2.50E-16	4.71E-17	1.12E-14	3.29E-10	0.00E+00	3.66E-10
Total		1.80E-11	1.90E-11	2.50E-16	4.71E-17	1.12E-14	3.29E-10	0.00E+00	3.66E-10
Source: 4		External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor	1	1.80E-11	1.90E-11	2.50E-16	4.71E-17	1.12E-14	3.29E-10	0.00E+00	3.66E-10
Total		1.80E-11	1.90E-11	2.50E-16	4.71E-17	1.12E-14	3.29E-10	0.00E+00	3.66E-10
Source: 5		External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor	1	1.80E-11	1.90E-11	2.50E-16	4.71E-17	1.12E-14	3.29E-10	0.00E+00	3.66E-10
Total		1.80E-11	1.90E-11	2.50E-16	4.71E-17	1.12E-14	3.29E-10	0.00E+00	3.66E-10

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:22:29 Page: 34 **
Title : SLDS DCGL Industrial Worker
Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld
Evaluation Time: 20.0000000 years

Nuclide Detail of Risks

[Risk]

Source: 1

Nuclide	Receptor 1	Total
Ac-227	2.67E-11	2.67E-11
Pa-231	1.45E-11	1.45E-11
Ac-227	3.78E-11	3.78E-11
Pb-210	2.76E-12	2.76E-12
Ra-226	1.91E-10	1.91E-10
Pb-210	3.41E-12	3.41E-12
Ra-228	2.04E-12	2.04E-12
Th-228	7.27E-11	7.27E-11
Th-228	1.37E-13	1.37E-13
Th-230	4.80E-12	4.80E-12
Ra-226	2.69E-12	2.69E-12
Pb-210	2.31E-14	2.31E-14
Th-232	6.05E-12	6.05E-12
Ra-228	6.29E-11	6.29E-11
Th-228	1.61E-09	1.61E-09
U-234	3.94E-12	3.94E-12
Th-230	1.06E-15	1.06E-15
Ra-226	4.21E-16	4.21E-16
Pb-210	2.20E-18	2.20E-18
U-235	1.62E-11	1.62E-11
Pa-231	8.01E-15	8.01E-15
Ac-227	1.37E-14	1.37E-14
U-238	1.13E-11	1.13E-11
U-234	2.67E-16	2.67E-16
Th-230	3.61E-20	3.61E-20
Ra-226	1.40E-20	1.40E-20
Pb-210	5.04E-23	5.04E-23

Source: 2

Nuclide	Receptor 1	Total
Ac-227	3.43E-12	3.43E-12
Pa-231	2.21E-12	2.21E-12
Ac-227	4.25E-12	4.25E-12
Pb-210	4.43E-13	4.43E-13
Ra-226	2.19E-11	2.19E-11
Pb-210	5.01E-13	5.01E-13

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:22:29 Page: 35 **

Title : SLDS DCGL Industrial Worker
 Input File : C:\RESRAD Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld
 Evaluation Time: 20.0000000 years

Ra-228	1.65E-13	1.65E-13
Th-228	1.40E-11	1.40E-11
Th-228	2.63E-14	2.63E-14
Th-230	9.39E-13	9.39E-13
Ra-226	3.07E-13	3.07E-13
Pb-210	3.07E-15	3.07E-15
Th-232	1.19E-12	1.19E-12
Ra-228	4.31E-12	4.31E-12
Th-228	3.10E-10	3.10E-10
U-234	7.67E-13	7.67E-13
Th-230	2.05E-16	2.05E-16
Ra-226	4.79E-17	4.79E-17
Pb-210	2.59E-19	2.59E-19
U-235	1.27E-12	1.27E-12
Pa-231	1.13E-15	1.13E-15
Ac-227	1.36E-15	1.36E-15
U-238	1.08E-12	1.08E-12
U-234	5.14E-17	5.14E-17
Th-230	6.92E-21	6.92E-21
Ra-226	1.59E-21	1.59E-21
Pb-210	5.14E-24	5.14E-24

Source: 3

Nuclide	Receptor	Total
	1	
Ac-227	3.43E-12	3.43E-12
Pa-231	2.21E-12	2.21E-12
Ac-227	4.25E-12	4.25E-12
Pb-210	4.43E-13	4.43E-13
Ra-226	2.19E-11	2.19E-11
Pb-210	5.01E-13	5.01E-13
Ra-228	1.65E-13	1.65E-13
Th-228	1.40E-11	1.40E-11
Th-228	2.63E-14	2.63E-14
Th-230	9.39E-13	9.39E-13
Ra-226	3.07E-13	3.07E-13
Pb-210	3.07E-15	3.07E-15
Th-232	1.19E-12	1.19E-12
Ra-228	4.31E-12	4.31E-12
Th-228	3.10E-10	3.10E-10
U-234	7.67E-13	7.67E-13
Th-230	2.05E-16	2.05E-16
Ra-226	4.79E-17	4.79E-17
Pb-210	2.59E-19	2.59E-19
U-235	1.27E-12	1.27E-12
Pa-231	1.13E-15	1.13E-15
Ac-227	1.36E-15	1.36E-15
U-238	1.08E-12	1.08E-12
U-234	5.14E-17	5.14E-17

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:22:29 Page: 36 **
 Title : SLDS DCGL Industrial Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld
 Evaluation Time: 20.0000000 years

Th-230	6.92E-21	6.92E-21
Ra-226	1.59E-21	1.59E-21
Pb-210	5.14E-24	5.14E-24

Source: 4

Nuclide	Receptor	Total
	1	
Ac-227	3.43E-12	3.43E-12
Pa-231	2.21E-12	2.21E-12
Ac-227	4.25E-12	4.25E-12
Pb-210	4.43E-13	4.43E-13
Ra-226	2.19E-11	2.19E-11
Pb-210	5.01E-13	5.01E-13
Ra-228	1.65E-13	1.65E-13
Th-228	1.40E-11	1.40E-11
Th-228	2.63E-14	2.63E-14
Th-230	9.39E-13	9.39E-13
Ra-226	3.07E-13	3.07E-13
Pb-210	3.07E-15	3.07E-15
Th-232	1.19E-12	1.19E-12
Ra-228	4.31E-12	4.31E-12
Th-228	3.10E-10	3.10E-10
U-234	7.67E-13	7.67E-13
Th-230	2.05E-16	2.05E-16
Ra-226	4.79E-17	4.79E-17
Pb-210	2.59E-19	2.59E-19
U-235	1.27E-12	1.27E-12
Pa-231	1.13E-15	1.13E-15
Ac-227	1.36E-15	1.36E-15
U-238	1.08E-12	1.08E-12
U-234	5.14E-17	5.14E-17
Th-230	6.92E-21	6.92E-21
Ra-226	1.59E-21	1.59E-21
Pb-210	5.14E-24	5.14E-24

Source: 5

Nuclide	Receptor	Total
	1	
Ac-227	3.43E-12	3.43E-12
Pa-231	2.21E-12	2.21E-12
Ac-227	4.25E-12	4.25E-12
Pb-210	4.43E-13	4.43E-13
Ra-226	2.19E-11	2.19E-11

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:22:29 Page: 37 **
Title : SLDS DCGL Industrial Worker
Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld
Evaluation Time: 20.0000000 years

Pb-210	5.01E-13	5.01E-13
Ra-228	1.65E-13	1.65E-13
Th-228	1.40E-11	1.40E-11
Th-228	2.63E-14	2.63E-14
Th-230	9.39E-13	9.39E-13
Ra-226	3.07E-13	3.07E-13
Pb-210	3.07E-15	3.07E-15
Th-232	1.19E-12	1.19E-12
Ra-228	4.31E-12	4.31E-12
Th-228	3.10E-10	3.10E-10
U-234	7.67E-13	7.67E-13
Th-230	2.05E-16	2.05E-16
Ra-226	4.79E-17	4.79E-17
Pb-210	2.59E-19	2.59E-19
U-235	1.27E-12	1.27E-12
Pa-231	1.13E-15	1.13E-15
Ac-227	1.36E-15	1.36E-15
U-238	1.08E-12	1.08E-12
U-234	5.14E-17	5.14E-17
Th-230	6.92E-21	6.92E-21
Ra-226	1.59E-21	1.59E-21
Pb-210	5.14E-24	5.14E-24

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:22:29 Page: 38 **
 Title : SLDS DCGL Industrial Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld
 Evaluation Time: 30.0000000 years

RESRAD-BUILD Risk Tables

Source Contributions to Receptor Risks

		[Risk]					
		Source 1	Source 2	Source 3	Source 4	Source 5	Total
Receptor	1	1.97E-09	3.46E-10	3.46E-10	3.46E-10	3.46E-10	3.35E-09
Total		1.97E-09	3.46E-10	3.46E-10	3.46E-10	3.46E-10	3.35E-09

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:22:29 Page: 39 **

Title : SLDS DCGL Industrial Worker

Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld

Evaluation Time: 30.0000000 years

Pathway Detail of Risks

[Risk]

Source: 1

	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	3.28E-10	1.61E-23	5.10E-28	3.99E-29	2.29E-26	1.64E-09	0.00E+00	1.97E-09
Total	3.28E-10	1.61E-23	5.10E-28	3.99E-29	2.29E-26	1.64E-09	0.00E+00	1.97E-09

Source: 2

	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	1.80E-11	3.22E-24	1.02E-28	7.99E-30	4.57E-27	3.28E-10	0.00E+00	3.46E-10
Total	1.80E-11	3.22E-24	1.02E-28	7.99E-30	4.57E-27	3.28E-10	0.00E+00	3.46E-10

Source: 3

	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	1.80E-11	3.22E-24	1.02E-28	7.99E-30	4.57E-27	3.28E-10	0.00E+00	3.46E-10
Total	1.80E-11	3.22E-24	1.02E-28	7.99E-30	4.57E-27	3.28E-10	0.00E+00	3.46E-10

Source: 4

	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	1.80E-11	3.22E-24	1.02E-28	7.99E-30	4.57E-27	3.28E-10	0.00E+00	3.46E-10
Total	1.80E-11	3.22E-24	1.02E-28	7.99E-30	4.57E-27	3.28E-10	0.00E+00	3.46E-10

Source: 5

	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	1.80E-11	3.22E-24	1.02E-28	7.99E-30	4.57E-27	3.28E-10	0.00E+00	3.46E-10
Total	1.80E-11	3.22E-24	1.02E-28	7.99E-30	4.57E-27	3.28E-10	0.00E+00	3.46E-10

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:22:29 Page: 40 **
 Title : SLDS DCGL Industrial Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld
 Evaluation Time: 30.0000000 years

Nuclide Detail of Risks

[Risk]

Source: 1

Nuclide	Receptor 1	Total
Ac-227	9.30E-12	9.30E-12
Pa-231	3.98E-12	3.98E-12
Ac-227	2.57E-11	2.57E-11
Pb-210	5.20E-13	5.20E-13
Ra-226	1.86E-10	1.86E-10
Pb-210	1.38E-12	1.38E-12
Ra-228	4.98E-13	4.98E-13
Th-228	2.11E-11	2.11E-11
Th-228	3.45E-15	3.45E-15
Th-230	1.11E-13	1.11E-13
Ra-226	3.45E-12	3.45E-12
Pb-210	1.58E-14	1.58E-14
Th-232	8.64E-14	8.64E-14
Ra-228	5.82E-11	5.82E-11
Th-228	1.64E-09	1.64E-09
U-234	1.11E-13	1.11E-13
Th-230	4.33E-17	4.33E-17
Ra-226	6.95E-16	6.95E-16
Pb-210	2.38E-18	2.38E-18
U-235	1.27E-11	1.27E-11
Pa-231	3.58E-15	3.58E-15
Ac-227	1.44E-14	1.44E-14
U-238	7.99E-12	7.99E-12
U-234	1.33E-17	1.33E-17
Th-230	2.67E-21	2.67E-21
Ra-226	2.94E-20	2.94E-20
Pb-210	8.17E-23	8.17E-23

Source: 2

Nuclide	Receptor 1	Total
Ac-227	4.79E-13	4.79E-13
Pa-231	1.15E-13	1.15E-13
Ac-227	1.33E-12	1.33E-12
Pb-210	2.50E-14	2.50E-14
Ra-226	2.10E-11	2.10E-11
Pb-210	6.61E-14	6.61E-14

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:22:29 Page: 41 **
 Title : SLDS DCGL Industrial Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld
 Evaluation Time: 30.0000000 years

Ra-228	2.76E-14	2.76E-14
Th-228	4.04E-12	4.04E-12
Th-228	6.62E-16	6.62E-16
Th-230	1.40E-15	1.40E-15
Ra-226	3.89E-13	3.89E-13
Pb-210	7.58E-16	7.58E-16
Th-232	1.23E-15	1.23E-15
Ra-228	3.22E-12	3.22E-12
Th-228	3.14E-10	3.14E-10
U-234	1.30E-15	1.30E-15
Th-230	5.49E-19	5.49E-19
Ra-226	7.85E-17	7.85E-17
Pb-210	1.14E-19	1.14E-19
U-235	5.78E-13	5.78E-13
Pa-231	1.04E-16	1.04E-16
Ac-227	7.42E-16	7.42E-16
U-238	4.30E-13	4.30E-13
U-234	1.57E-19	1.57E-19
Th-230	3.39E-23	3.39E-23
Ra-226	3.32E-21	3.32E-21
Pb-210	3.93E-24	3.93E-24

Source: 3

Nuclide	Receptor 1	Total
Ac-227	4.79E-13	4.79E-13
Pa-231	1.15E-13	1.15E-13
Ac-227	1.33E-12	1.33E-12
Pb-210	2.50E-14	2.50E-14
Ra-226	2.10E-11	2.10E-11
Pb-210	6.61E-14	6.61E-14
Ra-228	2.76E-14	2.76E-14
Th-228	4.04E-12	4.04E-12
Th-228	6.62E-16	6.62E-16
Th-230	1.40E-15	1.40E-15
Ra-226	3.89E-13	3.89E-13
Pb-210	7.58E-16	7.58E-16
Th-232	1.23E-15	1.23E-15
Ra-228	3.22E-12	3.22E-12
Th-228	3.14E-10	3.14E-10
U-234	1.30E-15	1.30E-15
Th-230	5.49E-19	5.49E-19
Ra-226	7.85E-17	7.85E-17
Pb-210	1.14E-19	1.14E-19
U-235	5.78E-13	5.78E-13
Pa-231	1.04E-16	1.04E-16
Ac-227	7.42E-16	7.42E-16
U-238	4.30E-13	4.30E-13
U-234	1.57E-19	1.57E-19

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:22:29 Page: 42 **
 Title : SLDS DCGL Industrial Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld
 Evaluation Time: 30.0000000 years

Th-230	3.39E-23	3.39E-23
Ra-226	3.32E-21	3.32E-21
Pb-210	3.93E-24	3.93E-24

Source: 4

Nuclide	Receptor 1	Total
Ac-227	4.79E-13	4.79E-13
Pa-231	1.15E-13	1.15E-13
Ac-227	1.33E-12	1.33E-12
Pb-210	2.50E-14	2.50E-14
Ra-226	2.10E-11	2.10E-11
Pb-210	6.61E-14	6.61E-14
Ra-228	2.76E-14	2.76E-14
Th-228	4.04E-12	4.04E-12
Th-228	6.62E-16	6.62E-16
Th-230	1.40E-15	1.40E-15
Ra-226	3.89E-13	3.89E-13
Pb-210	7.58E-16	7.58E-16
Th-232	1.23E-15	1.23E-15
Ra-228	3.22E-12	3.22E-12
Th-228	3.14E-10	3.14E-10
U-234	1.30E-15	1.30E-15
Th-230	5.49E-19	5.49E-19
Ra-226	7.85E-17	7.85E-17
Pb-210	1.14E-19	1.14E-19
U-235	5.78E-13	5.78E-13
Pa-231	1.04E-16	1.04E-16
Ac-227	7.42E-16	7.42E-16
U-238	4.30E-13	4.30E-13
U-234	1.57E-19	1.57E-19
Th-230	3.39E-23	3.39E-23
Ra-226	3.32E-21	3.32E-21
Pb-210	3.93E-24	3.93E-24

Source: 5

Nuclide	Receptor 1	Total
Ac-227	4.79E-13	4.79E-13
Pa-231	1.15E-13	1.15E-13
Ac-227	1.33E-12	1.33E-12
Pb-210	2.50E-14	2.50E-14
Ra-226	2.10E-11	2.10E-11

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:22:29 Page: 43 **
Title : SLDS DCGL Industrial Worker
Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld
Evaluation Time: 30.0000000 years

Pb-210	6.61E-14	6.61E-14
Ra-228	2.76E-14	2.76E-14
Th-228	4.04E-12	4.04E-12
Th-228	6.62E-16	6.62E-16
Th-230	1.40E-15	1.40E-15
Ra-226	3.89E-13	3.89E-13
Pb-210	7.58E-16	7.58E-16
Th-232	1.23E-15	1.23E-15
Ra-228	3.22E-12	3.22E-12
Th-228	3.14E-10	3.14E-10
U-234	1.30E-15	1.30E-15
Th-230	5.49E-19	5.49E-19
Ra-226	7.85E-17	7.85E-17
Pb-210	1.14E-19	1.14E-19
U-235	5.78E-13	5.78E-13
Pa-231	1.04E-16	1.04E-16
Ac-227	7.42E-16	7.42E-16
U-238	4.30E-13	4.30E-13
U-234	1.57E-19	1.57E-19
Th-230	3.39E-23	3.39E-23
Ra-226	3.32E-21	3.32E-21
Pb-210	3.93E-24	3.93E-24

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:22:29 Page: 44 **
 Title : SLDS DCGL Industrial Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld
 Evaluation Time: 100.000008 years

RESRAD-BUILD Risk Tables

Source Contributions to Receptor Risks

		[Risk]					
		Source 1	Source 2	Source 3	Source 4	Source 5	Total
Receptor	1	1.97E-09	3.46E-10	3.46E-10	3.46E-10	3.46E-10	3.35E-09
Total		1.97E-09	3.46E-10	3.46E-10	3.46E-10	3.46E-10	3.35E-09

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:22:29 Page: 45 **

Title : SLDS DCGL Industrial Worker

Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld

Evaluation Time: 100.000008 years

Pathway Detail of Risks

[Risk]

Source: 1								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	3.28E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.64E-09	0.00E+00	1.97E-09
Total	3.28E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.64E-09	0.00E+00	1.97E-09
Source: 2								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	1.80E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.28E-10	0.00E+00	3.46E-10
Total	1.80E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.28E-10	0.00E+00	3.46E-10
Source: 3								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	1.80E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.28E-10	0.00E+00	3.46E-10
Total	1.80E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.28E-10	0.00E+00	3.46E-10
Source: 4								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	1.80E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.28E-10	0.00E+00	3.46E-10
Total	1.80E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.28E-10	0.00E+00	3.46E-10
Source: 5								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	1.80E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.28E-10	0.00E+00	3.46E-10
Total	1.80E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.28E-10	0.00E+00	3.46E-10

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:22:29 Page: 46 **
 Title : SLDS DCGL Industrial Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld
 Evaluation Time: 100.000008 years

Nuclide Detail of Risks

[Risk]

Source: 1

Nuclide	Receptor 1	Total
Ac-227	1.00E-12	1.00E-12
Pa-231	3.97E-12	3.97E-12
Ac-227	3.40E-11	3.40E-11
Pb-210	5.85E-14	5.85E-14
Ra-226	1.80E-10	1.80E-10
Pb-210	1.79E-12	1.79E-12
Ra-228	1.08E-16	1.08E-16
Th-228	4.56E-15	4.56E-15
Th-228	3.27E-26	3.27E-26
Th-230	1.11E-13	1.11E-13
Ra-226	8.99E-12	8.99E-12
Pb-210	6.61E-14	6.61E-14
Th-232	8.64E-14	8.64E-14
Ra-228	5.87E-11	5.87E-11
Th-228	1.66E-09	1.66E-09
U-234	1.11E-13	1.11E-13
Th-230	1.15E-16	1.15E-16
Ra-226	4.71E-15	4.71E-15
Pb-210	2.81E-17	2.81E-17
U-235	1.27E-11	1.27E-11
Pa-231	9.46E-15	9.46E-15
Ac-227	6.07E-14	6.07E-14
U-238	7.99E-12	7.99E-12
U-234	3.51E-17	3.51E-17
Th-230	1.83E-20	1.83E-20
Ra-226	5.05E-19	5.05E-19
Pb-210	2.56E-21	2.56E-21

Source: 2

Nuclide	Receptor 1	Total
Ac-227	5.16E-14	5.16E-14
Pa-231	1.15E-13	1.15E-13
Ac-227	1.75E-12	1.75E-12
Pb-210	2.81E-15	2.81E-15
Ra-226	2.03E-11	2.03E-11
Pb-210	8.58E-14	8.58E-14

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:22:29 Page: 47 **

Title : SLDS DCGL Industrial Worker

Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld

Evaluation Time: 100.000008 years

Ra-228	5.97E-18	5.97E-18
Th-228	8.75E-16	8.75E-16
Th-228	6.28E-27	6.28E-27
Th-230	1.40E-15	1.40E-15
Ra-226	1.02E-12	1.02E-12
Pb-210	3.18E-15	3.18E-15
Th-232	1.23E-15	1.23E-15
Ra-228	3.25E-12	3.25E-12
Th-228	3.18E-10	3.18E-10
U-234	1.30E-15	1.30E-15
Th-230	1.45E-18	1.45E-18
Ra-226	5.32E-16	5.32E-16
Pb-210	1.35E-18	1.35E-18
U-235	5.78E-13	5.78E-13
Pa-231	2.74E-16	2.74E-16
Ac-227	3.13E-15	3.13E-15
U-238	4.30E-13	4.30E-13
U-234	4.14E-19	4.14E-19
Th-230	2.32E-22	2.32E-22
Ra-226	5.70E-20	5.70E-20
Pb-210	1.23E-22	1.23E-22

Source: 3

Nuclide	Receptor 1	Total
Ac-227	5.16E-14	5.16E-14
Pa-231	1.15E-13	1.15E-13
Ac-227	1.75E-12	1.75E-12
Pb-210	2.81E-15	2.81E-15
Ra-226	2.03E-11	2.03E-11
Pb-210	8.58E-14	8.58E-14
Ra-228	5.97E-18	5.97E-18
Th-228	8.75E-16	8.75E-16
Th-228	6.28E-27	6.28E-27
Th-230	1.40E-15	1.40E-15
Ra-226	1.02E-12	1.02E-12
Pb-210	3.18E-15	3.18E-15
Th-232	1.23E-15	1.23E-15
Ra-228	3.25E-12	3.25E-12
Th-228	3.18E-10	3.18E-10
U-234	1.30E-15	1.30E-15
Th-230	1.45E-18	1.45E-18
Ra-226	5.32E-16	5.32E-16
Pb-210	1.35E-18	1.35E-18
U-235	5.78E-13	5.78E-13
Pa-231	2.74E-16	2.74E-16
Ac-227	3.13E-15	3.13E-15
U-238	4.30E-13	4.30E-13
U-234	4.14E-19	4.14E-19

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:22:29 Page: 48 **
 Title : SLDS DCGL Industrial Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld
 Evaluation Time: 100.000008 years

Th-230	2.32E-22	2.32E-22
Ra-226	5.70E-20	5.70E-20
Pb-210	1.23E-22	1.23E-22

Source: 4

Nuclide	Receptor	Total
	1	
Ac-227	5.16E-14	5.16E-14
Pa-231	1.15E-13	1.15E-13
Ac-227	1.75E-12	1.75E-12
Pb-210	2.81E-15	2.81E-15
Ra-226	2.03E-11	2.03E-11
Pb-210	8.58E-14	8.58E-14
Ra-228	5.97E-18	5.97E-18
Th-228	8.75E-16	8.75E-16
Th-228	6.28E-27	6.28E-27
Th-230	1.40E-15	1.40E-15
Ra-226	1.02E-12	1.02E-12
Pb-210	3.18E-15	3.18E-15
Th-232	1.23E-15	1.23E-15
Ra-228	3.25E-12	3.25E-12
Th-228	3.18E-10	3.18E-10
U-234	1.30E-15	1.30E-15
Th-230	1.45E-18	1.45E-18
Ra-226	5.32E-16	5.32E-16
Pb-210	1.35E-18	1.35E-18
U-235	5.78E-13	5.78E-13
Pa-231	2.74E-16	2.74E-16
Ac-227	3.13E-15	3.13E-15
U-238	4.30E-13	4.30E-13
U-234	4.14E-19	4.14E-19
Th-230	2.32E-22	2.32E-22
Ra-226	5.70E-20	5.70E-20
Pb-210	1.23E-22	1.23E-22

Source: 5

Nuclide	Receptor	Total
	1	
Ac-227	5.16E-14	5.16E-14
Pa-231	1.15E-13	1.15E-13
Ac-227	1.75E-12	1.75E-12
Pb-210	2.81E-15	2.81E-15
Ra-226	2.03E-11	2.03E-11

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:22:29 Page: 49 **
Title : SLDS DCGL Industrial Worker
Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld
Evaluation Time: 100.000008 years

Pb-210	8.58E-14	8.58E-14
Ra-228	5.97E-18	5.97E-18
Th-228	8.75E-16	8.75E-16
Th-228	6.28E-27	6.28E-27
Th-230	1.40E-15	1.40E-15
Ra-226	1.02E-12	1.02E-12
Pb-210	3.18E-15	3.18E-15
Th-232	1.23E-15	1.23E-15
Ra-228	3.25E-12	3.25E-12
Th-228	3.18E-10	3.18E-10
U-234	1.30E-15	1.30E-15
Th-230	1.45E-18	1.45E-18
Ra-226	5.32E-16	5.32E-16
Pb-210	1.35E-18	1.35E-18
U-235	5.78E-13	5.78E-13
Pa-231	2.74E-16	2.74E-16
Ac-227	3.13E-15	3.13E-15
U-238	4.30E-13	4.30E-13
U-234	4.14E-19	4.14E-19
Th-230	2.32E-22	2.32E-22
Ra-226	5.70E-20	5.70E-20
Pb-210	1.23E-22	1.23E-22

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:22:29 Page: 50 **
 Title : SLDS DCGL Industrial Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld
 Evaluation Time: 300.000031 years

RESRAD-BUILD Risk Tables

Source Contributions to Receptor Risks

		[Risk]					
		Source 1	Source 2	Source 3	Source 4	Source 5	Total
Receptor	1	1.97E-09	3.46E-10	3.46E-10	3.46E-10	3.46E-10	3.35E-09
Total		1.97E-09	3.46E-10	3.46E-10	3.46E-10	3.46E-10	3.35E-09

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:22:29 Page: 51 **
 Title : SLDS DCGL Industrial Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld
 Evaluation Time: 300.000031 years

Pathway Detail of Risks

[Risk]

Source: 1	External	Inhalation	External	External	Ingestion	Radon	Ingestion
Total	directly		from	from	of		of
	from		Deposition	Suspension	Deposition		Source
Receptor	Source		on floor	in air			
1	3.28E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.64E-09	0.00E+00
1.97E-09							
Total	3.28E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.64E-09	0.00E+00
1.97E-09							
Source: 2	External	Inhalation	External	External	Ingestion	Radon	Ingestion
Total	directly		from	from	of		of
	from		Deposition	Suspension	Deposition		Source
Receptor	Source		on floor	in air			
1	1.80E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.28E-10	0.00E+00
3.46E-10							
Total	1.80E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.28E-10	0.00E+00
3.46E-10							
Source: 3	External	Inhalation	External	External	Ingestion	Radon	Ingestion
Total	directly		from	from	of		of
	from		Deposition	Suspension	Deposition		Source
Receptor	Source		on floor	in air			
1	1.80E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.28E-10	0.00E+00
3.46E-10							
Total	1.80E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.28E-10	0.00E+00
3.46E-10							
Source: 4	External	Inhalation	External	External	Ingestion	Radon	Ingestion
Total	directly		from	from	of		of
	from		Deposition	Suspension	Deposition		Source
Receptor	Source		on floor	in air			
1	1.80E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.28E-10	0.00E+00
3.46E-10							
Total	1.80E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.28E-10	0.00E+00
3.46E-10							
Source: 5	External	Inhalation	External	External	Ingestion	Radon	Ingestion
Total	directly		from	from	of		of
	from		Deposition	Suspension	Deposition		Source
Receptor	Source		on floor	in air			
1	1.80E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.28E-10	0.00E+00
3.46E-10							
Total	1.80E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.28E-10	0.00E+00
3.46E-10							

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:22:29 Page: 52 **
 Title : SLDS DCGL Industrial Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld
 Evaluation Time: 300.000031 years

Nuclide Detail of Risks

[Risk]

Source: 1

Nuclide	Receptor	Total
	1	
Ac-227	1.72E-15	1.72E-15
Pa-231	3.95E-12	3.95E-12
Ac-227	3.48E-11	3.48E-11
Pb-210	1.13E-16	1.13E-16
Ra-226	1.65E-10	1.65E-10
Pb-210	1.69E-12	1.69E-12
Ra-228	3.65E-27	3.65E-27
Th-228	1.54E-25	1.54E-25
Th-228	0.00E+00	0.00E+00
Th-230	1.11E-13	1.11E-13
Ra-226	2.39E-11	2.39E-11
Pb-210	2.18E-13	2.18E-13
Th-232	8.64E-14	8.64E-14
Ra-228	5.87E-11	5.87E-11
Th-228	1.66E-09	1.66E-09
U-234	1.11E-13	1.11E-13
Th-230	3.18E-16	3.18E-16
Ra-226	3.52E-14	3.52E-14
Pb-210	2.91E-16	2.91E-16
U-235	1.27E-11	1.27E-11
Pa-231	2.62E-14	2.62E-14
Ac-227	2.08E-13	2.08E-13
U-238	7.99E-12	7.99E-12
U-234	9.76E-17	9.76E-17
Th-230	1.40E-19	1.40E-19
Ra-226	1.05E-17	1.05E-17
Pb-210	7.95E-20	7.95E-20

Source: 2

Nuclide	Receptor	Total
	1	
Ac-227	8.86E-17	8.86E-17
Pa-231	1.15E-13	1.15E-13
Ac-227	1.80E-12	1.80E-12
Pb-210	5.45E-18	5.45E-18
Ra-226	1.87E-11	1.87E-11
Pb-210	8.13E-14	8.13E-14

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:22:29 Page: 53 **

Title : SLDS DCGL Industrial Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld
 Evaluation Time: 300.000031 years

Ra-228	2.02E-28	2.02E-28
Th-228	2.96E-26	2.96E-26
Th-228	0.00E+00	0.00E+00
Th-230	1.40E-15	1.40E-15
Ra-226	2.70E-12	2.70E-12
Pb-210	1.05E-14	1.05E-14
Th-232	1.23E-15	1.23E-15
Ra-228	3.25E-12	3.25E-12
Th-228	3.18E-10	3.18E-10
U-234	1.30E-15	1.30E-15
Th-230	4.03E-18	4.03E-18
Ra-226	3.97E-15	3.97E-15
Pb-210	1.40E-17	1.40E-17
U-235	5.78E-13	5.78E-13
Pa-231	7.60E-16	7.60E-16
Ac-227	1.07E-14	1.07E-14
U-238	4.30E-13	4.30E-13
U-234	1.15E-18	1.15E-18
Th-230	1.78E-21	1.78E-21
Ra-226	1.18E-18	1.18E-18
Pb-210	3.82E-21	3.82E-21

Source: 3

Nuclide	Receptor	Total
	1	
Ac-227	8.86E-17	8.86E-17
Pa-231	1.15E-13	1.15E-13
Ac-227	1.80E-12	1.80E-12
Pb-210	5.45E-18	5.45E-18
Ra-226	1.87E-11	1.87E-11
Pb-210	8.13E-14	8.13E-14
Ra-228	2.02E-28	2.02E-28
Th-228	2.96E-26	2.96E-26
Th-228	0.00E+00	0.00E+00
Th-230	1.40E-15	1.40E-15
Ra-226	2.70E-12	2.70E-12
Pb-210	1.05E-14	1.05E-14
Th-232	1.23E-15	1.23E-15
Ra-228	3.25E-12	3.25E-12
Th-228	3.18E-10	3.18E-10
U-234	1.30E-15	1.30E-15
Th-230	4.03E-18	4.03E-18
Ra-226	3.97E-15	3.97E-15
Pb-210	1.40E-17	1.40E-17
U-235	5.78E-13	5.78E-13
Pa-231	7.60E-16	7.60E-16
Ac-227	1.07E-14	1.07E-14
U-238	4.30E-13	4.30E-13
U-234	1.15E-18	1.15E-18

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:22:29 Page: 54 **
 Title : SLDS DCGL Industrial Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld
 Evaluation Time: 300.000031 years

Th-230	1.78E-21	1.78E-21
Ra-226	1.18E-18	1.18E-18
Pb-210	3.82E-21	3.82E-21

Source: 4

Nuclide	Receptor	Total
	1	
Ac-227	8.86E-17	8.86E-17
Pa-231	1.15E-13	1.15E-13
Ac-227	1.80E-12	1.80E-12
Pb-210	5.45E-18	5.45E-18
Ra-226	1.87E-11	1.87E-11
Pb-210	8.13E-14	8.13E-14
Ra-228	2.02E-28	2.02E-28
Th-228	2.96E-26	2.96E-26
Th-228	0.00E+00	0.00E+00
Th-230	1.40E-15	1.40E-15
Ra-226	2.70E-12	2.70E-12
Pb-210	1.05E-14	1.05E-14
Th-232	1.23E-15	1.23E-15
Ra-228	3.25E-12	3.25E-12
Th-228	3.18E-10	3.18E-10
U-234	1.30E-15	1.30E-15
Th-230	4.03E-18	4.03E-18
Ra-226	3.97E-15	3.97E-15
Pb-210	1.40E-17	1.40E-17
U-235	5.78E-13	5.78E-13
Pa-231	7.60E-16	7.60E-16
Ac-227	1.07E-14	1.07E-14
U-238	4.30E-13	4.30E-13
U-234	1.15E-18	1.15E-18
Th-230	1.78E-21	1.78E-21
Ra-226	1.18E-18	1.18E-18
Pb-210	3.82E-21	3.82E-21

Source: 5

Nuclide	Receptor	Total
	1	
Ac-227	8.86E-17	8.86E-17
Pa-231	1.15E-13	1.15E-13
Ac-227	1.80E-12	1.80E-12
Pb-210	5.45E-18	5.45E-18
Ra-226	1.87E-11	1.87E-11

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:22:29 Page: 55 **
Title : SLDS DCGL Industrial Worker
Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld
Evaluation Time: 300.000031 years

Pb-210	8.13E-14	8.13E-14
Ra-228	2.02E-28	2.02E-28
Th-228	2.96E-26	2.96E-26
Th-228	0.00E+00	0.00E+00
Th-230	1.40E-15	1.40E-15
Ra-226	2.70E-12	2.70E-12
Pb-210	1.05E-14	1.05E-14
Th-232	1.23E-15	1.23E-15
Ra-228	3.25E-12	3.25E-12
Th-228	3.18E-10	3.18E-10
U-234	1.30E-15	1.30E-15
Th-230	4.03E-18	4.03E-18
Ra-226	3.97E-15	3.97E-15
Pb-210	1.40E-17	1.40E-17
U-235	5.78E-13	5.78E-13
Pa-231	7.60E-16	7.60E-16
Ac-227	1.07E-14	1.07E-14
U-238	4.30E-13	4.30E-13
U-234	1.15E-18	1.15E-18
Th-230	1.78E-21	1.78E-21
Ra-226	1.18E-18	1.18E-18
Pb-210	3.82E-21	3.82E-21

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:22:29 Page: 56 **
 Title : SLDS DCGL Industrial Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld
 Evaluation Time: 1000.00000 years

RESRAD-BUILD Risk Tables

Source Contributions to Receptor Risks

		[Risk]					
		Source 1	Source 2	Source 3	Source 4	Source 5	Total
Receptor	1	1.97E-09	3.46E-10	3.46E-10	3.46E-10	3.46E-10	3.35E-09
Total		1.97E-09	3.46E-10	3.46E-10	3.46E-10	3.46E-10	3.35E-09

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:22:29 Page: 57 **

Title : SLDS DCGL Industrial Worker

Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld

Evaluation Time: 1000.00000 years

Pathway Detail of Risks

[Risk]

Source: 1								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	3.28E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.64E-09	0.00E+00	1.97E-09
Total	3.28E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.64E-09	0.00E+00	1.97E-09
Source: 2								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	1.80E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.28E-10	0.00E+00	3.46E-10
Total	1.80E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.28E-10	0.00E+00	3.46E-10
Source: 3								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	1.80E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.28E-10	0.00E+00	3.46E-10
Total	1.80E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.28E-10	0.00E+00	3.46E-10
Source: 4								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	1.80E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.28E-10	0.00E+00	3.46E-10
Total	1.80E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.28E-10	0.00E+00	3.46E-10
Source: 5								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	1.80E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.28E-10	0.00E+00	3.46E-10
Total	1.80E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.28E-10	0.00E+00	3.46E-10

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:22:29 Page: 58 **
 Title : SLDS DCGL Industrial Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld
 Evaluation Time: 1000.00000 years

Nuclide Detail of Risks

[Risk]

Source: 1

Nuclide	Receptor	Total
	1	
Ac-227	3.60E-25	3.60E-25
Pa-231	3.90E-12	3.90E-12
Ac-227	3.43E-11	3.43E-11
Pb-210	3.66E-26	3.66E-26
Ra-226	1.22E-10	1.22E-10
Pb-210	1.25E-12	1.25E-12
Ra-228	0.00E+00	0.00E+00
Th-228	0.00E+00	0.00E+00
Th-228	0.00E+00	0.00E+00
Th-230	1.10E-13	1.10E-13
Ra-226	6.69E-11	6.69E-11
Pb-210	6.58E-13	6.58E-13
Th-232	8.64E-14	8.64E-14
Ra-228	5.87E-11	5.87E-11
Th-228	1.66E-09	1.66E-09
U-234	1.10E-13	1.10E-13
Th-230	1.03E-15	1.03E-15
Ra-226	3.34E-13	3.34E-13
Pb-210	3.18E-15	3.18E-15
U-235	1.27E-11	1.27E-11
Pa-231	8.44E-14	8.44E-14
Ac-227	7.20E-13	7.20E-13
U-238	7.99E-12	7.99E-12
U-234	3.16E-16	3.16E-16
Th-230	1.47E-18	1.47E-18
Ra-226	3.30E-16	3.30E-16
Pb-210	3.05E-18	3.05E-18

Source: 2

Nuclide	Receptor	Total
	1	
Ac-227	1.86E-26	1.86E-26
Pa-231	1.13E-13	1.13E-13
Ac-227	1.77E-12	1.77E-12
Pb-210	1.76E-27	1.76E-27
Ra-226	1.38E-11	1.38E-11
Pb-210	6.01E-14	6.01E-14

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:22:29 Page: 59 **

Title : SLDS DCGL Industrial Worker

Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld

Evaluation Time: 1000.00000 years

Ra-228	0.00E+00	0.00E+00
Th-228	0.00E+00	0.00E+00
Th-228	0.00E+00	0.00E+00
Th-230	1.39E-15	1.39E-15
Ra-226	7.55E-12	7.55E-12
Pb-210	3.16E-14	3.16E-14
Th-232	1.23E-15	1.23E-15
Ra-228	3.25E-12	3.25E-12
Th-228	3.18E-10	3.18E-10
U-234	1.30E-15	1.30E-15
Th-230	1.30E-17	1.30E-17
Ra-226	3.77E-14	3.77E-14
Pb-210	1.53E-16	1.53E-16
U-235	5.78E-13	5.78E-13
Pa-231	2.45E-15	2.45E-15
Ac-227	3.71E-14	3.71E-14
U-238	4.30E-13	4.30E-13
U-234	3.72E-18	3.72E-18
Th-230	1.86E-20	1.86E-20
Ra-226	3.73E-17	3.73E-17
Pb-210	1.46E-19	1.46E-19

Source: 3

Nuclide	Receptor	Total
	1	
Ac-227	1.86E-26	1.86E-26
Pa-231	1.13E-13	1.13E-13
Ac-227	1.77E-12	1.77E-12
Pb-210	1.76E-27	1.76E-27
Ra-226	1.38E-11	1.38E-11
Pb-210	6.01E-14	6.01E-14
Ra-228	0.00E+00	0.00E+00
Th-228	0.00E+00	0.00E+00
Th-228	0.00E+00	0.00E+00
Th-230	1.39E-15	1.39E-15
Ra-226	7.55E-12	7.55E-12
Pb-210	3.16E-14	3.16E-14
Th-232	1.23E-15	1.23E-15
Ra-228	3.25E-12	3.25E-12
Th-228	3.18E-10	3.18E-10
U-234	1.30E-15	1.30E-15
Th-230	1.30E-17	1.30E-17
Ra-226	3.77E-14	3.77E-14
Pb-210	1.53E-16	1.53E-16
U-235	5.78E-13	5.78E-13
Pa-231	2.45E-15	2.45E-15
Ac-227	3.71E-14	3.71E-14
U-238	4.30E-13	4.30E-13
U-234	3.72E-18	3.72E-18

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:22:29 Page: 60 **
 Title : SLDS DCGL Industrial Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld
 Evaluation Time: 1000.00000 years

Th-230	1.86E-20	1.86E-20
Ra-226	3.73E-17	3.73E-17
Pb-210	1.46E-19	1.46E-19

Source: 4

Nuclide	Receptor	Total
	1	
Ac-227	1.86E-26	1.86E-26
Pa-231	1.13E-13	1.13E-13
Ac-227	1.77E-12	1.77E-12
Pb-210	1.76E-27	1.76E-27
Ra-226	1.38E-11	1.38E-11
Pb-210	6.01E-14	6.01E-14
Ra-228	0.00E+00	0.00E+00
Th-228	0.00E+00	0.00E+00
Th-228	0.00E+00	0.00E+00
Th-230	1.39E-15	1.39E-15
Ra-226	7.55E-12	7.55E-12
Pb-210	3.16E-14	3.16E-14
Th-232	1.23E-15	1.23E-15
Ra-228	3.25E-12	3.25E-12
Th-228	3.18E-10	3.18E-10
U-234	1.30E-15	1.30E-15
Th-230	1.30E-17	1.30E-17
Ra-226	3.77E-14	3.77E-14
Pb-210	1.53E-16	1.53E-16
U-235	5.78E-13	5.78E-13
Pa-231	2.45E-15	2.45E-15
Ac-227	3.71E-14	3.71E-14
U-238	4.30E-13	4.30E-13
U-234	3.72E-18	3.72E-18
Th-230	1.86E-20	1.86E-20
Ra-226	3.73E-17	3.73E-17
Pb-210	1.46E-19	1.46E-19

Source: 5

Nuclide	Receptor	Total
	1	
Ac-227	1.86E-26	1.86E-26
Pa-231	1.13E-13	1.13E-13
Ac-227	1.77E-12	1.77E-12
Pb-210	1.76E-27	1.76E-27
Ra-226	1.38E-11	1.38E-11

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:22:29 Page: 61 **
Title : SLDS DCGL Industrial Worker
Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL IW.bld
Evaluation Time: 1000.00000 years

Pb-210	6.01E-14	6.01E-14
Ra-228	0.00E+00	0.00E+00
Th-228	0.00E+00	0.00E+00
Th-228	0.00E+00	0.00E+00
Th-230	1.39E-15	1.39E-15
Ra-226	7.55E-12	7.55E-12
Pb-210	3.16E-14	3.16E-14
Th-232	1.23E-15	1.23E-15
Ra-228	3.25E-12	3.25E-12
Th-228	3.18E-10	3.18E-10
U-234	1.30E-15	1.30E-15
Th-230	1.30E-17	1.30E-17
Ra-226	3.77E-14	3.77E-14
Pb-210	1.53E-16	1.53E-16
U-235	5.78E-13	5.78E-13
Pa-231	2.45E-15	2.45E-15
Ac-227	3.71E-14	3.71E-14
U-238	4.30E-13	4.30E-13
U-234	3.72E-18	3.72E-18
Th-230	1.86E-20	1.86E-20
Ra-226	3.73E-17	3.73E-17
Pb-210	1.46E-19	1.46E-19

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:34:22 Page: 1 **
Title : SLDS DCGL Renovation Worker
Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld

RESRAD-BUILD Table of Contents	

RESRAD-BUILD Input Parameters.....	2
Building Information.....	3
Source Information.....	4
Temporal Dose Summary.....	7
For time = 0.00E+00 yr	
Receptor-Source Dose Summary.....	8
Dose by Pathway Detail.....	9
Dose by Nuclide Detail.....	10
For time = 1.00E+00 yr	
Receptor-Source Dose Summary.....	14
Dose by Pathway Detail.....	15
Dose by Nuclide Detail.....	16
For time = 3.00E+00 yr	
Receptor-Source Dose Summary.....	20
Dose by Pathway Detail.....	21
Dose by Nuclide Detail.....	22
For time = 1.00E+01 yr	
Receptor-Source Dose Summary.....	26
Dose by Pathway Detail.....	27
Dose by Nuclide Detail.....	28
For time = 3.00E+01 yr	
Receptor-Source Dose Summary.....	32
Dose by Pathway Detail.....	33
Dose by Nuclide Detail.....	34
For time = 1.00E+02 yr	
Receptor-Source Dose Summary.....	38
Dose by Pathway Detail.....	39
Dose by Nuclide Detail.....	40
For time = 3.00E+02 yr	
Receptor-Source Dose Summary.....	44
Dose by Pathway Detail.....	45
Dose by Nuclide Detail.....	46
For time = 1.00E+03 yr	
Receptor-Source Dose Summary.....	50
Dose by Pathway Detail.....	51
Dose by Nuclide Detail.....	52

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:34:22 Page: 2 **
 Title : SLDS DCGL Renovation Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld

```

=====
=====
=====
RESRAD-BUILD Input Parameters
=====
=====
    
```

```

Number of Sources : 5
Number of Receptors: 1
Total Time : 3.650000E+02 days
Fraction Inside : 8.000000E-02
    
```

```

Transformations data from: ICRP107
Cut off half life : 180.000000 days
Library information in the Dose Coefficients and Slope Factors report
    
```

```

===== Receptor Information =====
Receptor Room x y z FracTime Inhalation Ingestion(Dust)
           [m] [m] [m] [m3/day] [m2/hr]
1          1 5.000 5.000 1.000 1.000 3.36E+01 2.00E-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

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:34:22 Page: 3 **
Title : SLDS DCGL Renovation Worker
Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld

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

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

Height[m]	Air Exchanges [m3/hr]	
Area [m2]	*****	
	*	*
	*	*
	*	<=Q01: 0.00E+00
H1: 2.500	* Room 1	* Q10 : 0.00E+00
	* LAMBDA: 0.00E+00	*
Area 100.000	*	*
	*	*

Deposition velocity: 3.90E-04 [m/s] Resuspension Rate: 0.00E+00 [1/s]
Deposition velocity: 1.70E-06 [m/s] Resuspension Rate:

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:34:22 Page: 4 **
 Title : SLDS DCGL Renovation Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld

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

Source: 1

Location:: Room : 1 x: 5.00 y: 5.00 z: 0.00[m]
 Geometry:: Type: Area Length[m]:1.00E+01 Width[m]:1.00E+01 Direction: z
 Pathway ::
 Direct Ingestion Rate: 0.000E+00 [1/hr]
 Fraction released to air: 3.500E-02
 Removable fraction: 1.000E-01
 Time to Remove: 1.825E+03 [day]

Radon Release Fraction: 1.000E-01

Contamination::

Nuclide Concentration

	[dpm/m2]
Ac-227	1.000E+00
Pa-231	1.000E+00
Pb-210	1.000E+00
Ra-226	1.000E+00
Ra-228	1.000E+00
Th-228	1.000E+00
Th-230	1.000E+00
Th-232	1.000E+00
U-234	1.000E+00
U-235	1.000E+00
U-238	1.000E+00

Source: 2

Location:: Room : 1 x: 10.00 y: 5.00 z: 1.00[m]
 Geometry:: Type: Area Length[m]:1.00E+01 Width[m]:2.00E+00 Direction: x
 Pathway ::
 Direct Ingestion Rate: 0.000E+00 [1/hr]
 Fraction released to air: 3.500E-02
 Removable fraction: 1.000E-01
 Time to Remove: 1.825E+03 [day]

Radon Release Fraction: 1.000E-01

Contamination::

Nuclide Concentration

	[dpm/m2]
Ac-227	1.000E+00
Pa-231	1.000E+00
Pb-210	1.000E+00
Ra-226	1.000E+00
Ra-228	1.000E+00
Th-228	1.000E+00
Th-230	1.000E+00
Th-232	1.000E+00
U-234	1.000E+00
U-235	1.000E+00
U-238	1.000E+00

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:34:22 Page: 5 **

Title : SLDS DCGL Renovation Worker

Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld

Source: 3

Location:: Room : 1 x: 5.00 y: 10.00 z: 1.00[m]
 Geometry:: Type: Area Length[m]:1.00E+01 Width[m]:2.00E+00 Direction: y
 Pathway ::
 Direct Ingestion Rate: 0.000E+00 [1/hr]
 Fraction released to air: 3.500E-02
 Removable fraction: 1.000E-01
 Time to Remove: 1.825E+03 [day]

 Radon Release Fraction: 1.000E-01

Contamination::

Nuclide Concentration

	[dpm/m2]
Ac-227	1.000E+00
Pa-231	1.000E+00
Pb-210	1.000E+00
Ra-226	1.000E+00
Ra-228	1.000E+00
Th-228	1.000E+00
Th-230	1.000E+00
Th-232	1.000E+00
U-234	1.000E+00
U-235	1.000E+00
U-238	1.000E+00

Source: 4

Location:: Room : 1 x: 0.00 y: 5.00 z: 1.00[m]
 Geometry:: Type: Area Length[m]:1.00E+01 Width[m]:2.00E+00 Direction: x
 Pathway ::
 Direct Ingestion Rate: 0.000E+00 [1/hr]
 Fraction released to air: 3.500E-02
 Removable fraction: 1.000E-01
 Time to Remove: 1.825E+03 [day]

 Radon Release Fraction: 1.000E-01

Contamination::

Nuclide Concentration

	[dpm/m2]
Ac-227	1.000E+00
Pa-231	1.000E+00
Pb-210	1.000E+00
Ra-226	1.000E+00
Ra-228	1.000E+00
Th-228	1.000E+00
Th-230	1.000E+00
Th-232	1.000E+00
U-234	1.000E+00
U-235	1.000E+00
U-238	1.000E+00

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:34:22 Page: 6 **
Title : SLDS DCGL Renovation Worker
Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld

Source: 5

Location:: Room : 1 x: 5.00 y: 0.00 z: 1.00[m]
Geometry:: Type: Area Length[m]:1.00E+01 Width[m]:2.00E+00 Direction: y
Pathway ::
Direct Ingestion Rate: 0.000E+00 [1/hr]
Fraction released to air: 3.500E-02
Removable fraction: 1.000E-01
Time to Remove: 1.825E+03 [day]

Radon Release Fraction: 1.000E-01

Contamination::

Nuclide Concentration

	[dpm/m2]
Ac-227	1.000E+00
Pa-231	1.000E+00
Pb-210	1.000E+00
Ra-226	1.000E+00
Ra-228	1.000E+00
Th-228	1.000E+00
Th-230	1.000E+00
Th-232	1.000E+00
U-234	1.000E+00
U-235	1.000E+00
U-238	1.000E+00

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:34:22 Page: 7 **
 Title : SLDS DCGL Renovation Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld
 Temporal Summary

RESRAD-BUILD Temporal Dose Tables

Dose to Receptor over the Exposure Duration

(mrem)

Evaluation Time years	Receptor 1	Total
0.000000000	1.66E-04	1.66E-04
1.000000000	1.66E-04	1.66E-04
3.000000000	1.63E-04	1.63E-04
10.00000000	7.52E-05	7.52E-05
30.00000000	7.52E-05	7.52E-05
100.0000080	7.52E-05	7.52E-05
300.0000310	7.52E-05	7.52E-05
1000.000000	7.52E-05	7.52E-05

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:34:22 Page: 8 **
 Title : SLDS DCGL Renovation Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld
 Evaluation Time: 0.00000000E+00 years

RESRAD-BUILD Dose Tables

Source Contributions to Receptor Doses

[mrem]						
	Source 1	Source 2	Source 3	Source 4	Source 5	Total
Receptor 1	9.45E-05	1.80E-05	1.80E-05	1.80E-05	1.80E-05	1.66E-04
Total	9.45E-05	1.80E-05	1.80E-05	1.80E-05	1.80E-05	1.66E-04

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:34:22 Page: 9 **

Title : SLDS DCGL Renovation Worker

Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld

Evaluation Time: 0.00000000E+00 years

Pathway Detail of Doses

[mrem]

Source: 1	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	6.33E-06	4.65E-05	5.71E-11	3.74E-11	9.39E-09	4.17E-05	0.00E+00	9.45E-05
Total	6.33E-06	4.65E-05	5.71E-11	3.74E-11	9.39E-09	4.17E-05	0.00E+00	9.45E-05

Source: 2	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	3.46E-07	9.29E-06	1.14E-11	7.48E-12	1.88E-09	8.34E-06	0.00E+00	1.80E-05
Total	3.46E-07	9.29E-06	1.14E-11	7.48E-12	1.88E-09	8.34E-06	0.00E+00	1.80E-05

Source: 3	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	3.46E-07	9.29E-06	1.14E-11	7.48E-12	1.88E-09	8.34E-06	0.00E+00	1.80E-05
Total	3.46E-07	9.29E-06	1.14E-11	7.48E-12	1.88E-09	8.34E-06	0.00E+00	1.80E-05

Source: 4	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	3.46E-07	9.29E-06	1.14E-11	7.48E-12	1.88E-09	8.34E-06	0.00E+00	1.80E-05
Total	3.46E-07	9.29E-06	1.14E-11	7.48E-12	1.88E-09	8.34E-06	0.00E+00	1.80E-05

Source: 5	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	3.46E-07	9.29E-06	1.14E-11	7.48E-12	1.88E-09	8.34E-06	0.00E+00	1.80E-05
Total	3.46E-07	9.29E-06	1.14E-11	7.48E-12	1.88E-09	8.34E-06	0.00E+00	1.80E-05

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:34:22 Page: 10 **
 Title : SLDS DCGL Renovation Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld
 Evaluation Time: 0.00000000E+00 years

Nuclide Detail of Doses

[mrem]

Source: 1

Nuclide	Receptor 1	Total
Ac-227	1.18E-05	1.18E-05
Pa-231	1.49E-05	1.49E-05
Ac-227	1.90E-07	1.90E-07
Pb-210	6.93E-07	6.93E-07
Ra-226	3.37E-06	3.37E-06
Pb-210	1.10E-08	1.10E-08
Ra-228	2.03E-06	2.03E-06
Th-228	7.05E-06	7.05E-06
Th-228	3.83E-05	3.83E-05
Th-230	6.55E-06	6.55E-06
Ra-226	7.29E-10	7.29E-10
Pb-210	1.59E-12	1.59E-12
Th-232	7.09E-06	7.09E-06
Ra-228	1.26E-07	1.26E-07
Th-228	2.94E-07	2.94E-07
U-234	6.09E-07	6.09E-07
Th-230	3.05E-11	3.05E-11
Ra-226	2.23E-15	2.23E-15
Pb-210	3.66E-18	3.66E-18
U-235	7.95E-07	7.95E-07
Pa-231	1.59E-10	1.59E-10
Ac-227	1.35E-12	1.35E-12
U-238	6.87E-07	6.87E-07
U-234	8.69E-13	8.69E-13
Th-230	2.87E-17	2.87E-17
Ra-226	2.03E-21	2.03E-21
Pb-210	1.71E-23	1.71E-23

Source: 2

Nuclide	Receptor 1	Total
Ac-227	2.25E-06	2.25E-06
Pa-231	2.97E-06	2.97E-06
Ac-227	3.64E-08	3.64E-08
Pb-210	1.31E-07	1.31E-07
Ra-226	3.60E-07	3.60E-07
Pb-210	2.07E-09	2.07E-09

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:34:22 Page: 11 **
 Title : SLDS DCGL Renovation Worker
 Input File : C:\RESRAD Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld
 Evaluation Time: 0.0000000E+00 years

Ra-228	2.54E-07	2.54E-07
Th-228	1.37E-06	1.37E-06
Th-228	7.45E-06	7.45E-06
Th-230	1.31E-06	1.31E-06
Ra-226	7.80E-11	7.80E-11
Pb-210	3.00E-13	3.00E-13
Th-232	1.42E-06	1.42E-06
Ra-228	1.57E-08	1.57E-08
Th-228	5.72E-08	5.72E-08
U-234	1.21E-07	1.21E-07
Th-230	6.09E-12	6.09E-12
Ra-226	2.39E-16	2.39E-16
Pb-210	6.91E-19	6.91E-19
U-235	1.20E-07	1.20E-07
Pa-231	3.18E-11	3.18E-11
Ac-227	2.58E-13	2.58E-13
U-238	1.13E-07	1.13E-07
U-234	1.73E-13	1.73E-13
Th-230	5.74E-18	5.74E-18
Ra-226	1.33E-22	1.33E-22
Pb-210	8.99E-24	8.99E-24

Source: 3

Nuclide	Receptor 1	Total
Ac-227	2.25E-06	2.25E-06
Pa-231	2.97E-06	2.97E-06
Ac-227	3.64E-08	3.64E-08
Pb-210	1.31E-07	1.31E-07
Ra-226	3.60E-07	3.60E-07
Pb-210	2.07E-09	2.07E-09
Ra-228	2.54E-07	2.54E-07
Th-228	1.37E-06	1.37E-06
Th-228	7.45E-06	7.45E-06
Th-230	1.31E-06	1.31E-06
Ra-226	7.80E-11	7.80E-11
Pb-210	3.00E-13	3.00E-13
Th-232	1.42E-06	1.42E-06
Ra-228	1.57E-08	1.57E-08
Th-228	5.72E-08	5.72E-08
U-234	1.21E-07	1.21E-07
Th-230	6.09E-12	6.09E-12
Ra-226	2.39E-16	2.39E-16
Pb-210	6.91E-19	6.91E-19
U-235	1.20E-07	1.20E-07
Pa-231	3.18E-11	3.18E-11
Ac-227	2.58E-13	2.58E-13
U-238	1.13E-07	1.13E-07
U-234	1.73E-13	1.73E-13

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:34:22 Page: 12 **
 Title : SLDS DCGL Renovation Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld
 Evaluation Time: 0.00000000E+00 years

Th-230	5.74E-18	5.74E-18
Ra-226	1.33E-22	1.33E-22
Pb-210	8.99E-24	8.99E-24

Source: 4

Nuclide	Receptor	Total
	1	
Ac-227	2.25E-06	2.25E-06
Pa-231	2.97E-06	2.97E-06
Ac-227	3.64E-08	3.64E-08
Pb-210	1.31E-07	1.31E-07
Ra-226	3.60E-07	3.60E-07
Pb-210	2.07E-09	2.07E-09
Ra-228	2.54E-07	2.54E-07
Th-228	1.37E-06	1.37E-06
Th-228	7.45E-06	7.45E-06
Th-230	1.31E-06	1.31E-06
Ra-226	7.80E-11	7.80E-11
Pb-210	3.00E-13	3.00E-13
Th-232	1.42E-06	1.42E-06
Ra-228	1.57E-08	1.57E-08
Th-228	5.72E-08	5.72E-08
U-234	1.21E-07	1.21E-07
Th-230	6.09E-12	6.09E-12
Ra-226	2.39E-16	2.39E-16
Pb-210	6.91E-19	6.91E-19
U-235	1.20E-07	1.20E-07
Pa-231	3.18E-11	3.18E-11
Ac-227	2.58E-13	2.58E-13
U-238	1.13E-07	1.13E-07
U-234	1.73E-13	1.73E-13
Th-230	5.74E-18	5.74E-18
Ra-226	1.33E-22	1.33E-22
Pb-210	8.99E-24	8.99E-24

Source: 5

Nuclide	Receptor	Total
	1	
Ac-227	2.25E-06	2.25E-06
Pa-231	2.97E-06	2.97E-06
Ac-227	3.64E-08	3.64E-08
Pb-210	1.31E-07	1.31E-07
Ra-226	3.60E-07	3.60E-07

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:34:22 Page: 13 **
Title : SLDS DCGL Renovation Worker
Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld
Evaluation Time: 0.00000000E+00 years

Pb-210	2.07E-09	2.07E-09
Ra-228	2.54E-07	2.54E-07
Th-228	1.37E-06	1.37E-06
Th-228	7.45E-06	7.45E-06
Th-230	1.31E-06	1.31E-06
Ra-226	7.80E-11	7.80E-11
Pb-210	3.00E-13	3.00E-13
Th-232	1.42E-06	1.42E-06
Ra-228	1.57E-08	1.57E-08
Th-228	5.72E-08	5.72E-08
U-234	1.21E-07	1.21E-07
Th-230	6.09E-12	6.09E-12
Ra-226	2.39E-16	2.39E-16
Pb-210	6.91E-19	6.91E-19
U-235	1.20E-07	1.20E-07
Pa-231	3.18E-11	3.18E-11
Ac-227	2.58E-13	2.58E-13
U-238	1.13E-07	1.13E-07
U-234	1.73E-13	1.73E-13
Th-230	5.74E-18	5.74E-18
Ra-226	1.33E-22	1.33E-22
Pb-210	8.99E-24	8.99E-24

RESRAD-BUILD Dose Tables

Source Contributions to Receptor Doses

```
[mrem]
```

	Source 1	Source 2	Source 3	Source 4	Source 5	Total
Receptor 1	9.41E-05	1.79E-05	1.79E-05	1.79E-05	1.79E-05	1.66E-04
Total	9.41E-05	1.79E-05	1.79E-05	1.79E-05	1.79E-05	1.66E-04

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:34:22 Page: 15 **

Title : SLDS DCGL Renovation Worker

Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld

Evaluation Time: 1.00000000 years

Pathway Detail of Doses

[mrem]

Source: 1	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	6.20E-06	4.71E-05	5.90E-11	3.79E-11	9.70E-09	4.08E-05	0.00E+00	9.41E-05
Total	6.20E-06	4.71E-05	5.90E-11	3.79E-11	9.70E-09	4.08E-05	0.00E+00	9.41E-05
Source: 2	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	3.39E-07	9.42E-06	1.18E-11	7.58E-12	1.94E-09	8.17E-06	0.00E+00	1.79E-05
Total	3.39E-07	9.42E-06	1.18E-11	7.58E-12	1.94E-09	8.17E-06	0.00E+00	1.79E-05
Source: 3	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	3.39E-07	9.42E-06	1.18E-11	7.58E-12	1.94E-09	8.17E-06	0.00E+00	1.79E-05
Total	3.39E-07	9.42E-06	1.18E-11	7.58E-12	1.94E-09	8.17E-06	0.00E+00	1.79E-05
Source: 4	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	3.39E-07	9.42E-06	1.18E-11	7.58E-12	1.94E-09	8.17E-06	0.00E+00	1.79E-05
Total	3.39E-07	9.42E-06	1.18E-11	7.58E-12	1.94E-09	8.17E-06	0.00E+00	1.79E-05
Source: 5	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	3.39E-07	9.42E-06	1.18E-11	7.58E-12	1.94E-09	8.17E-06	0.00E+00	1.79E-05
Total	3.39E-07	9.42E-06	1.18E-11	7.58E-12	1.94E-09	8.17E-06	0.00E+00	1.79E-05

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:34:22 Page: 16 **
 Title : SLDS DCGL Renovation Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld
 Evaluation Time: 1.00000000 years

Nuclide Detail of Doses

[mrem]

Source: 1

Nuclide	Receptor 1	Total
Ac-227	1.15E-05	1.15E-05
Pa-231	1.51E-05	1.51E-05
Ac-227	5.63E-07	5.63E-07
Pb-210	6.80E-07	6.80E-07
Ra-226	3.32E-06	3.32E-06
Pb-210	3.25E-08	3.25E-08
Ra-228	1.80E-06	1.80E-06
Th-228	1.69E-05	1.69E-05
Th-228	2.62E-05	2.62E-05
Th-230	6.64E-06	6.64E-06
Ra-226	2.16E-09	2.16E-09
Pb-210	1.10E-11	1.10E-11
Th-232	7.19E-06	7.19E-06
Ra-228	3.54E-07	3.54E-07
Th-228	1.78E-06	1.78E-06
U-234	6.17E-07	6.17E-07
Th-230	9.16E-11	9.16E-11
Ra-226	1.54E-14	1.54E-14
Pb-210	5.46E-17	5.46E-17
U-235	7.97E-07	7.97E-07
Pa-231	4.79E-10	4.79E-10
Ac-227	9.33E-12	9.33E-12
U-238	6.91E-07	6.91E-07
U-234	2.61E-12	2.61E-12
Th-230	2.01E-16	2.01E-16
Ra-226	2.36E-20	2.36E-20
Pb-210	7.27E-23	7.27E-23

Source: 2

Nuclide	Receptor 1	Total
Ac-227	2.21E-06	2.21E-06
Pa-231	3.01E-06	3.01E-06
Ac-227	1.08E-07	1.08E-07
Pb-210	1.28E-07	1.28E-07
Ra-226	3.56E-07	3.56E-07
Pb-210	6.14E-09	6.14E-09

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:34:22 Page: 17 **

Title : SLDS DCGL Renovation Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld
 Evaluation Time: 1.00000000 years

Ra-228	2.26E-07	2.26E-07
Th-228	3.28E-06	3.28E-06
Th-228	5.09E-06	5.09E-06
Th-230	1.33E-06	1.33E-06
Ra-226	2.31E-10	2.31E-10
Pb-210	2.08E-12	2.08E-12
Th-232	1.44E-06	1.44E-06
Ra-228	4.47E-08	4.47E-08
Th-228	3.45E-07	3.45E-07
U-234	1.23E-07	1.23E-07
Th-230	1.83E-11	1.83E-11
Ra-226	1.65E-15	1.65E-15
Pb-210	1.03E-17	1.03E-17
U-235	1.22E-07	1.22E-07
Pa-231	9.54E-11	9.54E-11
Ac-227	1.79E-12	1.79E-12
U-238	1.14E-07	1.14E-07
U-234	5.20E-13	5.20E-13
Th-230	4.02E-17	4.02E-17
Ra-226	2.45E-21	2.45E-21
Pb-210	1.53E-23	1.53E-23

Source: 3

Nuclide	Receptor 1	Total
Ac-227	2.21E-06	2.21E-06
Pa-231	3.01E-06	3.01E-06
Ac-227	1.08E-07	1.08E-07
Pb-210	1.28E-07	1.28E-07
Ra-226	3.56E-07	3.56E-07
Pb-210	6.14E-09	6.14E-09
Ra-228	2.26E-07	2.26E-07
Th-228	3.28E-06	3.28E-06
Th-228	5.09E-06	5.09E-06
Th-230	1.33E-06	1.33E-06
Ra-226	2.31E-10	2.31E-10
Pb-210	2.08E-12	2.08E-12
Th-232	1.44E-06	1.44E-06
Ra-228	4.47E-08	4.47E-08
Th-228	3.45E-07	3.45E-07
U-234	1.23E-07	1.23E-07
Th-230	1.83E-11	1.83E-11
Ra-226	1.65E-15	1.65E-15
Pb-210	1.03E-17	1.03E-17
U-235	1.22E-07	1.22E-07
Pa-231	9.54E-11	9.54E-11
Ac-227	1.79E-12	1.79E-12
U-238	1.14E-07	1.14E-07
U-234	5.20E-13	5.20E-13

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:34:22 Page: 18 **
 Title : SLDS DCGL Renovation Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld
 Evaluation Time: 1.00000000 years

Th-230	4.02E-17	4.02E-17
Ra-226	2.45E-21	2.45E-21
Pb-210	1.53E-23	1.53E-23

Source: 4

Nuclide	Receptor	Total
	1	
Ac-227	2.21E-06	2.21E-06
Pa-231	3.01E-06	3.01E-06
Ac-227	1.08E-07	1.08E-07
Pb-210	1.28E-07	1.28E-07
Ra-226	3.56E-07	3.56E-07
Pb-210	6.14E-09	6.14E-09
Ra-228	2.26E-07	2.26E-07
Th-228	3.28E-06	3.28E-06
Th-228	5.09E-06	5.09E-06
Th-230	1.33E-06	1.33E-06
Ra-226	2.31E-10	2.31E-10
Pb-210	2.08E-12	2.08E-12
Th-232	1.44E-06	1.44E-06
Ra-228	4.47E-08	4.47E-08
Th-228	3.45E-07	3.45E-07
U-234	1.23E-07	1.23E-07
Th-230	1.83E-11	1.83E-11
Ra-226	1.65E-15	1.65E-15
Pb-210	1.03E-17	1.03E-17
U-235	1.22E-07	1.22E-07
Pa-231	9.54E-11	9.54E-11
Ac-227	1.79E-12	1.79E-12
U-238	1.14E-07	1.14E-07
U-234	5.20E-13	5.20E-13
Th-230	4.02E-17	4.02E-17
Ra-226	2.45E-21	2.45E-21
Pb-210	1.53E-23	1.53E-23

Source: 5

Nuclide	Receptor	Total
	1	
Ac-227	2.21E-06	2.21E-06
Pa-231	3.01E-06	3.01E-06
Ac-227	1.08E-07	1.08E-07
Pb-210	1.28E-07	1.28E-07
Ra-226	3.56E-07	3.56E-07

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:34:22 Page: 19 **
Title : SLDS DCGL Renovation Worker
Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld
Evaluation Time: 1.00000000 years

Pb-210	6.14E-09	6.14E-09
Ra-228	2.26E-07	2.26E-07
Th-228	3.28E-06	3.28E-06
Th-228	5.09E-06	5.09E-06
Th-230	1.33E-06	1.33E-06
Ra-226	2.31E-10	2.31E-10
Pb-210	2.08E-12	2.08E-12
Th-232	1.44E-06	1.44E-06
Ra-228	4.47E-08	4.47E-08
Th-228	3.45E-07	3.45E-07
U-234	1.23E-07	1.23E-07
Th-230	1.83E-11	1.83E-11
Ra-226	1.65E-15	1.65E-15
Pb-210	1.03E-17	1.03E-17
U-235	1.22E-07	1.22E-07
Pa-231	9.54E-11	9.54E-11
Ac-227	1.79E-12	1.79E-12
U-238	1.14E-07	1.14E-07
U-234	5.20E-13	5.20E-13
Th-230	4.02E-17	4.02E-17
Ra-226	2.45E-21	2.45E-21
Pb-210	1.53E-23	1.53E-23

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:34:22 Page: 20 **
 Title : SLDS DCGL Renovation Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld
 Evaluation Time: 3.00000000 years

RESRAD-BUILD Dose Tables

Source Contributions to Receptor Doses

[mrem]						
	Source 1	Source 2	Source 3	Source 4	Source 5	Total
Receptor 1	9.22E-05	1.76E-05	1.76E-05	1.76E-05	1.76E-05	1.63E-04
Total	9.22E-05	1.76E-05	1.76E-05	1.76E-05	1.76E-05	1.63E-04

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:34:22 Page: 21 **
 Title : SLDS DCGL Renovation Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld
 Evaluation Time: 3.00000000 years

Pathway Detail of Doses

[mrem]

Source: 1	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	5.95E-06	4.71E-05	5.90E-11	3.79E-11	9.70E-09	3.92E-05	0.00E+00	9.22E-05
Total	5.95E-06	4.71E-05	5.90E-11	3.79E-11	9.70E-09	3.92E-05	0.00E+00	9.22E-05

Source: 2	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	3.25E-07	9.42E-06	1.18E-11	7.58E-12	1.94E-09	7.83E-06	0.00E+00	1.76E-05
Total	3.25E-07	9.42E-06	1.18E-11	7.58E-12	1.94E-09	7.83E-06	0.00E+00	1.76E-05

Source: 3	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	3.25E-07	9.42E-06	1.18E-11	7.58E-12	1.94E-09	7.83E-06	0.00E+00	1.76E-05
Total	3.25E-07	9.42E-06	1.18E-11	7.58E-12	1.94E-09	7.83E-06	0.00E+00	1.76E-05

Source: 4	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	3.25E-07	9.42E-06	1.18E-11	7.58E-12	1.94E-09	7.83E-06	0.00E+00	1.76E-05
Total	3.25E-07	9.42E-06	1.18E-11	7.58E-12	1.94E-09	7.83E-06	0.00E+00	1.76E-05

Source: 5	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	3.25E-07	9.42E-06	1.18E-11	7.58E-12	1.94E-09	7.83E-06	0.00E+00	1.76E-05
Total	3.25E-07	9.42E-06	1.18E-11	7.58E-12	1.94E-09	7.83E-06	0.00E+00	1.76E-05

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:34:22 Page: 22 **
 Title : SLDS DCGL Renovation Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld
 Evaluation Time: 3.00000000 years

Nuclide Detail of Doses

[mrem]

Source: 1

Nuclide	Receptor 1	Total
Ac-227	1.08E-05	1.08E-05
Pa-231	1.51E-05	1.51E-05
Ac-227	1.27E-06	1.27E-06
Pb-210	6.37E-07	6.37E-07
Ra-226	3.21E-06	3.21E-06
Pb-210	7.34E-08	7.34E-08
Ra-228	1.38E-06	1.38E-06
Th-228	2.41E-05	2.41E-05
Th-228	1.22E-05	1.22E-05
Th-230	6.64E-06	6.64E-06
Ra-226	4.86E-09	4.86E-09
Pb-210	5.70E-11	5.70E-11
Th-232	7.19E-06	7.19E-06
Ra-228	7.23E-07	7.23E-07
Th-228	6.80E-06	6.80E-06
U-234	6.17E-07	6.17E-07
Th-230	2.14E-10	2.14E-10
Ra-226	7.88E-14	7.88E-14
Pb-210	6.26E-16	6.26E-16
U-235	7.87E-07	7.87E-07
Pa-231	1.12E-09	1.12E-09
Ac-227	4.82E-11	4.82E-11
U-238	6.84E-07	6.84E-07
U-234	6.09E-12	6.09E-12
Th-230	1.06E-15	1.06E-15
Ra-226	2.63E-19	2.63E-19
Pb-210	1.64E-21	1.64E-21

Source: 2

Nuclide	Receptor 1	Total
Ac-227	2.07E-06	2.07E-06
Pa-231	3.01E-06	3.01E-06
Ac-227	2.44E-07	2.44E-07
Pb-210	1.20E-07	1.20E-07
Ra-226	3.47E-07	3.47E-07
Pb-210	1.39E-08	1.39E-08

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:34:22 Page: 23 **

Title : SLDS DCGL Renovation Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld
 Evaluation Time: 3.00000000 years

Ra-228	1.76E-07	1.76E-07
Th-228	4.69E-06	4.69E-06
Th-228	2.37E-06	2.37E-06
Th-230	1.33E-06	1.33E-06
Ra-226	5.26E-10	5.26E-10
Pb-210	1.08E-11	1.08E-11
Th-232	1.44E-06	1.44E-06
Ra-228	9.23E-08	9.23E-08
Th-228	1.32E-06	1.32E-06
U-234	1.23E-07	1.23E-07
Th-230	4.27E-11	4.27E-11
Ra-226	8.51E-15	8.51E-15
Pb-210	1.18E-16	1.18E-16
U-235	1.21E-07	1.21E-07
Pa-231	2.23E-10	2.23E-10
Ac-227	9.26E-12	9.26E-12
U-238	1.14E-07	1.14E-07
U-234	1.21E-12	1.21E-12
Th-230	2.13E-16	2.13E-16
Ra-226	2.83E-20	2.83E-20
Pb-210	2.93E-22	2.93E-22

Source: 3

Nuclide	Receptor 1	Total
Ac-227	2.07E-06	2.07E-06
Pa-231	3.01E-06	3.01E-06
Ac-227	2.44E-07	2.44E-07
Pb-210	1.20E-07	1.20E-07
Ra-226	3.47E-07	3.47E-07
Pb-210	1.39E-08	1.39E-08
Ra-228	1.76E-07	1.76E-07
Th-228	4.69E-06	4.69E-06
Th-228	2.37E-06	2.37E-06
Th-230	1.33E-06	1.33E-06
Ra-226	5.26E-10	5.26E-10
Pb-210	1.08E-11	1.08E-11
Th-232	1.44E-06	1.44E-06
Ra-228	9.23E-08	9.23E-08
Th-228	1.32E-06	1.32E-06
U-234	1.23E-07	1.23E-07
Th-230	4.27E-11	4.27E-11
Ra-226	8.51E-15	8.51E-15
Pb-210	1.18E-16	1.18E-16
U-235	1.21E-07	1.21E-07
Pa-231	2.23E-10	2.23E-10
Ac-227	9.26E-12	9.26E-12
U-238	1.14E-07	1.14E-07
U-234	1.21E-12	1.21E-12

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:34:22 Page: 24 **
 Title : SLDS DCGL Renovation Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld
 Evaluation Time: 3.00000000 years

Th-230	2.13E-16	2.13E-16
Ra-226	2.83E-20	2.83E-20
Pb-210	2.93E-22	2.93E-22

Source: 4

Nuclide	Receptor 1	Total
Ac-227	2.07E-06	2.07E-06
Pa-231	3.01E-06	3.01E-06
Ac-227	2.44E-07	2.44E-07
Pb-210	1.20E-07	1.20E-07
Ra-226	3.47E-07	3.47E-07
Pb-210	1.39E-08	1.39E-08
Ra-228	1.76E-07	1.76E-07
Th-228	4.69E-06	4.69E-06
Th-228	2.37E-06	2.37E-06
Th-230	1.33E-06	1.33E-06
Ra-226	5.26E-10	5.26E-10
Pb-210	1.08E-11	1.08E-11
Th-232	1.44E-06	1.44E-06
Ra-228	9.23E-08	9.23E-08
Th-228	1.32E-06	1.32E-06
U-234	1.23E-07	1.23E-07
Th-230	4.27E-11	4.27E-11
Ra-226	8.51E-15	8.51E-15
Pb-210	1.18E-16	1.18E-16
U-235	1.21E-07	1.21E-07
Pa-231	2.23E-10	2.23E-10
Ac-227	9.26E-12	9.26E-12
U-238	1.14E-07	1.14E-07
U-234	1.21E-12	1.21E-12
Th-230	2.13E-16	2.13E-16
Ra-226	2.83E-20	2.83E-20
Pb-210	2.93E-22	2.93E-22

Source: 5

Nuclide	Receptor 1	Total
Ac-227	2.07E-06	2.07E-06
Pa-231	3.01E-06	3.01E-06
Ac-227	2.44E-07	2.44E-07
Pb-210	1.20E-07	1.20E-07
Ra-226	3.47E-07	3.47E-07

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:34:22 Page: 25 **
Title : SLDS DCGL Renovation Worker
Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld
Evaluation Time: 3.00000000 years

Pb-210	1.39E-08	1.39E-08
Ra-228	1.76E-07	1.76E-07
Th-228	4.69E-06	4.69E-06
Th-228	2.37E-06	2.37E-06
Th-230	1.33E-06	1.33E-06
Ra-226	5.26E-10	5.26E-10
Pb-210	1.08E-11	1.08E-11
Th-232	1.44E-06	1.44E-06
Ra-228	9.23E-08	9.23E-08
Th-228	1.32E-06	1.32E-06
U-234	1.23E-07	1.23E-07
Th-230	4.27E-11	4.27E-11
Ra-226	8.51E-15	8.51E-15
Pb-210	1.18E-16	1.18E-16
U-235	1.21E-07	1.21E-07
Pa-231	2.23E-10	2.23E-10
Ac-227	9.26E-12	9.26E-12
U-238	1.14E-07	1.14E-07
U-234	1.21E-12	1.21E-12
Th-230	2.13E-16	2.13E-16
Ra-226	2.83E-20	2.83E-20
Pb-210	2.93E-22	2.93E-22

RESRAD-BUILD Dose Tables

Source Contributions to Receptor Doses

```
[mrem]
```

	Source 1	Source 2	Source 3	Source 4	Source 5	Total
Receptor 1	4.36E-05	7.89E-06	7.89E-06	7.89E-06	7.89E-06	7.52E-05
Total	4.36E-05	7.89E-06	7.89E-06	7.89E-06	7.89E-06	7.52E-05

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:34:22 Page: 27 **

Title : SLDS DCGL Renovation Worker

Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld

Evaluation Time: 10.0000000 years

Pathway Detail of Doses

[mrem]

Source: 1								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	5.76E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.79E-05	0.00E+00	4.36E-05
Total	5.76E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.79E-05	0.00E+00	4.36E-05
Source: 2								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	3.14E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.58E-06	0.00E+00	7.89E-06
Total	3.14E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.58E-06	0.00E+00	7.89E-06
Source: 3								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	3.14E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.58E-06	0.00E+00	7.89E-06
Total	3.14E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.58E-06	0.00E+00	7.89E-06
Source: 4								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	3.14E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.58E-06	0.00E+00	7.89E-06
Total	3.14E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.58E-06	0.00E+00	7.89E-06
Source: 5								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	3.14E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.58E-06	0.00E+00	7.89E-06
Total	3.14E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.58E-06	0.00E+00	7.89E-06

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:34:22 Page: 28 **
 Title : SLDS DCGL Renovation Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld
 Evaluation Time: 10.0000000 years

Nuclide Detail of Doses

[mrem]

Source: 1

Nuclide	Receptor 1	Total
Ac-227	4.50E-07	4.50E-07
Pa-231	6.99E-08	6.99E-08
Ac-227	1.79E-07	1.79E-07
Pb-210	3.57E-08	3.57E-08
Ra-226	2.49E-06	2.49E-06
Pb-210	1.38E-08	1.38E-08
Ra-228	2.88E-07	2.88E-07
Th-228	1.52E-05	1.52E-05
Th-228	8.71E-07	8.71E-07
Th-230	2.02E-09	2.02E-09
Ra-226	1.14E-08	1.14E-08
Pb-210	3.31E-11	3.31E-11
Th-232	1.60E-09	1.60E-09
Ra-228	7.32E-07	7.32E-07
Th-228	2.29E-05	2.29E-05
U-234	2.10E-09	2.10E-09
Th-230	1.95E-13	1.95E-13
Ra-226	5.50E-13	5.50E-13
Pb-210	1.10E-15	1.10E-15
U-235	2.26E-07	2.26E-07
Pa-231	1.55E-11	1.55E-11
Ac-227	2.10E-11	2.10E-11
U-238	1.53E-07	1.53E-07
U-234	6.23E-14	6.23E-14
Th-230	2.89E-18	2.89E-18
Ra-226	5.44E-18	5.44E-18
Pb-210	8.29E-21	8.29E-21

Source: 2

Nuclide	Receptor 1	Total
Ac-227	2.32E-08	2.32E-08
Pa-231	2.03E-09	2.03E-09
Ac-227	9.22E-09	9.22E-09
Pb-210	1.79E-09	1.79E-09
Ra-226	2.14E-07	2.14E-07
Pb-210	6.93E-10	6.93E-10

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:34:22 Page: 29 **

Title : SLDS DCGL Renovation Worker

Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld

Evaluation Time: 10.0000000 years

Ra-228	1.59E-08	1.59E-08
Th-228	2.95E-06	2.95E-06

Th-228	1.69E-07	1.69E-07

Th-230	2.56E-11	2.56E-11
Ra-226	9.76E-10	9.76E-10
Pb-210	1.66E-12	1.66E-12

Th-232	2.28E-11	2.28E-11
Ra-228	4.05E-08	4.05E-08
Th-228	4.45E-06	4.45E-06

U-234	2.48E-11	2.48E-11
Th-230	2.47E-15	2.47E-15
Ra-226	4.72E-14	4.72E-14
Pb-210	5.51E-17	5.51E-17

U-235	1.02E-08	1.02E-08
Pa-231	4.50E-13	4.50E-13
Ac-227	1.08E-12	1.08E-12

U-238	8.26E-09	8.26E-09
U-234	7.34E-16	7.34E-16
Th-230	3.66E-20	3.66E-20
Ra-226	4.67E-19	4.67E-19
Pb-210	4.16E-22	4.16E-22

Source: 3

Nuclide	Receptor	Total
	1	
Ac-227	2.32E-08	2.32E-08

Pa-231	2.03E-09	2.03E-09
Ac-227	9.22E-09	9.22E-09

Pb-210	1.79E-09	1.79E-09

Ra-226	2.14E-07	2.14E-07
Pb-210	6.93E-10	6.93E-10

Ra-228	1.59E-08	1.59E-08
Th-228	2.95E-06	2.95E-06

Th-228	1.69E-07	1.69E-07

Th-230	2.56E-11	2.56E-11
Ra-226	9.76E-10	9.76E-10
Pb-210	1.66E-12	1.66E-12

Th-232	2.28E-11	2.28E-11
Ra-228	4.05E-08	4.05E-08
Th-228	4.45E-06	4.45E-06

U-234	2.48E-11	2.48E-11
Th-230	2.47E-15	2.47E-15
Ra-226	4.72E-14	4.72E-14
Pb-210	5.51E-17	5.51E-17

U-235	1.02E-08	1.02E-08
Pa-231	4.50E-13	4.50E-13
Ac-227	1.08E-12	1.08E-12

U-238	8.26E-09	8.26E-09
U-234	7.34E-16	7.34E-16

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:34:22 Page: 30 **
 Title : SLDS DCGL Renovation Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld
 Evaluation Time: 10.0000000 years

Th-230	3.66E-20	3.66E-20
Ra-226	4.67E-19	4.67E-19
Pb-210	4.16E-22	4.16E-22

Source: 4

Nuclide	Receptor	Total
	1	
Ac-227	2.32E-08	2.32E-08
Pa-231	2.03E-09	2.03E-09
Ac-227	9.22E-09	9.22E-09
Pb-210	1.79E-09	1.79E-09
Ra-226	2.14E-07	2.14E-07
Pb-210	6.93E-10	6.93E-10
Ra-228	1.59E-08	1.59E-08
Th-228	2.95E-06	2.95E-06
Th-228	1.69E-07	1.69E-07
Th-230	2.56E-11	2.56E-11
Ra-226	9.76E-10	9.76E-10
Pb-210	1.66E-12	1.66E-12
Th-232	2.28E-11	2.28E-11
Ra-228	4.05E-08	4.05E-08
Th-228	4.45E-06	4.45E-06
U-234	2.48E-11	2.48E-11
Th-230	2.47E-15	2.47E-15
Ra-226	4.72E-14	4.72E-14
Pb-210	5.51E-17	5.51E-17
U-235	1.02E-08	1.02E-08
Pa-231	4.50E-13	4.50E-13
Ac-227	1.08E-12	1.08E-12
U-238	8.26E-09	8.26E-09
U-234	7.34E-16	7.34E-16
Th-230	3.66E-20	3.66E-20
Ra-226	4.67E-19	4.67E-19
Pb-210	4.16E-22	4.16E-22

Source: 5

Nuclide	Receptor	Total
	1	
Ac-227	2.32E-08	2.32E-08
Pa-231	2.03E-09	2.03E-09
Ac-227	9.22E-09	9.22E-09
Pb-210	1.79E-09	1.79E-09
Ra-226	2.14E-07	2.14E-07

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:34:22 Page: 31 **
Title : SLDS DCGL Renovation Worker
Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld
Evaluation Time: 10.0000000 years

Pb-210	6.93E-10	6.93E-10
Ra-228	1.59E-08	1.59E-08
Th-228	2.95E-06	2.95E-06
Th-228	1.69E-07	1.69E-07
Th-230	2.56E-11	2.56E-11
Ra-226	9.76E-10	9.76E-10
Pb-210	1.66E-12	1.66E-12
Th-232	2.28E-11	2.28E-11
Ra-228	4.05E-08	4.05E-08
Th-228	4.45E-06	4.45E-06
U-234	2.48E-11	2.48E-11
Th-230	2.47E-15	2.47E-15
Ra-226	4.72E-14	4.72E-14
Pb-210	5.51E-17	5.51E-17
U-235	1.02E-08	1.02E-08
Pa-231	4.50E-13	4.50E-13
Ac-227	1.08E-12	1.08E-12
U-238	8.26E-09	8.26E-09
U-234	7.34E-16	7.34E-16
Th-230	3.66E-20	3.66E-20
Ra-226	4.67E-19	4.67E-19
Pb-210	4.16E-22	4.16E-22

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:34:22 Page: 32 **
 Title : SLDS DCGL Renovation Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld
 Evaluation Time: 30.0000000 years

RESRAD-BUILD Dose Tables

Source Contributions to Receptor Doses

[mrem]						
	Source 1	Source 2	Source 3	Source 4	Source 5	Total
Receptor 1	4.36E-05	7.89E-06	7.89E-06	7.89E-06	7.89E-06	7.52E-05
Total	4.36E-05	7.89E-06	7.89E-06	7.89E-06	7.89E-06	7.52E-05

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:34:22 Page: 33 **
 Title : SLDS DCGL Renovation Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld
 Evaluation Time: 30.0000000 years

Pathway Detail of Doses

[mrem]

Source: 1								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	5.76E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.79E-05	0.00E+00	4.36E-05
Total	5.76E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.79E-05	0.00E+00	4.36E-05
Source: 2								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	3.14E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.58E-06	0.00E+00	7.89E-06
Total	3.14E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.58E-06	0.00E+00	7.89E-06
Source: 3								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	3.14E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.58E-06	0.00E+00	7.89E-06
Total	3.14E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.58E-06	0.00E+00	7.89E-06
Source: 4								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	3.14E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.58E-06	0.00E+00	7.89E-06
Total	3.14E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.58E-06	0.00E+00	7.89E-06
Source: 5								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	3.14E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.58E-06	0.00E+00	7.89E-06
Total	3.14E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.58E-06	0.00E+00	7.89E-06

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:34:22 Page: 34 **
 Title : SLDS DCGL Renovation Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld
 Evaluation Time: 30.0000000 years

Nuclide Detail of Doses

[mrem]

Source: 1

Nuclide	Receptor 1	Total
Ac-227	2.38E-07	2.38E-07
Pa-231	6.99E-08	6.99E-08
Ac-227	3.91E-07	3.91E-07
Pb-210	1.91E-08	1.91E-08
Ra-226	2.47E-06	2.47E-06
Pb-210	3.02E-08	3.02E-08
Ra-228	2.58E-08	2.58E-08
Th-228	1.48E-06	1.48E-06
Th-228	6.17E-10	6.17E-10
Th-230	2.02E-09	2.02E-09
Ra-226	3.29E-08	3.29E-08
Pb-210	2.31E-10	2.31E-10
Th-232	1.60E-09	1.60E-09
Ra-228	9.94E-07	9.94E-07
Th-228	3.75E-05	3.75E-05
U-234	2.10E-09	2.10E-09
Th-230	5.66E-13	5.66E-13
Ra-226	4.62E-12	4.62E-12
Pb-210	2.32E-14	2.32E-14
U-235	2.26E-07	2.26E-07
Pa-231	4.51E-11	4.51E-11
Ac-227	1.46E-10	1.46E-10
U-238	1.53E-07	1.53E-07
U-234	1.81E-13	1.81E-13
Th-230	2.44E-17	2.44E-17
Ra-226	1.33E-16	1.33E-16
Pb-210	5.23E-19	5.23E-19

Source: 2

Nuclide	Receptor 1	Total
Ac-227	1.23E-08	1.23E-08
Pa-231	2.03E-09	2.03E-09
Ac-227	2.02E-08	2.02E-08
Pb-210	9.59E-10	9.59E-10
Ra-226	2.12E-07	2.12E-07
Pb-210	1.51E-09	1.51E-09

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:34:22 Page: 35 **

Title : SLDS DCGL Renovation Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld
 Evaluation Time: 30.0000000 years

Ra-228	1.43E-09	1.43E-09
Th-228	2.87E-07	2.87E-07
Th-228	1.20E-10	1.20E-10
Th-230	2.56E-11	2.56E-11
Ra-226	2.82E-09	2.82E-09
Pb-210	1.16E-11	1.16E-11
Th-232	2.28E-11	2.28E-11
Ra-228	5.50E-08	5.50E-08
Th-228	7.28E-06	7.28E-06
U-234	2.48E-11	2.48E-11
Th-230	7.17E-15	7.17E-15
Ra-226	3.97E-13	3.97E-13
Pb-210	1.17E-15	1.17E-15
U-235	1.02E-08	1.02E-08
Pa-231	1.31E-12	1.31E-12
Ac-227	7.54E-12	7.54E-12
U-238	8.26E-09	8.26E-09
U-234	2.13E-15	2.13E-15
Th-230	3.09E-19	3.09E-19
Ra-226	1.14E-17	1.14E-17
Pb-210	2.62E-20	2.62E-20

Source: 3

Nuclide	Receptor 1	Total
Ac-227	1.23E-08	1.23E-08
Pa-231	2.03E-09	2.03E-09
Ac-227	2.02E-08	2.02E-08
Pb-210	9.59E-10	9.59E-10
Ra-226	2.12E-07	2.12E-07
Pb-210	1.51E-09	1.51E-09
Ra-228	1.43E-09	1.43E-09
Th-228	2.87E-07	2.87E-07
Th-228	1.20E-10	1.20E-10
Th-230	2.56E-11	2.56E-11
Ra-226	2.82E-09	2.82E-09
Pb-210	1.16E-11	1.16E-11
Th-232	2.28E-11	2.28E-11
Ra-228	5.50E-08	5.50E-08
Th-228	7.28E-06	7.28E-06
U-234	2.48E-11	2.48E-11
Th-230	7.17E-15	7.17E-15
Ra-226	3.97E-13	3.97E-13
Pb-210	1.17E-15	1.17E-15
U-235	1.02E-08	1.02E-08
Pa-231	1.31E-12	1.31E-12
Ac-227	7.54E-12	7.54E-12
U-238	8.26E-09	8.26E-09
U-234	2.13E-15	2.13E-15

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:34:22 Page: 36 **
 Title : SLDS DCGL Renovation Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld
 Evaluation Time: 30.0000000 years

Th-230	3.09E-19	3.09E-19
Ra-226	1.14E-17	1.14E-17
Pb-210	2.62E-20	2.62E-20

Source: 4

Nuclide	Receptor 1	Total
Ac-227	1.23E-08	1.23E-08
Pa-231	2.03E-09	2.03E-09
Ac-227	2.02E-08	2.02E-08
Pb-210	9.59E-10	9.59E-10
Ra-226	2.12E-07	2.12E-07
Pb-210	1.51E-09	1.51E-09
Ra-228	1.43E-09	1.43E-09
Th-228	2.87E-07	2.87E-07
Th-228	1.20E-10	1.20E-10
Th-230	2.56E-11	2.56E-11
Ra-226	2.82E-09	2.82E-09
Pb-210	1.16E-11	1.16E-11
Th-232	2.28E-11	2.28E-11
Ra-228	5.50E-08	5.50E-08
Th-228	7.28E-06	7.28E-06
U-234	2.48E-11	2.48E-11
Th-230	7.17E-15	7.17E-15
Ra-226	3.97E-13	3.97E-13
Pb-210	1.17E-15	1.17E-15
U-235	1.02E-08	1.02E-08
Pa-231	1.31E-12	1.31E-12
Ac-227	7.54E-12	7.54E-12
U-238	8.26E-09	8.26E-09
U-234	2.13E-15	2.13E-15
Th-230	3.09E-19	3.09E-19
Ra-226	1.14E-17	1.14E-17
Pb-210	2.62E-20	2.62E-20

Source: 5

Nuclide	Receptor 1	Total
Ac-227	1.23E-08	1.23E-08
Pa-231	2.03E-09	2.03E-09
Ac-227	2.02E-08	2.02E-08
Pb-210	9.59E-10	9.59E-10
Ra-226	2.12E-07	2.12E-07

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:34:22 Page: 37 **
Title : SLDS DCGL Renovation Worker
Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld
Evaluation Time: 30.0000000 years

Pb-210	1.51E-09	1.51E-09
Ra-228	1.43E-09	1.43E-09
Th-228	2.87E-07	2.87E-07
Th-228	1.20E-10	1.20E-10
Th-230	2.56E-11	2.56E-11
Ra-226	2.82E-09	2.82E-09
Pb-210	1.16E-11	1.16E-11
Th-232	2.28E-11	2.28E-11
Ra-228	5.50E-08	5.50E-08
Th-228	7.28E-06	7.28E-06
U-234	2.48E-11	2.48E-11
Th-230	7.17E-15	7.17E-15
Ra-226	3.97E-13	3.97E-13
Pb-210	1.17E-15	1.17E-15
U-235	1.02E-08	1.02E-08
Pa-231	1.31E-12	1.31E-12
Ac-227	7.54E-12	7.54E-12
U-238	8.26E-09	8.26E-09
U-234	2.13E-15	2.13E-15
Th-230	3.09E-19	3.09E-19
Ra-226	1.14E-17	1.14E-17
Pb-210	2.62E-20	2.62E-20

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:34:22 Page: 38 **
 Title : SLDS DCGL Renovation Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld
 Evaluation Time: 100.000008 years

RESRAD-BUILD Dose Tables

Source Contributions to Receptor Doses

[mrem]						
	Source 1	Source 2	Source 3	Source 4	Source 5	Total
Receptor 1	4.36E-05	7.89E-06	7.89E-06	7.89E-06	7.89E-06	7.52E-05
Total	4.36E-05	7.89E-06	7.89E-06	7.89E-06	7.89E-06	7.52E-05

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:34:22 Page: 39 **
 Title : SLDS DCGL Renovation Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld
 Evaluation Time: 100.000008 years

Pathway Detail of Doses

[mrem]

Source: 1								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	5.76E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.79E-05	0.00E+00	4.36E-05
Total	5.76E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.79E-05	0.00E+00	4.36E-05
Source: 2								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	3.14E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.58E-06	0.00E+00	7.89E-06
Total	3.14E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.58E-06	0.00E+00	7.89E-06
Source: 3								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	3.14E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.58E-06	0.00E+00	7.89E-06
Total	3.14E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.58E-06	0.00E+00	7.89E-06
Source: 4								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	3.14E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.58E-06	0.00E+00	7.89E-06
Total	3.14E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.58E-06	0.00E+00	7.89E-06
Source: 5								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	3.14E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.58E-06	0.00E+00	7.89E-06
Total	3.14E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.58E-06	0.00E+00	7.89E-06

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:34:22 Page: 40 **
 Title : SLDS DCGL Renovation Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld
 Evaluation Time: 100.000008 years

Nuclide Detail of Doses

[mrem]

Source: 1

Nuclide	Receptor 1	Total
Ac-227	2.56E-08	2.56E-08
Pa-231	6.98E-08	6.98E-08
Ac-227	6.02E-07	6.02E-07
Pb-210	2.15E-09	2.15E-09
Ra-226	2.40E-06	2.40E-06
Pb-210	4.59E-08	4.59E-08
Ra-228	5.59E-12	5.59E-12
Th-228	3.20E-10	3.20E-10
Th-228	5.85E-21	5.85E-21
Th-230	2.02E-09	2.02E-09
Ra-226	1.07E-07	1.07E-07
Pb-210	1.47E-09	1.47E-09
Th-232	1.60E-09	1.60E-09
Ra-228	1.02E-06	1.02E-06
Th-228	3.90E-05	3.90E-05
U-234	2.10E-09	2.10E-09
Th-230	1.86E-12	1.86E-12
Ra-226	4.97E-11	4.97E-11
Pb-210	5.48E-13	5.48E-13
U-235	2.26E-07	2.26E-07
Pa-231	1.49E-10	1.49E-10
Ac-227	9.36E-10	9.36E-10
U-238	1.53E-07	1.53E-07
U-234	5.96E-13	5.96E-13
Th-230	2.65E-16	2.65E-16
Ra-226	4.71E-15	4.71E-15
Pb-210	4.36E-17	4.36E-17

Source: 2

Nuclide	Receptor 1	Total
Ac-227	1.32E-09	1.32E-09
Pa-231	2.02E-09	2.02E-09
Ac-227	3.11E-08	3.11E-08
Pb-210	1.08E-10	1.08E-10
Ra-226	2.06E-07	2.06E-07
Pb-210	2.30E-09	2.30E-09

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:34:22 Page: 41 **

Title : SLDS DCGL Renovation Worker

Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld

Evaluation Time: 100.000008 years

Ra-228	3.09E-13	3.09E-13
Th-228	6.21E-11	6.21E-11

Th-228	1.13E-21	1.13E-21

Th-230	2.55E-11	2.55E-11
Ra-226	9.16E-09	9.16E-09
Pb-210	7.39E-11	7.39E-11

Th-232	2.28E-11	2.28E-11
Ra-228	5.65E-08	5.65E-08
Th-228	7.57E-06	7.57E-06

U-234	2.48E-11	2.48E-11
Th-230	2.36E-14	2.36E-14
Ra-226	4.26E-12	4.26E-12
Pb-210	2.75E-14	2.75E-14

U-235	1.02E-08	1.02E-08
Pa-231	4.31E-12	4.31E-12
Ac-227	4.83E-11	4.83E-11

U-238	8.26E-09	8.26E-09
U-234	7.03E-15	7.03E-15
Th-230	3.35E-18	3.35E-18
Ra-226	4.05E-16	4.05E-16
Pb-210	2.19E-18	2.19E-18

Source: 3

Nuclide	Receptor	Total
	1	

Ac-227	1.32E-09	1.32E-09

Pa-231	2.02E-09	2.02E-09
Ac-227	3.11E-08	3.11E-08

Pb-210	1.08E-10	1.08E-10

Ra-226	2.06E-07	2.06E-07
Pb-210	2.30E-09	2.30E-09

Ra-228	3.09E-13	3.09E-13
Th-228	6.21E-11	6.21E-11

Th-228	1.13E-21	1.13E-21

Th-230	2.55E-11	2.55E-11
Ra-226	9.16E-09	9.16E-09
Pb-210	7.39E-11	7.39E-11

Th-232	2.28E-11	2.28E-11
Ra-228	5.65E-08	5.65E-08
Th-228	7.57E-06	7.57E-06

U-234	2.48E-11	2.48E-11
Th-230	2.36E-14	2.36E-14
Ra-226	4.26E-12	4.26E-12
Pb-210	2.75E-14	2.75E-14

U-235	1.02E-08	1.02E-08
Pa-231	4.31E-12	4.31E-12
Ac-227	4.83E-11	4.83E-11

U-238	8.26E-09	8.26E-09
U-234	7.03E-15	7.03E-15

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:34:22 Page: 42 **
 Title : SLDS DCGL Renovation Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld
 Evaluation Time: 100.000008 years

Th-230	3.35E-18	3.35E-18
Ra-226	4.05E-16	4.05E-16
Pb-210	2.19E-18	2.19E-18

Source: 4

Nuclide	Receptor 1	Total
Ac-227	1.32E-09	1.32E-09
Pa-231	2.02E-09	2.02E-09
Ac-227	3.11E-08	3.11E-08
Pb-210	1.08E-10	1.08E-10
Ra-226	2.06E-07	2.06E-07
Pb-210	2.30E-09	2.30E-09
Ra-228	3.09E-13	3.09E-13
Th-228	6.21E-11	6.21E-11
Th-228	1.13E-21	1.13E-21
Th-230	2.55E-11	2.55E-11
Ra-226	9.16E-09	9.16E-09
Pb-210	7.39E-11	7.39E-11
Th-232	2.28E-11	2.28E-11
Ra-228	5.65E-08	5.65E-08
Th-228	7.57E-06	7.57E-06
U-234	2.48E-11	2.48E-11
Th-230	2.36E-14	2.36E-14
Ra-226	4.26E-12	4.26E-12
Pb-210	2.75E-14	2.75E-14
U-235	1.02E-08	1.02E-08
Pa-231	4.31E-12	4.31E-12
Ac-227	4.83E-11	4.83E-11
U-238	8.26E-09	8.26E-09
U-234	7.03E-15	7.03E-15
Th-230	3.35E-18	3.35E-18
Ra-226	4.05E-16	4.05E-16
Pb-210	2.19E-18	2.19E-18

Source: 5

Nuclide	Receptor 1	Total
Ac-227	1.32E-09	1.32E-09
Pa-231	2.02E-09	2.02E-09
Ac-227	3.11E-08	3.11E-08
Pb-210	1.08E-10	1.08E-10
Ra-226	2.06E-07	2.06E-07

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:34:22 Page: 43 **
Title : SLDS DCGL Renovation Worker
Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld
Evaluation Time: 100.000008 years

Pb-210	2.30E-09	2.30E-09
Ra-228	3.09E-13	3.09E-13
Th-228	6.21E-11	6.21E-11
Th-228	1.13E-21	1.13E-21
Th-230	2.55E-11	2.55E-11
Ra-226	9.16E-09	9.16E-09
Pb-210	7.39E-11	7.39E-11
Th-232	2.28E-11	2.28E-11
Ra-228	5.65E-08	5.65E-08
Th-228	7.57E-06	7.57E-06
U-234	2.48E-11	2.48E-11
Th-230	2.36E-14	2.36E-14
Ra-226	4.26E-12	4.26E-12
Pb-210	2.75E-14	2.75E-14
U-235	1.02E-08	1.02E-08
Pa-231	4.31E-12	4.31E-12
Ac-227	4.83E-11	4.83E-11
U-238	8.26E-09	8.26E-09
U-234	7.03E-15	7.03E-15
Th-230	3.35E-18	3.35E-18
Ra-226	4.05E-16	4.05E-16
Pb-210	2.19E-18	2.19E-18

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:34:22 Page: 44 **
 Title : SLDS DCGL Renovation Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld
 Evaluation Time: 300.000031 years

RESRAD-BUILD Dose Tables

Source Contributions to Receptor Doses

[mrem]						
	Source 1	Source 2	Source 3	Source 4	Source 5	Total
Receptor 1	4.36E-05	7.89E-06	7.89E-06	7.89E-06	7.89E-06	7.52E-05
Total	4.36E-05	7.89E-06	7.89E-06	7.89E-06	7.89E-06	7.52E-05

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:34:22 Page: 45 **

Title : SLDS DCGL Renovation Worker

Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld

Evaluation Time: 300.000031 years

Pathway Detail of Doses

[mrem]

Source: 1	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	5.76E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.79E-05	0.00E+00	4.36E-05
Total	5.76E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.79E-05	0.00E+00	4.36E-05
Source: 2	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	3.14E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.58E-06	0.00E+00	7.89E-06
Total	3.14E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.58E-06	0.00E+00	7.89E-06
Source: 3	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	3.14E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.58E-06	0.00E+00	7.89E-06
Total	3.14E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.58E-06	0.00E+00	7.89E-06
Source: 4	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	3.14E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.58E-06	0.00E+00	7.89E-06
Total	3.14E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.58E-06	0.00E+00	7.89E-06
Source: 5	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	3.14E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.58E-06	0.00E+00	7.89E-06
Total	3.14E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.58E-06	0.00E+00	7.89E-06

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:34:22 Page: 46 **
 Title : SLDS DCGL Renovation Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld
 Evaluation Time: 300.000031 years

Nuclide Detail of Doses

[mrem]

Source: 1

Nuclide	Receptor 1	Total
Ac-227	4.40E-11	4.40E-11
Pa-231	6.95E-08	6.95E-08
Ac-227	6.25E-07	6.25E-07
Pb-210	4.17E-12	4.17E-12
Ra-226	2.20E-06	2.20E-06
Pb-210	4.41E-08	4.41E-08
Ra-228	1.89E-22	1.89E-22
Th-228	1.08E-20	1.08E-20
Th-228	0.00E+00	0.00E+00
Th-230	2.01E-09	2.01E-09
Ra-226	3.05E-07	3.05E-07
Pb-210	5.42E-09	5.42E-09
Th-232	1.60E-09	1.60E-09
Ra-228	1.02E-06	1.02E-06
Th-228	3.90E-05	3.90E-05
U-234	2.10E-09	2.10E-09
Th-230	5.57E-12	5.57E-12
Ra-226	4.31E-10	4.31E-10
Pb-210	6.92E-12	6.92E-12
U-235	2.26E-07	2.26E-07
Pa-231	4.43E-10	4.43E-10
Ac-227	3.57E-09	3.57E-09
U-238	1.53E-07	1.53E-07
U-234	1.78E-12	1.78E-12
Th-230	2.36E-15	2.36E-15
Ra-226	1.23E-13	1.23E-13
Pb-210	1.81E-15	1.81E-15

Source: 2

Nuclide	Receptor 1	Total
Ac-227	2.27E-12	2.27E-12
Pa-231	2.01E-09	2.01E-09
Ac-227	3.23E-08	3.23E-08
Pb-210	2.09E-13	2.09E-13
Ra-226	1.89E-07	1.89E-07
Pb-210	2.21E-09	2.21E-09

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:34:22 Page: 47 **

Title : SLDS DCGL Renovation Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld
 Evaluation Time: 300.000031 years

Ra-228	1.05E-23	1.05E-23
Th-228	2.10E-21	2.10E-21
Th-228	0.00E+00	0.00E+00
Th-230	2.55E-11	2.55E-11
Ra-226	2.62E-08	2.62E-08
Pb-210	2.72E-10	2.72E-10
Th-232	2.28E-11	2.28E-11
Ra-228	5.65E-08	5.65E-08
Th-228	7.57E-06	7.57E-06
U-234	2.47E-11	2.47E-11
Th-230	7.05E-14	7.05E-14
Ra-226	3.70E-11	3.70E-11
Pb-210	3.47E-13	3.47E-13
U-235	1.02E-08	1.02E-08
Pa-231	1.29E-11	1.29E-11
Ac-227	1.84E-10	1.84E-10
U-238	8.26E-09	8.26E-09
U-234	2.10E-14	2.10E-14
Th-230	2.99E-17	2.99E-17
Ra-226	1.06E-14	1.06E-14
Pb-210	9.08E-17	9.08E-17

Source: 3

Nuclide	Receptor 1	Total
Ac-227	2.27E-12	2.27E-12
Pa-231	2.01E-09	2.01E-09
Ac-227	3.23E-08	3.23E-08
Pb-210	2.09E-13	2.09E-13
Ra-226	1.89E-07	1.89E-07
Pb-210	2.21E-09	2.21E-09
Ra-228	1.05E-23	1.05E-23
Th-228	2.10E-21	2.10E-21
Th-228	0.00E+00	0.00E+00
Th-230	2.55E-11	2.55E-11
Ra-226	2.62E-08	2.62E-08
Pb-210	2.72E-10	2.72E-10
Th-232	2.28E-11	2.28E-11
Ra-228	5.65E-08	5.65E-08
Th-228	7.57E-06	7.57E-06
U-234	2.47E-11	2.47E-11
Th-230	7.05E-14	7.05E-14
Ra-226	3.70E-11	3.70E-11
Pb-210	3.47E-13	3.47E-13
U-235	1.02E-08	1.02E-08
Pa-231	1.29E-11	1.29E-11
Ac-227	1.84E-10	1.84E-10
U-238	8.26E-09	8.26E-09
U-234	2.10E-14	2.10E-14

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:34:22 Page: 48 **
 Title : SLDS DCGL Renovation Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld
 Evaluation Time: 300.000031 years

Th-230	2.99E-17	2.99E-17
Ra-226	1.06E-14	1.06E-14
Pb-210	9.08E-17	9.08E-17

Source: 4

Nuclide	Receptor	Total
	1	
Ac-227	2.27E-12	2.27E-12
Pa-231	2.01E-09	2.01E-09
Ac-227	3.23E-08	3.23E-08
Pb-210	2.09E-13	2.09E-13
Ra-226	1.89E-07	1.89E-07
Pb-210	2.21E-09	2.21E-09
Ra-228	1.05E-23	1.05E-23
Th-228	2.10E-21	2.10E-21
Th-228	0.00E+00	0.00E+00
Th-230	2.55E-11	2.55E-11
Ra-226	2.62E-08	2.62E-08
Pb-210	2.72E-10	2.72E-10
Th-232	2.28E-11	2.28E-11
Ra-228	5.65E-08	5.65E-08
Th-228	7.57E-06	7.57E-06
U-234	2.47E-11	2.47E-11
Th-230	7.05E-14	7.05E-14
Ra-226	3.70E-11	3.70E-11
Pb-210	3.47E-13	3.47E-13
U-235	1.02E-08	1.02E-08
Pa-231	1.29E-11	1.29E-11
Ac-227	1.84E-10	1.84E-10
U-238	8.26E-09	8.26E-09
U-234	2.10E-14	2.10E-14
Th-230	2.99E-17	2.99E-17
Ra-226	1.06E-14	1.06E-14
Pb-210	9.08E-17	9.08E-17

Source: 5

Nuclide	Receptor	Total
	1	
Ac-227	2.27E-12	2.27E-12
Pa-231	2.01E-09	2.01E-09
Ac-227	3.23E-08	3.23E-08
Pb-210	2.09E-13	2.09E-13
Ra-226	1.89E-07	1.89E-07

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:34:22 Page: 49 **
Title : SLDS DCGL Renovation Worker
Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld
Evaluation Time: 300.000031 years

Pb-210	2.21E-09	2.21E-09
Ra-228	1.05E-23	1.05E-23
Th-228	2.10E-21	2.10E-21
Th-228	0.00E+00	0.00E+00
Th-230	2.55E-11	2.55E-11
Ra-226	2.62E-08	2.62E-08
Pb-210	2.72E-10	2.72E-10
Th-232	2.28E-11	2.28E-11
Ra-228	5.65E-08	5.65E-08
Th-228	7.57E-06	7.57E-06
U-234	2.47E-11	2.47E-11
Th-230	7.05E-14	7.05E-14
Ra-226	3.70E-11	3.70E-11
Pb-210	3.47E-13	3.47E-13
U-235	1.02E-08	1.02E-08
Pa-231	1.29E-11	1.29E-11
Ac-227	1.84E-10	1.84E-10
U-238	8.26E-09	8.26E-09
U-234	2.10E-14	2.10E-14
Th-230	2.99E-17	2.99E-17
Ra-226	1.06E-14	1.06E-14
Pb-210	9.08E-17	9.08E-17

RESRAD-BUILD Dose Tables

Source Contributions to Receptor Doses

```
[mrem]
```

	Source 1	Source 2	Source 3	Source 4	Source 5	Total
Receptor 1	4.36E-05	7.89E-06	7.89E-06	7.89E-06	7.89E-06	7.52E-05
Total	4.36E-05	7.89E-06	7.89E-06	7.89E-06	7.89E-06	7.52E-05

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:34:22 Page: 51 **

Title : SLDS DCGL Renovation Worker

Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld

Evaluation Time: 1000.00000 years

Pathway Detail of Doses

[mrem]

Source: 1	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	5.76E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.79E-05	0.00E+00	4.36E-05
Total	5.76E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.79E-05	0.00E+00	4.36E-05
Source: 2	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	3.14E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.58E-06	0.00E+00	7.89E-06
Total	3.14E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.58E-06	0.00E+00	7.89E-06
Source: 3	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	3.14E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.58E-06	0.00E+00	7.89E-06
Total	3.14E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.58E-06	0.00E+00	7.89E-06
Source: 4	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	3.14E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.58E-06	0.00E+00	7.89E-06
Total	3.14E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.58E-06	0.00E+00	7.89E-06
Source: 5	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	3.14E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.58E-06	0.00E+00	7.89E-06
Total	3.14E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.58E-06	0.00E+00	7.89E-06

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:34:22 Page: 52 **
 Title : SLDS DCGL Renovation Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld
 Evaluation Time: 1000.00000 years

Nuclide Detail of Doses

[mrem]

Source: 1

Nuclide	Receptor 1	Total
Ac-227	9.23E-21	9.23E-21
Pa-231	6.85E-08	6.85E-08
Ac-227	6.16E-07	6.16E-07
Pb-210	1.34E-21	1.34E-21
Ra-226	1.62E-06	1.62E-06
Pb-210	3.25E-08	3.25E-08
Ra-228	0.00E+00	0.00E+00
Th-228	0.00E+00	0.00E+00
Th-228	0.00E+00	0.00E+00
Th-230	2.00E-09	2.00E-09
Ra-226	8.77E-07	8.77E-07
Pb-210	1.69E-08	1.69E-08
Th-232	1.60E-09	1.60E-09
Ra-228	1.02E-06	1.02E-06
Th-228	3.90E-05	3.90E-05
U-234	2.09E-09	2.09E-09
Th-230	1.85E-11	1.85E-11
Ra-226	4.33E-09	4.33E-09
Pb-210	8.05E-11	8.05E-11
U-235	2.26E-07	2.26E-07
Pa-231	1.47E-09	1.47E-09
Ac-227	1.28E-08	1.28E-08
U-238	1.53E-07	1.53E-07
U-234	5.93E-12	5.93E-12
Th-230	2.61E-14	2.61E-14
Ra-226	4.22E-12	4.22E-12
Pb-210	7.61E-14	7.61E-14

Source: 2

Nuclide	Receptor 1	Total
Ac-227	4.76E-22	4.76E-22
Pa-231	1.99E-09	1.99E-09
Ac-227	3.18E-08	3.18E-08
Pb-210	6.74E-23	6.74E-23
Ra-226	1.39E-07	1.39E-07
Pb-210	1.63E-09	1.63E-09

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:34:22 Page: 53 **

Title : SLDS DCGL Renovation Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld
 Evaluation Time: 1000.00000 years

Ra-228	0.00E+00	0.00E+00
Th-228	0.00E+00	0.00E+00
Th-228	0.00E+00	0.00E+00
Th-230	2.53E-11	2.53E-11
Ra-226	7.53E-08	7.53E-08
Pb-210	8.47E-10	8.47E-10
Th-232	2.28E-11	2.28E-11
Ra-228	5.65E-08	5.65E-08
Th-228	7.57E-06	7.57E-06
U-234	2.47E-11	2.47E-11
Th-230	2.34E-13	2.34E-13
Ra-226	3.72E-10	3.72E-10
Pb-210	4.04E-12	4.04E-12
U-235	1.02E-08	1.02E-08
Pa-231	4.25E-11	4.25E-11
Ac-227	6.59E-10	6.59E-10
U-238	8.26E-09	8.26E-09
U-234	6.99E-14	6.99E-14
Th-230	3.31E-16	3.31E-16
Ra-226	3.63E-13	3.63E-13
Pb-210	3.82E-15	3.82E-15

Source: 3

Nuclide	Receptor 1	Total
Ac-227	4.76E-22	4.76E-22
Pa-231	1.99E-09	1.99E-09
Ac-227	3.18E-08	3.18E-08
Pb-210	6.74E-23	6.74E-23
Ra-226	1.39E-07	1.39E-07
Pb-210	1.63E-09	1.63E-09
Ra-228	0.00E+00	0.00E+00
Th-228	0.00E+00	0.00E+00
Th-228	0.00E+00	0.00E+00
Th-230	2.53E-11	2.53E-11
Ra-226	7.53E-08	7.53E-08
Pb-210	8.47E-10	8.47E-10
Th-232	2.28E-11	2.28E-11
Ra-228	5.65E-08	5.65E-08
Th-228	7.57E-06	7.57E-06
U-234	2.47E-11	2.47E-11
Th-230	2.34E-13	2.34E-13
Ra-226	3.72E-10	3.72E-10
Pb-210	4.04E-12	4.04E-12
U-235	1.02E-08	1.02E-08
Pa-231	4.25E-11	4.25E-11
Ac-227	6.59E-10	6.59E-10
U-238	8.26E-09	8.26E-09
U-234	6.99E-14	6.99E-14

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:34:22 Page: 54 **

Title : SLDS DCGL Renovation Worker

Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld

Evaluation Time: 1000.00000 years

Th-230	3.31E-16	3.31E-16
Ra-226	3.63E-13	3.63E-13
Pb-210	3.82E-15	3.82E-15

Source: 4

Nuclide	Receptor 1	Total
Ac-227	4.76E-22	4.76E-22
Pa-231	1.99E-09	1.99E-09
Ac-227	3.18E-08	3.18E-08
Pb-210	6.74E-23	6.74E-23
Ra-226	1.39E-07	1.39E-07
Pb-210	1.63E-09	1.63E-09
Ra-228	0.00E+00	0.00E+00
Th-228	0.00E+00	0.00E+00
Th-228	0.00E+00	0.00E+00
Th-230	2.53E-11	2.53E-11
Ra-226	7.53E-08	7.53E-08
Pb-210	8.47E-10	8.47E-10
Th-232	2.28E-11	2.28E-11
Ra-228	5.65E-08	5.65E-08
Th-228	7.57E-06	7.57E-06
U-234	2.47E-11	2.47E-11
Th-230	2.34E-13	2.34E-13
Ra-226	3.72E-10	3.72E-10
Pb-210	4.04E-12	4.04E-12
U-235	1.02E-08	1.02E-08
Pa-231	4.25E-11	4.25E-11
Ac-227	6.59E-10	6.59E-10
U-238	8.26E-09	8.26E-09
U-234	6.99E-14	6.99E-14
Th-230	3.31E-16	3.31E-16
Ra-226	3.63E-13	3.63E-13
Pb-210	3.82E-15	3.82E-15

Source: 5

Nuclide	Receptor 1	Total
Ac-227	4.76E-22	4.76E-22
Pa-231	1.99E-09	1.99E-09
Ac-227	3.18E-08	3.18E-08
Pb-210	6.74E-23	6.74E-23
Ra-226	1.39E-07	1.39E-07

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:34:22 Page: 55 **
Title : SLDS DCGL Renovation Worker
Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld
Evaluation Time: 1000.00000 years

Pb-210	1.63E-09	1.63E-09
Ra-228	0.00E+00	0.00E+00
Th-228	0.00E+00	0.00E+00
Th-228	0.00E+00	0.00E+00
Th-230	2.53E-11	2.53E-11
Ra-226	7.53E-08	7.53E-08
Pb-210	8.47E-10	8.47E-10
Th-232	2.28E-11	2.28E-11
Ra-228	5.65E-08	5.65E-08
Th-228	7.57E-06	7.57E-06
U-234	2.47E-11	2.47E-11
Th-230	2.34E-13	2.34E-13
Ra-226	3.72E-10	3.72E-10
Pb-210	4.04E-12	4.04E-12
U-235	1.02E-08	1.02E-08
Pa-231	4.25E-11	4.25E-11
Ac-227	6.59E-10	6.59E-10
U-238	8.26E-09	8.26E-09
U-234	6.99E-14	6.99E-14
Th-230	3.31E-16	3.31E-16
Ra-226	3.63E-13	3.63E-13
Pb-210	3.82E-15	3.82E-15

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:33:49 Page: 1 **
 Title : SLDS DCGL Renovation Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld

=====	
=====	
=====	=====
RESRAD-BUILD Table of Contents	=====
=====	=====
=====	

RESRAD-BUILD Input Parameters.....	2
Building Information.....	3
Source Information.....	4
Temporal Risk Summary.....	7
For time = 0.00E+00 yr	
Receptor-Source Risk Summary.....	8
Risk by Pathway Detail.....	9
Risk by Nuclide Detail.....	10
For time = 1.00E+00 yr	
Receptor-Source Risk Summary.....	14
Risk by Pathway Detail.....	15
Risk by Nuclide Detail.....	16
For time = 3.00E+00 yr	
Receptor-Source Risk Summary.....	20
Risk by Pathway Detail.....	21
Risk by Nuclide Detail.....	22
For time = 1.00E+01 yr	
Receptor-Source Risk Summary.....	26
Risk by Pathway Detail.....	27
Risk by Nuclide Detail.....	28
For time = 3.00E+01 yr	
Receptor-Source Risk Summary.....	32
Risk by Pathway Detail.....	33
Risk by Nuclide Detail.....	34
For time = 1.00E+02 yr	
Receptor-Source Risk Summary.....	38
Risk by Pathway Detail.....	39
Risk by Nuclide Detail.....	40
For time = 3.00E+02 yr	
Receptor-Source Risk Summary.....	44
Risk by Pathway Detail.....	45
Risk by Nuclide Detail.....	46
For time = 1.00E+03 yr	
Receptor-Source Risk Summary.....	50
Risk by Pathway Detail.....	51
Risk by Nuclide Detail.....	52

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:33:49 Page: 2 **
 Title : SLDS DCGL Renovation Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld

```

=====
=====
=====
RESRAD-BUILD Input Parameters
=====
=====
=====
    
```

Number of Sources : 5
 Number of Receptors: 1
 Total Time : 9.125000E+03 days
 Fraction Inside : 8.000000E-02

Transformations data from: ICRP107
 Cut off half life : 180.000000 days
 Library information in the Dose Coefficients and Slope Factors report

```

===== Receptor Information =====
Receptor  Room      x          y          z  FracTime Inhalation Ingestion(Dust)
           [m]      [m]      [m]      [m3/day]  [m2/hr]
1          1      5.000    5.000    1.000  1.000    3.36E+01  2.00E-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

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:33:49 Page: 3 **
Title : SLDS DCGL Renovation Worker
Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld

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

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

Height[m]	Air Exchanges [m3/hr]	
Area [m2]	*****	
	*	*
	*	*
	*	<=Q01: 0.00E+00
H1: 2.500	Room 1	Q10 : 0.00E+00
	LAMBDA: 0.00E+00	*
Area 100.000	*	*
	*	*

Deposition velocity: 3.90E-04 [m/s] Resuspension Rate: 0.00E+00 [1/s]
Deposition velocity: 1.70E-06 [m/s] Resuspension Rate:

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:33:49 Page: 4 **
 Title : SLDS DCGL Renovation Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld

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

Source: 1

Location:: Room : 1 x: 5.00 y: 5.00 z: 0.00[m]
 Geometry:: Type: Area Length[m]:1.00E+01 Width[m]:1.00E+01 Direction: z
 Pathway ::
 Direct Ingestion Rate: 0.000E+00 [1/hr]
 Fraction released to air: 3.500E-02
 Removable fraction: 1.000E-01
 Time to Remove: 1.825E+03 [day]

Radon Release Fraction: 1.000E-01

Contamination::

Nuclide Concentration

	[dpm/m2]
Ac-227	1.000E+00
Pa-231	1.000E+00
Pb-210	1.000E+00
Ra-226	1.000E+00
Ra-228	1.000E+00
Th-228	1.000E+00
Th-230	1.000E+00
Th-232	1.000E+00
U-234	1.000E+00
U-235	1.000E+00
U-238	1.000E+00

Source: 2

Location:: Room : 1 x: 10.00 y: 5.00 z: 1.00[m]
 Geometry:: Type: Area Length[m]:1.00E+01 Width[m]:2.00E+00 Direction: x
 Pathway ::
 Direct Ingestion Rate: 0.000E+00 [1/hr]
 Fraction released to air: 3.500E-02
 Removable fraction: 1.000E-01
 Time to Remove: 1.825E+03 [day]

Radon Release Fraction: 1.000E-01

Contamination::

Nuclide Concentration

	[dpm/m2]
Ac-227	1.000E+00
Pa-231	1.000E+00
Pb-210	1.000E+00
Ra-226	1.000E+00
Ra-228	1.000E+00
Th-228	1.000E+00
Th-230	1.000E+00
Th-232	1.000E+00
U-234	1.000E+00
U-235	1.000E+00
U-238	1.000E+00

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:33:49 Page: 5 **

Title : SLDS DCGL Renovation Worker

Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld

Source: 3

Location:: Room : 1 x: 5.00 y: 10.00 z: 1.00[m]
 Geometry:: Type: Area Length[m]:1.00E+01 Width[m]:2.00E+00 Direction: y
 Pathway ::
 Direct Ingestion Rate: 0.000E+00 [1/hr]
 Fraction released to air: 3.500E-02
 Removable fraction: 1.000E-01
 Time to Remove: 1.825E+03 [day]

 Radon Release Fraction: 1.000E-01

Contamination::

Nuclide Concentration

	[dpm/m2]
Ac-227	1.000E+00
Pa-231	1.000E+00
Pb-210	1.000E+00
Ra-226	1.000E+00
Ra-228	1.000E+00
Th-228	1.000E+00
Th-230	1.000E+00
Th-232	1.000E+00
U-234	1.000E+00
U-235	1.000E+00
U-238	1.000E+00

Source: 4

Location:: Room : 1 x: 0.00 y: 5.00 z: 1.00[m]
 Geometry:: Type: Area Length[m]:1.00E+01 Width[m]:2.00E+00 Direction: x
 Pathway ::
 Direct Ingestion Rate: 0.000E+00 [1/hr]
 Fraction released to air: 3.500E-02
 Removable fraction: 1.000E-01
 Time to Remove: 1.825E+03 [day]

 Radon Release Fraction: 1.000E-01

Contamination::

Nuclide Concentration

	[dpm/m2]
Ac-227	1.000E+00
Pa-231	1.000E+00
Pb-210	1.000E+00
Ra-226	1.000E+00
Ra-228	1.000E+00
Th-228	1.000E+00
Th-230	1.000E+00
Th-232	1.000E+00
U-234	1.000E+00
U-235	1.000E+00
U-238	1.000E+00

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:33:49 Page: 6 **
Title : SLDS DCGL Renovation Worker
Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld

Source: 5

Location:: Room : 1 x: 5.00 y: 0.00 z: 1.00[m]
Geometry:: Type: Area Length[m]:1.00E+01 Width[m]:2.00E+00 Direction: y
Pathway ::
Direct Ingestion Rate: 0.000E+00 [1/hr]
Fraction released to air: 3.500E-02
Removable fraction: 1.000E-01
Time to Remove: 1.825E+03 [day]

Radon Release Fraction: 1.000E-01

Contamination::

Nuclide Concentration

	[dpm/m2]
Ac-227	1.000E+00
Pa-231	1.000E+00
Pb-210	1.000E+00
Ra-226	1.000E+00
Ra-228	1.000E+00
Th-228	1.000E+00
Th-230	1.000E+00
Th-232	1.000E+00
U-234	1.000E+00
U-235	1.000E+00
U-238	1.000E+00

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:33:49 Page: 7 **
 Title : SLDS DCGL Renovation Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld
 Temporal Summary

RESRAD-BUILD Temporal Risk Tables

Risk to Receptor over the Exposure Duration

(Risk)

Evaluation Time years	Receptor 1	Total
0.000000000	1.32E-09	1.32E-09
1.000000000	1.29E-09	1.29E-09
3.000000000	1.24E-09	1.24E-09
10.00000000	1.20E-09	1.20E-09
30.00000000	1.20E-09	1.20E-09
100.0000080	1.20E-09	1.20E-09
300.0000310	1.20E-09	1.20E-09
1000.000000	1.20E-09	1.20E-09

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:33:49 Page: 8 **
 Title : SLDS DCGL Renovation Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld
 Evaluation Time: 0.00000000E+00 years

RESRAD-BUILD Risk Tables

Source Contributions to Receptor Risks

[Risk]						
	Source 1	Source 2	Source 3	Source 4	Source 5	Total
Receptor 1	7.70E-10	1.37E-10	1.37E-10	1.37E-10	1.37E-10	1.32E-09
Total	7.70E-10	1.37E-10	1.37E-10	1.37E-10	1.37E-10	1.32E-09

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:33:49 Page: 9 **

Title : SLDS DCGL Renovation Worker

Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld

Evaluation Time: 0.00000000E+00 years

Pathway Detail of Risks

[Risk]								
Source: 1	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	1.16E-10	6.10E-11	2.34E-16	1.51E-16	2.10E-14	5.93E-10	0.00E+00	7.70E-10
Total	1.16E-10	6.10E-11	2.34E-16	1.51E-16	2.10E-14	5.93E-10	0.00E+00	7.70E-10
Source: 2	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	6.31E-12	1.22E-11	4.68E-17	3.02E-17	4.20E-15	1.19E-10	0.00E+00	1.37E-10
Total	6.31E-12	1.22E-11	4.68E-17	3.02E-17	4.20E-15	1.19E-10	0.00E+00	1.37E-10
Source: 3	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	6.31E-12	1.22E-11	4.68E-17	3.02E-17	4.20E-15	1.19E-10	0.00E+00	1.37E-10
Total	6.31E-12	1.22E-11	4.68E-17	3.02E-17	4.20E-15	1.19E-10	0.00E+00	1.37E-10
Source: 4	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	6.31E-12	1.22E-11	4.68E-17	3.02E-17	4.20E-15	1.19E-10	0.00E+00	1.37E-10
Total	6.31E-12	1.22E-11	4.68E-17	3.02E-17	4.20E-15	1.19E-10	0.00E+00	1.37E-10
Source: 5	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	6.31E-12	1.22E-11	4.68E-17	3.02E-17	4.20E-15	1.19E-10	0.00E+00	1.37E-10
Total	6.31E-12	1.22E-11	4.68E-17	3.02E-17	4.20E-15	1.19E-10	0.00E+00	1.37E-10

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:33:49 Page: 10 **
 Title : SLDS DCGL Renovation Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld
 Evaluation Time: 0.00000000E+00 years

Nuclide Detail of Risks

[Risk]

Source: 1

Nuclide	Receptor 1	Total
Ac-227	2.59E-11	2.59E-11
Pa-231	8.13E-12	8.13E-12
Ac-227	5.22E-12	5.22E-12
Pb-210	3.00E-12	3.00E-12
Ra-226	6.87E-11	6.87E-11
Pb-210	4.06E-13	4.06E-13
Ra-228	9.53E-12	9.53E-12
Th-228	1.90E-10	1.90E-10
Th-228	7.53E-11	7.53E-11
Th-230	3.05E-12	3.05E-12
Ra-226	3.58E-13	3.58E-13
Pb-210	9.25E-16	9.25E-16
Th-232	3.85E-12	3.85E-12
Ra-228	1.50E-11	1.50E-11
Th-228	3.47E-10	3.47E-10
U-234	2.50E-12	2.50E-12
Th-230	7.39E-17	7.39E-17
Ra-226	2.73E-17	2.73E-17
Pb-210	4.79E-20	4.79E-20
U-235	6.68E-12	6.68E-12
Pa-231	7.24E-16	7.24E-16
Ac-227	7.59E-16	7.59E-16
U-238	4.90E-12	4.90E-12
U-234	1.88E-17	1.88E-17
Th-230	4.32E-22	4.32E-22
Ra-226	4.80E-22	4.80E-22
Pb-210	6.73E-25	6.73E-25

Source: 2

Nuclide	Receptor 1	Total
Ac-227	3.92E-12	3.92E-12
Pa-231	1.39E-12	1.39E-12
Ac-227	4.81E-13	4.81E-13
Pb-210	5.28E-13	5.28E-13
Ra-226	7.97E-12	7.97E-12
Pb-210	5.04E-14	5.04E-14

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:33:49 Page: 11 **

Title : SLDS DCGL Renovation Worker

Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld

Evaluation Time: 0.0000000E+00 years

Ra-228	9.47E-13	9.47E-13
Th-228	3.66E-11	3.66E-11
Th-228	1.45E-11	1.45E-11
Th-230	6.02E-13	6.02E-13
Ra-226	4.07E-14	4.07E-14
Pb-210	6.71E-17	6.71E-17
Th-232	7.65E-13	7.65E-13
Ra-228	9.69E-13	9.69E-13
Th-228	6.67E-11	6.67E-11
U-234	4.92E-13	4.92E-13
Th-230	1.40E-17	1.40E-17
Ra-226	3.08E-18	3.08E-18
Pb-210	2.57E-21	2.57E-21
U-235	6.45E-13	6.45E-13
Pa-231	8.21E-17	8.21E-17
Ac-227	4.67E-17	4.67E-17
U-238	5.69E-13	5.69E-13
U-234	3.50E-18	3.50E-18
Th-230	6.68E-23	6.68E-23
Ra-226	5.42E-23	5.42E-23
Pb-210	3.31E-26	3.31E-26

Source: 3

Nuclide	Receptor	Total
	1	
Ac-227	3.92E-12	3.92E-12
Pa-231	1.39E-12	1.39E-12
Ac-227	4.81E-13	4.81E-13
Pb-210	5.28E-13	5.28E-13
Ra-226	7.97E-12	7.97E-12
Pb-210	5.04E-14	5.04E-14
Ra-228	9.47E-13	9.47E-13
Th-228	3.66E-11	3.66E-11
Th-228	1.45E-11	1.45E-11
Th-230	6.02E-13	6.02E-13
Ra-226	4.07E-14	4.07E-14
Pb-210	6.71E-17	6.71E-17
Th-232	7.65E-13	7.65E-13
Ra-228	9.69E-13	9.69E-13
Th-228	6.67E-11	6.67E-11
U-234	4.92E-13	4.92E-13
Th-230	1.40E-17	1.40E-17
Ra-226	3.08E-18	3.08E-18
Pb-210	2.57E-21	2.57E-21
U-235	6.45E-13	6.45E-13
Pa-231	8.21E-17	8.21E-17
Ac-227	4.67E-17	4.67E-17
U-238	5.69E-13	5.69E-13
U-234	3.50E-18	3.50E-18

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:33:49 Page: 12 **
 Title : SLDS DCGL Renovation Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld
 Evaluation Time: 0.0000000E+00 years

Th-230	6.68E-23	6.68E-23
Ra-226	5.42E-23	5.42E-23
Pb-210	3.31E-26	3.31E-26

Source: 4

Nuclide	Receptor	Total
	1	
Ac-227	3.92E-12	3.92E-12
Pa-231	1.39E-12	1.39E-12
Ac-227	4.81E-13	4.81E-13
Pb-210	5.28E-13	5.28E-13
Ra-226	7.97E-12	7.97E-12
Pb-210	5.04E-14	5.04E-14
Ra-228	9.47E-13	9.47E-13
Th-228	3.66E-11	3.66E-11
Th-228	1.45E-11	1.45E-11
Th-230	6.02E-13	6.02E-13
Ra-226	4.07E-14	4.07E-14
Pb-210	6.71E-17	6.71E-17
Th-232	7.65E-13	7.65E-13
Ra-228	9.69E-13	9.69E-13
Th-228	6.67E-11	6.67E-11
U-234	4.92E-13	4.92E-13
Th-230	1.40E-17	1.40E-17
Ra-226	3.08E-18	3.08E-18
Pb-210	2.57E-21	2.57E-21
U-235	6.45E-13	6.45E-13
Pa-231	8.21E-17	8.21E-17
Ac-227	4.67E-17	4.67E-17
U-238	5.69E-13	5.69E-13
U-234	3.50E-18	3.50E-18
Th-230	6.68E-23	6.68E-23
Ra-226	5.42E-23	5.42E-23
Pb-210	3.31E-26	3.31E-26

Source: 5

Nuclide	Receptor	Total
	1	
Ac-227	3.92E-12	3.92E-12
Pa-231	1.39E-12	1.39E-12
Ac-227	4.81E-13	4.81E-13
Pb-210	5.28E-13	5.28E-13
Ra-226	7.97E-12	7.97E-12

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:33:49 Page: 13 **
Title : SLDS DCGL Renovation Worker
Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld
Evaluation Time: 0.00000000E+00 years

Pb-210	5.04E-14	5.04E-14
Ra-228	9.47E-13	9.47E-13
Th-228	3.66E-11	3.66E-11
Th-228	1.45E-11	1.45E-11
Th-230	6.02E-13	6.02E-13
Ra-226	4.07E-14	4.07E-14
Pb-210	6.71E-17	6.71E-17
Th-232	7.65E-13	7.65E-13
Ra-228	9.69E-13	9.69E-13
Th-228	6.67E-11	6.67E-11
U-234	4.92E-13	4.92E-13
Th-230	1.40E-17	1.40E-17
Ra-226	3.08E-18	3.08E-18
Pb-210	2.57E-21	2.57E-21
U-235	6.45E-13	6.45E-13
Pa-231	8.21E-17	8.21E-17
Ac-227	4.67E-17	4.67E-17
U-238	5.69E-13	5.69E-13
U-234	3.50E-18	3.50E-18
Th-230	6.68E-23	6.68E-23
Ra-226	5.42E-23	5.42E-23
Pb-210	3.31E-26	3.31E-26

RESRAD-BUILD Risk Tables

[Risk]

	Source 1	Source 2	Source 3	Source 4	Source 5	Total
Receptor 1	7.55E-10	1.34E-10	1.34E-10	1.34E-10	1.34E-10	1.29E-09
Total	7.55E-10	1.34E-10	1.34E-10	1.34E-10	1.34E-10	1.29E-09

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:33:49 Page: 15 **

Title : SLDS DCGL Renovation Worker

Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld

Evaluation Time: 1.00000000 years

Pathway Detail of Risks

[Risk]								
Source: 1	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	1.15E-10	4.89E-11	1.89E-16	1.21E-16	1.69E-14	5.91E-10	0.00E+00	7.55E-10
Total	1.15E-10	4.89E-11	1.89E-16	1.21E-16	1.69E-14	5.91E-10	0.00E+00	7.55E-10
Source: 2	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	6.29E-12	9.78E-12	3.78E-17	2.42E-17	3.38E-15	1.18E-10	0.00E+00	1.34E-10
Total	6.29E-12	9.78E-12	3.78E-17	2.42E-17	3.38E-15	1.18E-10	0.00E+00	1.34E-10
Source: 3	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	6.29E-12	9.78E-12	3.78E-17	2.42E-17	3.38E-15	1.18E-10	0.00E+00	1.34E-10
Total	6.29E-12	9.78E-12	3.78E-17	2.42E-17	3.38E-15	1.18E-10	0.00E+00	1.34E-10
Source: 4	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	6.29E-12	9.78E-12	3.78E-17	2.42E-17	3.38E-15	1.18E-10	0.00E+00	1.34E-10
Total	6.29E-12	9.78E-12	3.78E-17	2.42E-17	3.38E-15	1.18E-10	0.00E+00	1.34E-10
Source: 5	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	6.29E-12	9.78E-12	3.78E-17	2.42E-17	3.38E-15	1.18E-10	0.00E+00	1.34E-10
Total	6.29E-12	9.78E-12	3.78E-17	2.42E-17	3.38E-15	1.18E-10	0.00E+00	1.34E-10

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:33:49 Page: 16 **
 Title : SLDS DCGL Renovation Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld
 Evaluation Time: 1.00000000 years

Nuclide Detail of Risks

[Risk]

Source: 1

Nuclide	Receptor 1	Total
Ac-227	2.20E-11	2.20E-11
Pa-231	6.79E-12	6.79E-12
Ac-227	5.42E-12	5.42E-12
Pb-210	2.45E-12	2.45E-12
Ra-226	6.79E-11	6.79E-11
Pb-210	4.12E-13	4.12E-13
Ra-228	8.00E-12	8.00E-12
Th-228	1.88E-10	1.88E-10
Th-228	5.12E-11	5.12E-11
Th-230	2.45E-12	2.45E-12
Ra-226	3.86E-13	3.86E-13
Pb-210	1.01E-15	1.01E-15
Th-232	3.10E-12	3.10E-12
Ra-228	1.57E-11	1.57E-11
Th-228	3.69E-10	3.69E-10
U-234	2.01E-12	2.01E-12
Th-230	7.15E-17	7.15E-17
Ra-226	3.06E-17	3.06E-17
Pb-210	5.55E-20	5.55E-20
U-235	6.23E-12	6.23E-12
Pa-231	7.39E-16	7.39E-16
Ac-227	8.42E-16	8.42E-16
U-238	4.48E-12	4.48E-12
U-234	1.82E-17	1.82E-17
Th-230	4.42E-22	4.42E-22
Ra-226	5.62E-22	5.62E-22
Pb-210	8.14E-25	8.14E-25

Source: 2

Nuclide	Receptor 1	Total
Ac-227	3.17E-12	3.17E-12
Pa-231	1.12E-12	1.12E-12
Ac-227	4.83E-13	4.83E-13
Pb-210	4.21E-13	4.21E-13
Ra-226	7.84E-12	7.84E-12
Pb-210	4.94E-14	4.94E-14

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:33:49 Page: 17 **

Title : SLDS DCGL Renovation Worker

Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld

Evaluation Time: 1.00000000 years

Ra-228	7.58E-13	7.58E-13
Th-228	3.61E-11	3.61E-11
Th-228	9.87E-12	9.87E-12
Th-230	4.83E-13	4.83E-13
Ra-226	4.39E-14	4.39E-14
Pb-210	7.12E-17	7.12E-17
Th-232	6.14E-13	6.14E-13
Ra-228	1.00E-12	1.00E-12
Th-228	7.09E-11	7.09E-11
U-234	3.95E-13	3.95E-13
Th-230	1.34E-17	1.34E-17
Ra-226	3.46E-18	3.46E-18
Pb-210	2.93E-21	2.93E-21
U-235	5.57E-13	5.57E-13
Pa-231	8.01E-17	8.01E-17
Ac-227	5.09E-17	5.09E-17
U-238	4.86E-13	4.86E-13
U-234	3.36E-18	3.36E-18
Th-230	6.65E-23	6.65E-23
Ra-226	6.34E-23	6.34E-23
Pb-210	3.99E-26	3.99E-26

Source: 3

Nuclide	Receptor	Total
	1	
Ac-227	3.17E-12	3.17E-12
Pa-231	1.12E-12	1.12E-12
Ac-227	4.83E-13	4.83E-13
Pb-210	4.21E-13	4.21E-13
Ra-226	7.84E-12	7.84E-12
Pb-210	4.94E-14	4.94E-14
Ra-228	7.58E-13	7.58E-13
Th-228	3.61E-11	3.61E-11
Th-228	9.87E-12	9.87E-12
Th-230	4.83E-13	4.83E-13
Ra-226	4.39E-14	4.39E-14
Pb-210	7.12E-17	7.12E-17
Th-232	6.14E-13	6.14E-13
Ra-228	1.00E-12	1.00E-12
Th-228	7.09E-11	7.09E-11
U-234	3.95E-13	3.95E-13
Th-230	1.34E-17	1.34E-17
Ra-226	3.46E-18	3.46E-18
Pb-210	2.93E-21	2.93E-21
U-235	5.57E-13	5.57E-13
Pa-231	8.01E-17	8.01E-17
Ac-227	5.09E-17	5.09E-17
U-238	4.86E-13	4.86E-13
U-234	3.36E-18	3.36E-18

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:33:49 Page: 18 **
 Title : SLDS DCGL Renovation Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld
 Evaluation Time: 1.00000000 years

Th-230	6.65E-23	6.65E-23
Ra-226	6.34E-23	6.34E-23
Pb-210	3.99E-26	3.99E-26

Source: 4

Nuclide	Receptor 1	Total
Ac-227	3.17E-12	3.17E-12
Pa-231	1.12E-12	1.12E-12
Ac-227	4.83E-13	4.83E-13
Pb-210	4.21E-13	4.21E-13
Ra-226	7.84E-12	7.84E-12
Pb-210	4.94E-14	4.94E-14
Ra-228	7.58E-13	7.58E-13
Th-228	3.61E-11	3.61E-11
Th-228	9.87E-12	9.87E-12
Th-230	4.83E-13	4.83E-13
Ra-226	4.39E-14	4.39E-14
Pb-210	7.12E-17	7.12E-17
Th-232	6.14E-13	6.14E-13
Ra-228	1.00E-12	1.00E-12
Th-228	7.09E-11	7.09E-11
U-234	3.95E-13	3.95E-13
Th-230	1.34E-17	1.34E-17
Ra-226	3.46E-18	3.46E-18
Pb-210	2.93E-21	2.93E-21
U-235	5.57E-13	5.57E-13
Pa-231	8.01E-17	8.01E-17
Ac-227	5.09E-17	5.09E-17
U-238	4.86E-13	4.86E-13
U-234	3.36E-18	3.36E-18
Th-230	6.65E-23	6.65E-23
Ra-226	6.34E-23	6.34E-23
Pb-210	3.99E-26	3.99E-26

Source: 5

Nuclide	Receptor 1	Total
Ac-227	3.17E-12	3.17E-12
Pa-231	1.12E-12	1.12E-12
Ac-227	4.83E-13	4.83E-13
Pb-210	4.21E-13	4.21E-13
Ra-226	7.84E-12	7.84E-12

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:33:49 Page: 19 **
Title : SLDS DCGL Renovation Worker
Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld
Evaluation Time: 1.00000000 years

Pb-210	4.94E-14	4.94E-14
Ra-228	7.58E-13	7.58E-13
Th-228	3.61E-11	3.61E-11
Th-228	9.87E-12	9.87E-12
Th-230	4.83E-13	4.83E-13
Ra-226	4.39E-14	4.39E-14
Pb-210	7.12E-17	7.12E-17
Th-232	6.14E-13	6.14E-13
Ra-228	1.00E-12	1.00E-12
Th-228	7.09E-11	7.09E-11
U-234	3.95E-13	3.95E-13
Th-230	1.34E-17	1.34E-17
Ra-226	3.46E-18	3.46E-18
Pb-210	2.93E-21	2.93E-21
U-235	5.57E-13	5.57E-13
Pa-231	8.01E-17	8.01E-17
Ac-227	5.09E-17	5.09E-17
U-238	4.86E-13	4.86E-13
U-234	3.36E-18	3.36E-18
Th-230	6.65E-23	6.65E-23
Ra-226	6.34E-23	6.34E-23
Pb-210	3.99E-26	3.99E-26

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:33:49 Page: 20 **
 Title : SLDS DCGL Renovation Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld
 Evaluation Time: 3.00000000 years

RESRAD-BUILD Risk Tables

Source Contributions to Receptor Risks

[Risk]						
	Source 1	Source 2	Source 3	Source 4	Source 5	Total
Receptor 1	7.27E-10	1.29E-10	1.29E-10	1.29E-10	1.29E-10	1.24E-09
Total	7.27E-10	1.29E-10	1.29E-10	1.29E-10	1.29E-10	1.24E-09

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:33:49 Page: 21 **

Title : SLDS DCGL Renovation Worker

Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld

Evaluation Time: 3.00000000 years

Pathway Detail of Risks

[Risk]

Source: 1	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	1.14E-10	2.45E-11	9.50E-17	6.07E-17	8.52E-15	5.88E-10	0.00E+00	7.27E-10
Total	1.14E-10	2.45E-11	9.50E-17	6.07E-17	8.52E-15	5.88E-10	0.00E+00	7.27E-10
Source: 2	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	6.26E-12	4.90E-12	1.90E-17	1.21E-17	1.70E-15	1.18E-10	0.00E+00	1.29E-10
Total	6.26E-12	4.90E-12	1.90E-17	1.21E-17	1.70E-15	1.18E-10	0.00E+00	1.29E-10
Source: 3	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	6.26E-12	4.90E-12	1.90E-17	1.21E-17	1.70E-15	1.18E-10	0.00E+00	1.29E-10
Total	6.26E-12	4.90E-12	1.90E-17	1.21E-17	1.70E-15	1.18E-10	0.00E+00	1.29E-10
Source: 4	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	6.26E-12	4.90E-12	1.90E-17	1.21E-17	1.70E-15	1.18E-10	0.00E+00	1.29E-10
Total	6.26E-12	4.90E-12	1.90E-17	1.21E-17	1.70E-15	1.18E-10	0.00E+00	1.29E-10
Source: 5	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	6.26E-12	4.90E-12	1.90E-17	1.21E-17	1.70E-15	1.18E-10	0.00E+00	1.29E-10
Total	6.26E-12	4.90E-12	1.90E-17	1.21E-17	1.70E-15	1.18E-10	0.00E+00	1.29E-10

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:33:49 Page: 22 **
Title : SLDS DCGL Renovation Worker
Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld
Evaluation Time: 3.00000000 years

Nuclide Detail of Risks

[Risk]

Source: 1

Nuclide	Receptor 1	Total
Ac-227	1.43E-11	1.43E-11
Pa-231	4.09E-12	4.09E-12
Ac-227	5.45E-12	5.45E-12
Pb-210	1.39E-12	1.39E-12
Ra-226	6.65E-11	6.65E-11
Pb-210	3.72E-13	3.72E-13
Ra-228	5.47E-12	5.47E-12
Th-228	1.66E-10	1.66E-10
Th-228	2.36E-11	2.36E-11
Th-230	1.25E-12	1.25E-12
Ra-226	4.42E-13	4.42E-13
Pb-210	1.18E-15	1.18E-15
Th-232	1.57E-12	1.57E-12
Ra-228	1.65E-11	1.65E-11
Th-228	4.10E-10	4.10E-10
U-234	1.03E-12	1.03E-12
Th-230	5.01E-17	5.01E-17
Ra-226	3.82E-17	3.82E-17
Pb-210	7.30E-20	7.30E-20
U-235	5.32E-12	5.32E-12
Pa-231	6.83E-16	6.83E-16
Ac-227	1.01E-15	1.01E-15
U-238	3.63E-12	3.63E-12
U-234	1.29E-17	1.29E-17
Th-230	4.03E-22	4.03E-22
Ra-226	7.55E-22	7.55E-22
Pb-210	1.17E-24	1.17E-24

Source: 2

Nuclide	Receptor 1	Total
Ac-227	1.73E-12	1.73E-12
Pa-231	5.81E-13	5.81E-13
Ac-227	4.15E-13	4.15E-13
Pb-210	2.14E-13	2.14E-13
Ra-226	7.60E-12	7.60E-12
Pb-210	3.75E-14	3.75E-14

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:33:49 Page: 23 **

Title : SLDS DCGL Renovation Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld
 Evaluation Time: 3.00000000 years

Ra-228	4.42E-13	4.42E-13
Th-228	3.19E-11	3.19E-11
Th-228	4.54E-12	4.54E-12
Th-230	2.42E-13	2.42E-13
Ra-226	5.01E-14	5.01E-14
Pb-210	7.45E-17	7.45E-17
Th-232	3.08E-13	3.08E-13
Ra-228	1.00E-12	1.00E-12
Th-228	7.88E-11	7.88E-11
U-234	1.98E-13	1.98E-13
Th-230	8.98E-18	8.98E-18
Ra-226	4.32E-18	4.32E-18
Pb-210	3.74E-21	3.74E-21
U-235	3.79E-13	3.79E-13
Pa-231	5.90E-17	5.90E-17
Ac-227	5.81E-17	5.81E-17
U-238	3.18E-13	3.18E-13
U-234	2.25E-18	2.25E-18
Th-230	5.33E-23	5.33E-23
Ra-226	8.53E-23	8.53E-23
Pb-210	5.67E-26	5.67E-26

Source: 3

Nuclide	Receptor	Total
	1	
Ac-227	1.73E-12	1.73E-12
Pa-231	5.81E-13	5.81E-13
Ac-227	4.15E-13	4.15E-13
Pb-210	2.14E-13	2.14E-13
Ra-226	7.60E-12	7.60E-12
Pb-210	3.75E-14	3.75E-14
Ra-228	4.42E-13	4.42E-13
Th-228	3.19E-11	3.19E-11
Th-228	4.54E-12	4.54E-12
Th-230	2.42E-13	2.42E-13
Ra-226	5.01E-14	5.01E-14
Pb-210	7.45E-17	7.45E-17
Th-232	3.08E-13	3.08E-13
Ra-228	1.00E-12	1.00E-12
Th-228	7.88E-11	7.88E-11
U-234	1.98E-13	1.98E-13
Th-230	8.98E-18	8.98E-18
Ra-226	4.32E-18	4.32E-18
Pb-210	3.74E-21	3.74E-21
U-235	3.79E-13	3.79E-13
Pa-231	5.90E-17	5.90E-17
Ac-227	5.81E-17	5.81E-17
U-238	3.18E-13	3.18E-13
U-234	2.25E-18	2.25E-18

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:33:49 Page: 24 **
 Title : SLDS DCGL Renovation Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld
 Evaluation Time: 3.00000000 years

Th-230	5.33E-23	5.33E-23
Ra-226	8.53E-23	8.53E-23
Pb-210	5.67E-26	5.67E-26

Source: 4

Nuclide	Receptor	Total
	1	
Ac-227	1.73E-12	1.73E-12
Pa-231	5.81E-13	5.81E-13
Ac-227	4.15E-13	4.15E-13
Pb-210	2.14E-13	2.14E-13
Ra-226	7.60E-12	7.60E-12
Pb-210	3.75E-14	3.75E-14
Ra-228	4.42E-13	4.42E-13
Th-228	3.19E-11	3.19E-11
Th-228	4.54E-12	4.54E-12
Th-230	2.42E-13	2.42E-13
Ra-226	5.01E-14	5.01E-14
Pb-210	7.45E-17	7.45E-17
Th-232	3.08E-13	3.08E-13
Ra-228	1.00E-12	1.00E-12
Th-228	7.88E-11	7.88E-11
U-234	1.98E-13	1.98E-13
Th-230	8.98E-18	8.98E-18
Ra-226	4.32E-18	4.32E-18
Pb-210	3.74E-21	3.74E-21
U-235	3.79E-13	3.79E-13
Pa-231	5.90E-17	5.90E-17
Ac-227	5.81E-17	5.81E-17
U-238	3.18E-13	3.18E-13
U-234	2.25E-18	2.25E-18
Th-230	5.33E-23	5.33E-23
Ra-226	8.53E-23	8.53E-23
Pb-210	5.67E-26	5.67E-26

Source: 5

Nuclide	Receptor	Total
	1	
Ac-227	1.73E-12	1.73E-12
Pa-231	5.81E-13	5.81E-13
Ac-227	4.15E-13	4.15E-13
Pb-210	2.14E-13	2.14E-13
Ra-226	7.60E-12	7.60E-12

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:33:49 Page: 25 **
Title : SLDS DCGL Renovation Worker
Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld
Evaluation Time: 3.00000000 years

Pb-210	3.75E-14	3.75E-14
Ra-228	4.42E-13	4.42E-13
Th-228	3.19E-11	3.19E-11
Th-228	4.54E-12	4.54E-12
Th-230	2.42E-13	2.42E-13
Ra-226	5.01E-14	5.01E-14
Pb-210	7.45E-17	7.45E-17
Th-232	3.08E-13	3.08E-13
Ra-228	1.00E-12	1.00E-12
Th-228	7.88E-11	7.88E-11
U-234	1.98E-13	1.98E-13
Th-230	8.98E-18	8.98E-18
Ra-226	4.32E-18	4.32E-18
Pb-210	3.74E-21	3.74E-21
U-235	3.79E-13	3.79E-13
Pa-231	5.90E-17	5.90E-17
Ac-227	5.81E-17	5.81E-17
U-238	3.18E-13	3.18E-13
U-234	2.25E-18	2.25E-18
Th-230	5.33E-23	5.33E-23
Ra-226	8.53E-23	8.53E-23
Pb-210	5.67E-26	5.67E-26

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:33:49 Page: 26 **
 Title : SLDS DCGL Renovation Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld
 Evaluation Time: 10.0000000 years

RESRAD-BUILD Risk Tables

Source Contributions to Receptor Risks

[Risk]						
	Source 1	Source 2	Source 3	Source 4	Source 5	Total
Receptor 1	7.01E-10	1.24E-10	1.24E-10	1.24E-10	1.24E-10	1.20E-09
Total	7.01E-10	1.24E-10	1.24E-10	1.24E-10	1.24E-10	1.20E-09

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:33:49 Page: 27 **

Title : SLDS DCGL Renovation Worker

Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld

Evaluation Time: 10.0000000 years

Pathway Detail of Risks

[Risk]

Source: 1								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	1.14E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.87E-10	0.00E+00	7.01E-10
Total	1.14E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.87E-10	0.00E+00	7.01E-10
Source: 2								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	6.24E-12	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.17E-10	0.00E+00	1.24E-10
Total	6.24E-12	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.17E-10	0.00E+00	1.24E-10
Source: 3								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	6.24E-12	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.17E-10	0.00E+00	1.24E-10
Total	6.24E-12	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.17E-10	0.00E+00	1.24E-10
Source: 4								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	6.24E-12	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.17E-10	0.00E+00	1.24E-10
Total	6.24E-12	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.17E-10	0.00E+00	1.24E-10
Source: 5								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	6.24E-12	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.17E-10	0.00E+00	1.24E-10
Total	6.24E-12	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.17E-10	0.00E+00	1.24E-10

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:33:49 Page: 28 **
 Title : SLDS DCGL Renovation Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld
 Evaluation Time: 10.0000000 years

Nuclide Detail of Risks

[Risk]

Source: 1

Nuclide	Receptor 1	Total
Ac-227	6.11E-12	6.11E-12
Pa-231	1.38E-12	1.38E-12
Ac-227	6.07E-12	6.07E-12
Pb-210	3.38E-13	3.38E-13
Ra-226	6.52E-11	6.52E-11
Pb-210	3.25E-13	3.25E-13
Ra-228	1.93E-12	1.93E-12
Th-228	8.14E-11	8.14E-11
Th-228	1.74E-12	1.74E-12
Th-230	3.86E-14	3.86E-14
Ra-226	6.38E-13	6.38E-13
Pb-210	1.93E-15	1.93E-15
Th-232	3.01E-14	3.01E-14
Ra-228	1.85E-11	1.85E-11
Th-228	5.10E-10	5.10E-10
U-234	3.85E-14	3.85E-14
Th-230	7.98E-18	7.98E-18
Ra-226	7.29E-17	7.29E-17
Pb-210	1.67E-19	1.67E-19
U-235	4.42E-12	4.42E-12
Pa-231	6.59E-16	6.59E-16
Ac-227	1.76E-15	1.76E-15
U-238	2.78E-12	2.78E-12
U-234	2.44E-18	2.44E-18
Th-230	2.79E-22	2.79E-22
Ra-226	1.83E-21	1.83E-21
Pb-210	3.42E-24	3.42E-24

Source: 2

Nuclide	Receptor 1	Total
Ac-227	3.15E-13	3.15E-13
Pa-231	4.01E-14	4.01E-14
Ac-227	3.13E-13	3.13E-13
Pb-210	1.62E-14	1.62E-14
Ra-226	7.36E-12	7.36E-12
Pb-210	1.56E-14	1.56E-14

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:33:49 Page: 29 **

Title : SLDS DCGL Renovation Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld
 Evaluation Time: 10.0000000 years

Ra-228	1.07E-13	1.07E-13
Th-228	1.56E-11	1.56E-11
Th-228	3.35E-13	3.35E-13
Th-230	4.88E-16	4.88E-16
Ra-226	7.20E-14	7.20E-14
Pb-210	9.29E-17	9.29E-17
Th-232	4.27E-16	4.27E-16
Ra-228	1.02E-12	1.02E-12
Th-228	9.80E-11	9.80E-11
U-234	4.54E-16	4.54E-16
Th-230	1.01E-19	1.01E-19
Ra-226	8.23E-18	8.23E-18
Pb-210	8.01E-21	8.01E-21
U-235	2.01E-13	2.01E-13
Pa-231	1.91E-17	1.91E-17
Ac-227	9.09E-17	9.09E-17
U-238	1.50E-13	1.50E-13
U-234	2.88E-20	2.88E-20
Th-230	3.54E-24	3.54E-24
Ra-226	2.07E-22	2.07E-22
Pb-210	1.64E-25	1.64E-25

Source: 3

Nuclide	Receptor	Total
	1	
Ac-227	3.15E-13	3.15E-13
Pa-231	4.01E-14	4.01E-14
Ac-227	3.13E-13	3.13E-13
Pb-210	1.62E-14	1.62E-14
Ra-226	7.36E-12	7.36E-12
Pb-210	1.56E-14	1.56E-14
Ra-228	1.07E-13	1.07E-13
Th-228	1.56E-11	1.56E-11
Th-228	3.35E-13	3.35E-13
Th-230	4.88E-16	4.88E-16
Ra-226	7.20E-14	7.20E-14
Pb-210	9.29E-17	9.29E-17
Th-232	4.27E-16	4.27E-16
Ra-228	1.02E-12	1.02E-12
Th-228	9.80E-11	9.80E-11
U-234	4.54E-16	4.54E-16
Th-230	1.01E-19	1.01E-19
Ra-226	8.23E-18	8.23E-18
Pb-210	8.01E-21	8.01E-21
U-235	2.01E-13	2.01E-13
Pa-231	1.91E-17	1.91E-17
Ac-227	9.09E-17	9.09E-17
U-238	1.50E-13	1.50E-13
U-234	2.88E-20	2.88E-20

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:33:49 Page: 30 **
 Title : SLDS DCGL Renovation Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld
 Evaluation Time: 10.0000000 years

Th-230	3.54E-24	3.54E-24
Ra-226	2.07E-22	2.07E-22
Pb-210	1.64E-25	1.64E-25

Source: 4

Nuclide	Receptor 1	Total
Ac-227	3.15E-13	3.15E-13
Pa-231	4.01E-14	4.01E-14
Ac-227	3.13E-13	3.13E-13
Pb-210	1.62E-14	1.62E-14
Ra-226	7.36E-12	7.36E-12
Pb-210	1.56E-14	1.56E-14
Ra-228	1.07E-13	1.07E-13
Th-228	1.56E-11	1.56E-11
Th-228	3.35E-13	3.35E-13
Th-230	4.88E-16	4.88E-16
Ra-226	7.20E-14	7.20E-14
Pb-210	9.29E-17	9.29E-17
Th-232	4.27E-16	4.27E-16
Ra-228	1.02E-12	1.02E-12
Th-228	9.80E-11	9.80E-11
U-234	4.54E-16	4.54E-16
Th-230	1.01E-19	1.01E-19
Ra-226	8.23E-18	8.23E-18
Pb-210	8.01E-21	8.01E-21
U-235	2.01E-13	2.01E-13
Pa-231	1.91E-17	1.91E-17
Ac-227	9.09E-17	9.09E-17
U-238	1.50E-13	1.50E-13
U-234	2.88E-20	2.88E-20
Th-230	3.54E-24	3.54E-24
Ra-226	2.07E-22	2.07E-22
Pb-210	1.64E-25	1.64E-25

Source: 5

Nuclide	Receptor 1	Total
Ac-227	3.15E-13	3.15E-13
Pa-231	4.01E-14	4.01E-14
Ac-227	3.13E-13	3.13E-13
Pb-210	1.62E-14	1.62E-14
Ra-226	7.36E-12	7.36E-12

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:33:49 Page: 31 **
Title : SLDS DCGL Renovation Worker
Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld
Evaluation Time: 10.0000000 years

Pb-210	1.56E-14	1.56E-14
Ra-228	1.07E-13	1.07E-13
Th-228	1.56E-11	1.56E-11
Th-228	3.35E-13	3.35E-13
Th-230	4.88E-16	4.88E-16
Ra-226	7.20E-14	7.20E-14
Pb-210	9.29E-17	9.29E-17
Th-232	4.27E-16	4.27E-16
Ra-228	1.02E-12	1.02E-12
Th-228	9.80E-11	9.80E-11
U-234	4.54E-16	4.54E-16
Th-230	1.01E-19	1.01E-19
Ra-226	8.23E-18	8.23E-18
Pb-210	8.01E-21	8.01E-21
U-235	2.01E-13	2.01E-13
Pa-231	1.91E-17	1.91E-17
Ac-227	9.09E-17	9.09E-17
U-238	1.50E-13	1.50E-13
U-234	2.88E-20	2.88E-20
Th-230	3.54E-24	3.54E-24
Ra-226	2.07E-22	2.07E-22
Pb-210	1.64E-25	1.64E-25

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:33:49 Page: 32 **
 Title : SLDS DCGL Renovation Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld
 Evaluation Time: 30.0000000 years

RESRAD-BUILD Risk Tables

Source Contributions to Receptor Risks

[Risk]						
	Source 1	Source 2	Source 3	Source 4	Source 5	Total
Receptor 1	7.01E-10	1.24E-10	1.24E-10	1.24E-10	1.24E-10	1.20E-09
Total	7.01E-10	1.24E-10	1.24E-10	1.24E-10	1.24E-10	1.20E-09

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:33:49 Page: 33 **

Title : SLDS DCGL Renovation Worker

Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld

Evaluation Time: 30.0000000 years

Pathway Detail of Risks

[Risk]

Source: 1								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	1.14E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.87E-10	0.00E+00	7.01E-10
Total	1.14E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.87E-10	0.00E+00	7.01E-10
Source: 2								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	6.24E-12	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.17E-10	0.00E+00	1.24E-10
Total	6.24E-12	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.17E-10	0.00E+00	1.24E-10
Source: 3								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	6.24E-12	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.17E-10	0.00E+00	1.24E-10
Total	6.24E-12	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.17E-10	0.00E+00	1.24E-10
Source: 4								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	6.24E-12	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.17E-10	0.00E+00	1.24E-10
Total	6.24E-12	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.17E-10	0.00E+00	1.24E-10
Source: 5								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	6.24E-12	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.17E-10	0.00E+00	1.24E-10
Total	6.24E-12	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.17E-10	0.00E+00	1.24E-10

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:33:49 Page: 34 **
 Title : SLDS DCGL Renovation Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld
 Evaluation Time: 30.0000000 years

Nuclide Detail of Risks

[Risk]

Source: 1

Nuclide	Receptor 1	Total
Ac-227	3.23E-12	3.23E-12
Pa-231	1.38E-12	1.38E-12
Ac-227	8.95E-12	8.95E-12
Pb-210	1.81E-13	1.81E-13
Ra-226	6.46E-11	6.46E-11
Pb-210	4.78E-13	4.78E-13
Ra-228	1.73E-13	1.73E-13
Th-228	7.54E-12	7.54E-12
Th-228	1.24E-15	1.24E-15
Th-230	3.86E-14	3.86E-14
Ra-226	1.20E-12	1.20E-12
Pb-210	5.48E-15	5.48E-15
Th-232	3.01E-14	3.01E-14
Ra-228	2.02E-11	2.02E-11
Th-228	5.86E-10	5.86E-10
U-234	3.85E-14	3.85E-14
Th-230	1.51E-17	1.51E-17
Ra-226	2.42E-16	2.42E-16
Pb-210	8.28E-19	8.28E-19
U-235	4.42E-12	4.42E-12
Pa-231	1.24E-15	1.24E-15
Ac-227	5.01E-15	5.01E-15
U-238	2.78E-12	2.78E-12
U-234	4.62E-18	4.62E-18
Th-230	9.30E-22	9.30E-22
Ra-226	1.02E-20	1.02E-20
Pb-210	2.84E-23	2.84E-23

Source: 2

Nuclide	Receptor 1	Total
Ac-227	1.67E-13	1.67E-13
Pa-231	4.01E-14	4.01E-14
Ac-227	4.61E-13	4.61E-13
Pb-210	8.69E-15	8.69E-15
Ra-226	7.30E-12	7.30E-12
Pb-210	2.30E-14	2.30E-14

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:33:49 Page: 35 **

Title : SLDS DCGL Renovation Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld
 Evaluation Time: 30.0000000 years

Ra-228	9.59E-15	9.59E-15
Th-228	1.45E-12	1.45E-12
Th-228	2.37E-16	2.37E-16
Th-230	4.88E-16	4.88E-16
Ra-226	1.36E-13	1.36E-13
Pb-210	2.63E-16	2.63E-16
Th-232	4.27E-16	4.27E-16
Ra-228	1.12E-12	1.12E-12
Th-228	1.13E-10	1.13E-10
U-234	4.54E-16	4.54E-16
Th-230	1.91E-19	1.91E-19
Ra-226	2.73E-17	2.73E-17
Pb-210	3.98E-20	3.98E-20
U-235	2.01E-13	2.01E-13
Pa-231	3.61E-17	3.61E-17
Ac-227	2.58E-16	2.58E-16
U-238	1.50E-13	1.50E-13
U-234	5.44E-20	5.44E-20
Th-230	1.18E-23	1.18E-23
Ra-226	1.16E-21	1.16E-21
Pb-210	1.37E-24	1.37E-24

Source: 3

Nuclide	Receptor	Total
	1	
Ac-227	1.67E-13	1.67E-13
Pa-231	4.01E-14	4.01E-14
Ac-227	4.61E-13	4.61E-13
Pb-210	8.69E-15	8.69E-15
Ra-226	7.30E-12	7.30E-12
Pb-210	2.30E-14	2.30E-14
Ra-228	9.59E-15	9.59E-15
Th-228	1.45E-12	1.45E-12
Th-228	2.37E-16	2.37E-16
Th-230	4.88E-16	4.88E-16
Ra-226	1.36E-13	1.36E-13
Pb-210	2.63E-16	2.63E-16
Th-232	4.27E-16	4.27E-16
Ra-228	1.12E-12	1.12E-12
Th-228	1.13E-10	1.13E-10
U-234	4.54E-16	4.54E-16
Th-230	1.91E-19	1.91E-19
Ra-226	2.73E-17	2.73E-17
Pb-210	3.98E-20	3.98E-20
U-235	2.01E-13	2.01E-13
Pa-231	3.61E-17	3.61E-17
Ac-227	2.58E-16	2.58E-16
U-238	1.50E-13	1.50E-13
U-234	5.44E-20	5.44E-20

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:33:49 Page: 36 **
 Title : SLDS DCGL Renovation Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld
 Evaluation Time: 30.0000000 years

Th-230	1.18E-23	1.18E-23
Ra-226	1.16E-21	1.16E-21
Pb-210	1.37E-24	1.37E-24

Source: 4

Nuclide	Receptor	Total
	1	
Ac-227	1.67E-13	1.67E-13
Pa-231	4.01E-14	4.01E-14
Ac-227	4.61E-13	4.61E-13
Pb-210	8.69E-15	8.69E-15
Ra-226	7.30E-12	7.30E-12
Pb-210	2.30E-14	2.30E-14
Ra-228	9.59E-15	9.59E-15
Th-228	1.45E-12	1.45E-12
Th-228	2.37E-16	2.37E-16
Th-230	4.88E-16	4.88E-16
Ra-226	1.36E-13	1.36E-13
Pb-210	2.63E-16	2.63E-16
Th-232	4.27E-16	4.27E-16
Ra-228	1.12E-12	1.12E-12
Th-228	1.13E-10	1.13E-10
U-234	4.54E-16	4.54E-16
Th-230	1.91E-19	1.91E-19
Ra-226	2.73E-17	2.73E-17
Pb-210	3.98E-20	3.98E-20
U-235	2.01E-13	2.01E-13
Pa-231	3.61E-17	3.61E-17
Ac-227	2.58E-16	2.58E-16
U-238	1.50E-13	1.50E-13
U-234	5.44E-20	5.44E-20
Th-230	1.18E-23	1.18E-23
Ra-226	1.16E-21	1.16E-21
Pb-210	1.37E-24	1.37E-24

Source: 5

Nuclide	Receptor	Total
	1	
Ac-227	1.67E-13	1.67E-13
Pa-231	4.01E-14	4.01E-14
Ac-227	4.61E-13	4.61E-13
Pb-210	8.69E-15	8.69E-15
Ra-226	7.30E-12	7.30E-12

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:33:49 Page: 37 **
Title : SLDS DCGL Renovation Worker
Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld
Evaluation Time: 30.0000000 years

Pb-210	2.30E-14	2.30E-14
Ra-228	9.59E-15	9.59E-15
Th-228	1.45E-12	1.45E-12
Th-228	2.37E-16	2.37E-16
Th-230	4.88E-16	4.88E-16
Ra-226	1.36E-13	1.36E-13
Pb-210	2.63E-16	2.63E-16
Th-232	4.27E-16	4.27E-16
Ra-228	1.12E-12	1.12E-12
Th-228	1.13E-10	1.13E-10
U-234	4.54E-16	4.54E-16
Th-230	1.91E-19	1.91E-19
Ra-226	2.73E-17	2.73E-17
Pb-210	3.98E-20	3.98E-20
U-235	2.01E-13	2.01E-13
Pa-231	3.61E-17	3.61E-17
Ac-227	2.58E-16	2.58E-16
U-238	1.50E-13	1.50E-13
U-234	5.44E-20	5.44E-20
Th-230	1.18E-23	1.18E-23
Ra-226	1.16E-21	1.16E-21
Pb-210	1.37E-24	1.37E-24

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:33:49 Page: 38 **
 Title : SLDS DCGL Renovation Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld
 Evaluation Time: 100.000008 years

RESRAD-BUILD Risk Tables

Source Contributions to Receptor Risks

[Risk]						
	Source 1	Source 2	Source 3	Source 4	Source 5	Total
Receptor 1	7.01E-10	1.24E-10	1.24E-10	1.24E-10	1.24E-10	1.20E-09
Total	7.01E-10	1.24E-10	1.24E-10	1.24E-10	1.24E-10	1.20E-09

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:33:49 Page: 39 **
 Title : SLDS DCGL Renovation Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld
 Evaluation Time: 100.000008 years

Pathway Detail of Risks

[Risk]								
Source: 1	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	1.14E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.87E-10	0.00E+00	7.01E-10
Total	1.14E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.87E-10	0.00E+00	7.01E-10
Source: 2	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	6.24E-12	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.17E-10	0.00E+00	1.24E-10
Total	6.24E-12	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.17E-10	0.00E+00	1.24E-10
Source: 3	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	6.24E-12	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.17E-10	0.00E+00	1.24E-10
Total	6.24E-12	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.17E-10	0.00E+00	1.24E-10
Source: 4	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	6.24E-12	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.17E-10	0.00E+00	1.24E-10
Total	6.24E-12	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.17E-10	0.00E+00	1.24E-10
Source: 5	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	6.24E-12	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.17E-10	0.00E+00	1.24E-10
Total	6.24E-12	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.17E-10	0.00E+00	1.24E-10

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:33:49 Page: 40 **
 Title : SLDS DCGL Renovation Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld
 Evaluation Time: 100.000008 years

Nuclide Detail of Risks

[Risk]

Source: 1

Nuclide	Receptor 1	Total
Ac-227	3.48E-13	3.48E-13
Pa-231	1.38E-12	1.38E-12
Ac-227	1.18E-11	1.18E-11
Pb-210	2.03E-14	2.03E-14
Ra-226	6.27E-11	6.27E-11
Pb-210	6.21E-13	6.21E-13
Ra-228	3.75E-17	3.75E-17
Th-228	1.63E-15	1.63E-15
Th-228	1.17E-26	1.17E-26
Th-230	3.85E-14	3.85E-14
Ra-226	3.13E-12	3.13E-12
Pb-210	2.30E-14	2.30E-14
Th-232	3.01E-14	3.01E-14
Ra-228	2.04E-11	2.04E-11
Th-228	5.93E-10	5.93E-10
U-234	3.85E-14	3.85E-14
Th-230	3.99E-17	3.99E-17
Ra-226	1.64E-15	1.64E-15
Pb-210	9.78E-18	9.78E-18
U-235	4.42E-12	4.42E-12
Pa-231	3.29E-15	3.29E-15
Ac-227	2.11E-14	2.11E-14
U-238	2.78E-12	2.78E-12
U-234	1.22E-17	1.22E-17
Th-230	6.36E-21	6.36E-21
Ra-226	1.76E-19	1.76E-19
Pb-210	8.89E-22	8.89E-22

Source: 2

Nuclide	Receptor 1	Total
Ac-227	1.80E-14	1.80E-14
Pa-231	4.00E-14	4.00E-14
Ac-227	6.09E-13	6.09E-13
Pb-210	9.77E-16	9.77E-16
Ra-226	7.08E-12	7.08E-12
Pb-210	2.99E-14	2.99E-14

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:33:49 Page: 41 **

Title : SLDS DCGL Renovation Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld
 Evaluation Time: 100.000008 years

Ra-228	2.08E-18	2.08E-18
Th-228	3.14E-16	3.14E-16
Th-228	2.25E-27	2.25E-27
Th-230	4.88E-16	4.88E-16
Ra-226	3.53E-13	3.53E-13
Pb-210	1.10E-15	1.10E-15
Th-232	4.27E-16	4.27E-16
Ra-228	1.13E-12	1.13E-12
Th-228	1.14E-10	1.14E-10
U-234	4.54E-16	4.54E-16
Th-230	5.05E-19	5.05E-19
Ra-226	1.85E-16	1.85E-16
Pb-210	4.70E-19	4.70E-19
U-235	2.01E-13	2.01E-13
Pa-231	9.54E-17	9.54E-17
Ac-227	1.09E-15	1.09E-15
U-238	1.50E-13	1.50E-13
U-234	1.44E-19	1.44E-19
Th-230	8.05E-23	8.05E-23
Ra-226	1.98E-20	1.98E-20
Pb-210	4.27E-23	4.27E-23

Source: 3

Nuclide	Receptor 1	Total
Ac-227	1.80E-14	1.80E-14
Pa-231	4.00E-14	4.00E-14
Ac-227	6.09E-13	6.09E-13
Pb-210	9.77E-16	9.77E-16
Ra-226	7.08E-12	7.08E-12
Pb-210	2.99E-14	2.99E-14
Ra-228	2.08E-18	2.08E-18
Th-228	3.14E-16	3.14E-16
Th-228	2.25E-27	2.25E-27
Th-230	4.88E-16	4.88E-16
Ra-226	3.53E-13	3.53E-13
Pb-210	1.10E-15	1.10E-15
Th-232	4.27E-16	4.27E-16
Ra-228	1.13E-12	1.13E-12
Th-228	1.14E-10	1.14E-10
U-234	4.54E-16	4.54E-16
Th-230	5.05E-19	5.05E-19
Ra-226	1.85E-16	1.85E-16
Pb-210	4.70E-19	4.70E-19
U-235	2.01E-13	2.01E-13
Pa-231	9.54E-17	9.54E-17
Ac-227	1.09E-15	1.09E-15
U-238	1.50E-13	1.50E-13
U-234	1.44E-19	1.44E-19

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:33:49 Page: 42 **
 Title : SLDS DCGL Renovation Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld
 Evaluation Time: 100.000008 years

Th-230	8.05E-23	8.05E-23
Ra-226	1.98E-20	1.98E-20
Pb-210	4.27E-23	4.27E-23

Source: 4

Nuclide	Receptor	Total
	1	
Ac-227	1.80E-14	1.80E-14
Pa-231	4.00E-14	4.00E-14
Ac-227	6.09E-13	6.09E-13
Pb-210	9.77E-16	9.77E-16
Ra-226	7.08E-12	7.08E-12
Pb-210	2.99E-14	2.99E-14
Ra-228	2.08E-18	2.08E-18
Th-228	3.14E-16	3.14E-16
Th-228	2.25E-27	2.25E-27
Th-230	4.88E-16	4.88E-16
Ra-226	3.53E-13	3.53E-13
Pb-210	1.10E-15	1.10E-15
Th-232	4.27E-16	4.27E-16
Ra-228	1.13E-12	1.13E-12
Th-228	1.14E-10	1.14E-10
U-234	4.54E-16	4.54E-16
Th-230	5.05E-19	5.05E-19
Ra-226	1.85E-16	1.85E-16
Pb-210	4.70E-19	4.70E-19
U-235	2.01E-13	2.01E-13
Pa-231	9.54E-17	9.54E-17
Ac-227	1.09E-15	1.09E-15
U-238	1.50E-13	1.50E-13
U-234	1.44E-19	1.44E-19
Th-230	8.05E-23	8.05E-23
Ra-226	1.98E-20	1.98E-20
Pb-210	4.27E-23	4.27E-23

Source: 5

Nuclide	Receptor	Total
	1	
Ac-227	1.80E-14	1.80E-14
Pa-231	4.00E-14	4.00E-14
Ac-227	6.09E-13	6.09E-13
Pb-210	9.77E-16	9.77E-16
Ra-226	7.08E-12	7.08E-12

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:33:49 Page: 43 **
Title : SLDS DCGL Renovation Worker
Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld
Evaluation Time: 100.000008 years

Pb-210	2.99E-14	2.99E-14
Ra-228	2.08E-18	2.08E-18
Th-228	3.14E-16	3.14E-16
Th-228	2.25E-27	2.25E-27
Th-230	4.88E-16	4.88E-16
Ra-226	3.53E-13	3.53E-13
Pb-210	1.10E-15	1.10E-15
Th-232	4.27E-16	4.27E-16
Ra-228	1.13E-12	1.13E-12
Th-228	1.14E-10	1.14E-10
U-234	4.54E-16	4.54E-16
Th-230	5.05E-19	5.05E-19
Ra-226	1.85E-16	1.85E-16
Pb-210	4.70E-19	4.70E-19
U-235	2.01E-13	2.01E-13
Pa-231	9.54E-17	9.54E-17
Ac-227	1.09E-15	1.09E-15
U-238	1.50E-13	1.50E-13
U-234	1.44E-19	1.44E-19
Th-230	8.05E-23	8.05E-23
Ra-226	1.98E-20	1.98E-20
Pb-210	4.27E-23	4.27E-23

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:33:49 Page: 44 **
 Title : SLDS DCGL Renovation Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld
 Evaluation Time: 300.000031 years

RESRAD-BUILD Risk Tables

Source Contributions to Receptor Risks

[Risk]						
	Source 1	Source 2	Source 3	Source 4	Source 5	Total
Receptor 1	7.01E-10	1.24E-10	1.24E-10	1.24E-10	1.24E-10	1.20E-09
Total	7.01E-10	1.24E-10	1.24E-10	1.24E-10	1.24E-10	1.20E-09

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:33:49 Page: 45 **

Title : SLDS DCGL Renovation Worker

Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld

Evaluation Time: 300.000031 years

Pathway Detail of Risks

[Risk]

Source: 1								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	1.14E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.87E-10	0.00E+00	7.01E-10
Total	1.14E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.87E-10	0.00E+00	7.01E-10
Source: 2								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	6.24E-12	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.17E-10	0.00E+00	1.24E-10
Total	6.24E-12	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.17E-10	0.00E+00	1.24E-10
Source: 3								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	6.24E-12	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.17E-10	0.00E+00	1.24E-10
Total	6.24E-12	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.17E-10	0.00E+00	1.24E-10
Source: 4								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	6.24E-12	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.17E-10	0.00E+00	1.24E-10
Total	6.24E-12	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.17E-10	0.00E+00	1.24E-10
Source: 5								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	6.24E-12	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.17E-10	0.00E+00	1.24E-10
Total	6.24E-12	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.17E-10	0.00E+00	1.24E-10

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:33:49 Page: 46 **
 Title : SLDS DCGL Renovation Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld
 Evaluation Time: 300.000031 years

Nuclide Detail of Risks

[Risk]

Source: 1

Nuclide	Receptor 1	Total
Ac-227	5.98E-16	5.98E-16
Pa-231	1.38E-12	1.38E-12
Ac-227	1.21E-11	1.21E-11
Pb-210	3.95E-17	3.95E-17
Ra-226	5.75E-11	5.75E-11
Pb-210	5.89E-13	5.89E-13
Ra-228	1.27E-27	1.27E-27
Th-228	5.52E-26	5.52E-26
Th-228	0.00E+00	0.00E+00
Th-230	3.85E-14	3.85E-14
Ra-226	8.32E-12	8.32E-12
Pb-210	7.59E-14	7.59E-14
Th-232	3.01E-14	3.01E-14
Ra-228	2.04E-11	2.04E-11
Th-228	5.93E-10	5.93E-10
U-234	3.85E-14	3.85E-14
Th-230	1.11E-16	1.11E-16
Ra-226	1.22E-14	1.22E-14
Pb-210	1.01E-16	1.01E-16
U-235	4.42E-12	4.42E-12
Pa-231	9.12E-15	9.12E-15
Ac-227	7.23E-14	7.23E-14
U-238	2.78E-12	2.78E-12
U-234	3.39E-17	3.39E-17
Th-230	4.89E-20	4.89E-20
Ra-226	3.64E-18	3.64E-18
Pb-210	2.76E-20	2.76E-20

Source: 2

Nuclide	Receptor 1	Total
Ac-227	3.08E-17	3.08E-17
Pa-231	3.99E-14	3.99E-14
Ac-227	6.24E-13	6.24E-13
Pb-210	1.90E-18	1.90E-18
Ra-226	6.49E-12	6.49E-12
Pb-210	2.83E-14	2.83E-14

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:33:49 Page: 47 **

Title : SLDS DCGL Renovation Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld
 Evaluation Time: 300.000031 years

Ra-228	7.02E-29	7.02E-29
Th-228	1.06E-26	1.06E-26
Th-228	0.00E+00	0.00E+00
Th-230	4.87E-16	4.87E-16
Ra-226	9.40E-13	9.40E-13
Pb-210	3.65E-15	3.65E-15
Th-232	4.27E-16	4.27E-16
Ra-228	1.13E-12	1.13E-12
Th-228	1.14E-10	1.14E-10
U-234	4.53E-16	4.53E-16
Th-230	1.40E-18	1.40E-18
Ra-226	1.38E-15	1.38E-15
Pb-210	4.86E-18	4.86E-18
U-235	2.01E-13	2.01E-13
Pa-231	2.64E-16	2.64E-16
Ac-227	3.72E-15	3.72E-15
U-238	1.50E-13	1.50E-13
U-234	4.00E-19	4.00E-19
Th-230	6.19E-22	6.19E-22
Ra-226	4.11E-19	4.11E-19
Pb-210	1.33E-21	1.33E-21

Source: 3

Nuclide	Receptor	Total
	1	
Ac-227	3.08E-17	3.08E-17
Pa-231	3.99E-14	3.99E-14
Ac-227	6.24E-13	6.24E-13
Pb-210	1.90E-18	1.90E-18
Ra-226	6.49E-12	6.49E-12
Pb-210	2.83E-14	2.83E-14
Ra-228	7.02E-29	7.02E-29
Th-228	1.06E-26	1.06E-26
Th-228	0.00E+00	0.00E+00
Th-230	4.87E-16	4.87E-16
Ra-226	9.40E-13	9.40E-13
Pb-210	3.65E-15	3.65E-15
Th-232	4.27E-16	4.27E-16
Ra-228	1.13E-12	1.13E-12
Th-228	1.14E-10	1.14E-10
U-234	4.53E-16	4.53E-16
Th-230	1.40E-18	1.40E-18
Ra-226	1.38E-15	1.38E-15
Pb-210	4.86E-18	4.86E-18
U-235	2.01E-13	2.01E-13
Pa-231	2.64E-16	2.64E-16
Ac-227	3.72E-15	3.72E-15
U-238	1.50E-13	1.50E-13
U-234	4.00E-19	4.00E-19

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:33:49 Page: 48 **
 Title : SLDS DCGL Renovation Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld
 Evaluation Time: 300.000031 years

Th-230	6.19E-22	6.19E-22
Ra-226	4.11E-19	4.11E-19
Pb-210	1.33E-21	1.33E-21

Source: 4

Nuclide	Receptor	Total
	1	
Ac-227	3.08E-17	3.08E-17
Pa-231	3.99E-14	3.99E-14
Ac-227	6.24E-13	6.24E-13
Pb-210	1.90E-18	1.90E-18
Ra-226	6.49E-12	6.49E-12
Pb-210	2.83E-14	2.83E-14
Ra-228	7.02E-29	7.02E-29
Th-228	1.06E-26	1.06E-26
Th-228	0.00E+00	0.00E+00
Th-230	4.87E-16	4.87E-16
Ra-226	9.40E-13	9.40E-13
Pb-210	3.65E-15	3.65E-15
Th-232	4.27E-16	4.27E-16
Ra-228	1.13E-12	1.13E-12
Th-228	1.14E-10	1.14E-10
U-234	4.53E-16	4.53E-16
Th-230	1.40E-18	1.40E-18
Ra-226	1.38E-15	1.38E-15
Pb-210	4.86E-18	4.86E-18
U-235	2.01E-13	2.01E-13
Pa-231	2.64E-16	2.64E-16
Ac-227	3.72E-15	3.72E-15
U-238	1.50E-13	1.50E-13
U-234	4.00E-19	4.00E-19
Th-230	6.19E-22	6.19E-22
Ra-226	4.11E-19	4.11E-19
Pb-210	1.33E-21	1.33E-21

Source: 5

Nuclide	Receptor	Total
	1	
Ac-227	3.08E-17	3.08E-17
Pa-231	3.99E-14	3.99E-14
Ac-227	6.24E-13	6.24E-13
Pb-210	1.90E-18	1.90E-18
Ra-226	6.49E-12	6.49E-12

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:33:49 Page: 49 **
Title : SLDS DCGL Renovation Worker
Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld
Evaluation Time: 300.000031 years

Pb-210	2.83E-14	2.83E-14
Ra-228	7.02E-29	7.02E-29
Th-228	1.06E-26	1.06E-26
Th-228	0.00E+00	0.00E+00
Th-230	4.87E-16	4.87E-16
Ra-226	9.40E-13	9.40E-13
Pb-210	3.65E-15	3.65E-15
Th-232	4.27E-16	4.27E-16
Ra-228	1.13E-12	1.13E-12
Th-228	1.14E-10	1.14E-10
U-234	4.53E-16	4.53E-16
Th-230	1.40E-18	1.40E-18
Ra-226	1.38E-15	1.38E-15
Pb-210	4.86E-18	4.86E-18
U-235	2.01E-13	2.01E-13
Pa-231	2.64E-16	2.64E-16
Ac-227	3.72E-15	3.72E-15
U-238	1.50E-13	1.50E-13
U-234	4.00E-19	4.00E-19
Th-230	6.19E-22	6.19E-22
Ra-226	4.11E-19	4.11E-19
Pb-210	1.33E-21	1.33E-21

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:33:49 Page: 50 **
 Title : SLDS DCGL Renovation Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld
 Evaluation Time: 1000.00000 years

RESRAD-BUILD Risk Tables

Source Contributions to Receptor Risks

[Risk]						
	Source 1	Source 2	Source 3	Source 4	Source 5	Total
Receptor 1	7.01E-10	1.24E-10	1.24E-10	1.24E-10	1.24E-10	1.20E-09
Total	7.01E-10	1.24E-10	1.24E-10	1.24E-10	1.24E-10	1.20E-09

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:33:49 Page: 51 **
 Title : SLDS DCGL Renovation Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld
 Evaluation Time: 1000.00000 years

Pathway Detail of Risks

[Risk]								
Source: 1	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	1.14E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.87E-10	0.00E+00	7.01E-10
Total	1.14E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.87E-10	0.00E+00	7.01E-10
Source: 2	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	6.24E-12	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.17E-10	0.00E+00	1.24E-10
Total	6.24E-12	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.17E-10	0.00E+00	1.24E-10
Source: 3	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	6.24E-12	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.17E-10	0.00E+00	1.24E-10
Total	6.24E-12	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.17E-10	0.00E+00	1.24E-10
Source: 4	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	6.24E-12	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.17E-10	0.00E+00	1.24E-10
Total	6.24E-12	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.17E-10	0.00E+00	1.24E-10
Source: 5	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	6.24E-12	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.17E-10	0.00E+00	1.24E-10
Total	6.24E-12	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.17E-10	0.00E+00	1.24E-10

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:33:49 Page: 52 **
 Title : SLDS DCGL Renovation Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld
 Evaluation Time: 1000.00000 years

Nuclide Detail of Risks

[Risk]

Source: 1

Nuclide	Receptor 1	Total
Ac-227	1.25E-25	1.25E-25
Pa-231	1.35E-12	1.35E-12
Ac-227	1.19E-11	1.19E-11
Pb-210	1.27E-26	1.27E-26
Ra-226	4.25E-11	4.25E-11
Pb-210	4.35E-13	4.35E-13
Ra-228	0.00E+00	0.00E+00
Th-228	0.00E+00	0.00E+00
Th-228	0.00E+00	0.00E+00
Th-230	3.82E-14	3.82E-14
Ra-226	2.33E-11	2.33E-11
Pb-210	2.29E-13	2.29E-13
Th-232	3.01E-14	3.01E-14
Ra-228	2.04E-11	2.04E-11
Th-228	5.93E-10	5.93E-10
U-234	3.84E-14	3.84E-14
Th-230	3.57E-16	3.57E-16
Ra-226	1.16E-13	1.16E-13
Pb-210	1.11E-15	1.11E-15
U-235	4.42E-12	4.42E-12
Pa-231	2.93E-14	2.93E-14
Ac-227	2.50E-13	2.50E-13
U-238	2.78E-12	2.78E-12
U-234	1.10E-16	1.10E-16
Th-230	5.11E-19	5.11E-19
Ra-226	1.15E-16	1.15E-16
Pb-210	1.06E-18	1.06E-18

Source: 2

Nuclide	Receptor 1	Total
Ac-227	6.46E-27	6.46E-27
Pa-231	3.93E-14	3.93E-14
Ac-227	6.15E-13	6.15E-13
Pb-210	6.11E-28	6.11E-28
Ra-226	4.79E-12	4.79E-12
Pb-210	2.09E-14	2.09E-14

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:33:49 Page: 53 **

Title : SLDS DCGL Renovation Worker

Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld

Evaluation Time: 1000.00000 years

Ra-228	0.00E+00	0.00E+00
Th-228	0.00E+00	0.00E+00
Th-228	0.00E+00	0.00E+00
Th-230	4.84E-16	4.84E-16
Ra-226	2.63E-12	2.63E-12
Pb-210	1.10E-14	1.10E-14
Th-232	4.27E-16	4.27E-16
Ra-228	1.13E-12	1.13E-12
Th-228	1.14E-10	1.14E-10
U-234	4.52E-16	4.52E-16
Th-230	4.52E-18	4.52E-18
Ra-226	1.31E-14	1.31E-14
Pb-210	5.32E-17	5.32E-17
U-235	2.01E-13	2.01E-13
Pa-231	8.51E-16	8.51E-16
Ac-227	1.29E-14	1.29E-14
U-238	1.50E-13	1.50E-13
U-234	1.30E-18	1.30E-18
Th-230	6.47E-21	6.47E-21
Ra-226	1.30E-17	1.30E-17
Pb-210	5.09E-20	5.09E-20

Source: 3

Nuclide	Receptor	Total
	1	
Ac-227	6.46E-27	6.46E-27
Pa-231	3.93E-14	3.93E-14
Ac-227	6.15E-13	6.15E-13
Pb-210	6.11E-28	6.11E-28
Ra-226	4.79E-12	4.79E-12
Pb-210	2.09E-14	2.09E-14
Ra-228	0.00E+00	0.00E+00
Th-228	0.00E+00	0.00E+00
Th-228	0.00E+00	0.00E+00
Th-230	4.84E-16	4.84E-16
Ra-226	2.63E-12	2.63E-12
Pb-210	1.10E-14	1.10E-14
Th-232	4.27E-16	4.27E-16
Ra-228	1.13E-12	1.13E-12
Th-228	1.14E-10	1.14E-10
U-234	4.52E-16	4.52E-16
Th-230	4.52E-18	4.52E-18
Ra-226	1.31E-14	1.31E-14
Pb-210	5.32E-17	5.32E-17
U-235	2.01E-13	2.01E-13
Pa-231	8.51E-16	8.51E-16
Ac-227	1.29E-14	1.29E-14
U-238	1.50E-13	1.50E-13
U-234	1.30E-18	1.30E-18

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:33:49 Page: 54 **
 Title : SLDS DCGL Renovation Worker
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.blc
 Evaluation Time: 1000.00000 years

Th-230	6.47E-21	6.47E-21
Ra-226	1.30E-17	1.30E-17
Pb-210	5.09E-20	5.09E-20

Source: 4

Nuclide	Receptor	Total
	1	
Ac-227	6.46E-27	6.46E-27
Pa-231	3.93E-14	3.93E-14
Ac-227	6.15E-13	6.15E-13
Pb-210	6.11E-28	6.11E-28
Ra-226	4.79E-12	4.79E-12
Pb-210	2.09E-14	2.09E-14
Ra-228	0.00E+00	0.00E+00
Th-228	0.00E+00	0.00E+00
Th-228	0.00E+00	0.00E+00
Th-230	4.84E-16	4.84E-16
Ra-226	2.63E-12	2.63E-12
Pb-210	1.10E-14	1.10E-14
Th-232	4.27E-16	4.27E-16
Ra-228	1.13E-12	1.13E-12
Th-228	1.14E-10	1.14E-10
U-234	4.52E-16	4.52E-16
Th-230	4.52E-18	4.52E-18
Ra-226	1.31E-14	1.31E-14
Pb-210	5.32E-17	5.32E-17
U-235	2.01E-13	2.01E-13
Pa-231	8.51E-16	8.51E-16
Ac-227	1.29E-14	1.29E-14
U-238	1.50E-13	1.50E-13
U-234	1.30E-18	1.30E-18
Th-230	6.47E-21	6.47E-21
Ra-226	1.30E-17	1.30E-17
Pb-210	5.09E-20	5.09E-20

Source: 5

Nuclide	Receptor	Total
	1	
Ac-227	6.46E-27	6.46E-27
Pa-231	3.93E-14	3.93E-14
Ac-227	6.15E-13	6.15E-13
Pb-210	6.11E-28	6.11E-28
Ra-226	4.79E-12	4.79E-12

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:33:49 Page: 55 **
Title : SLDS DCGL Renovation Worker
Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL RW.bld
Evaluation Time: 1000.00000 years

Pb-210	2.09E-14	2.09E-14
Ra-228	0.00E+00	0.00E+00
Th-228	0.00E+00	0.00E+00
Th-228	0.00E+00	0.00E+00
Th-230	4.84E-16	4.84E-16
Ra-226	2.63E-12	2.63E-12
Pb-210	1.10E-14	1.10E-14
Th-232	4.27E-16	4.27E-16
Ra-228	1.13E-12	1.13E-12
Th-228	1.14E-10	1.14E-10
U-234	4.52E-16	4.52E-16
Th-230	4.52E-18	4.52E-18
Ra-226	1.31E-14	1.31E-14
Pb-210	5.32E-17	5.32E-17
U-235	2.01E-13	2.01E-13
Pa-231	8.51E-16	8.51E-16
Ac-227	1.29E-14	1.29E-14
U-238	1.50E-13	1.50E-13
U-234	1.30E-18	1.30E-18
Th-230	6.47E-21	6.47E-21
Ra-226	1.30E-17	1.30E-17
Pb-210	5.09E-20	5.09E-20

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:45:31 Page: 1 **
 Title : SLDS DCGL Resident
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld

RESRAD-BUILD Table of Contents	

RESRAD-BUILD Input Parameters.....	2
Building Information.....	3
Source Information.....	4
Temporal Dose Summary.....	7
For time = 0.00E+00 yr	
Receptor-Source Dose Summary.....	8
Dose by Pathway Detail.....	9
Dose by Nuclide Detail.....	10
For time = 1.00E+00 yr	
Receptor-Source Dose Summary.....	14
Dose by Pathway Detail.....	15
Dose by Nuclide Detail.....	16
For time = 3.00E+00 yr	
Receptor-Source Dose Summary.....	20
Dose by Pathway Detail.....	21
Dose by Nuclide Detail.....	22
For time = 1.00E+01 yr	
Receptor-Source Dose Summary.....	26
Dose by Pathway Detail.....	27
Dose by Nuclide Detail.....	28
For time = 2.00E+01 yr	
Receptor-Source Dose Summary.....	32
Dose by Pathway Detail.....	33
Dose by Nuclide Detail.....	34
For time = 3.00E+01 yr	
Receptor-Source Dose Summary.....	38
Dose by Pathway Detail.....	39
Dose by Nuclide Detail.....	40
For time = 1.00E+02 yr	
Receptor-Source Dose Summary.....	44
Dose by Pathway Detail.....	45
Dose by Nuclide Detail.....	46
For time = 3.00E+02 yr	
Receptor-Source Dose Summary.....	50
Dose by Pathway Detail.....	51
Dose by Nuclide Detail.....	52
For time = 1.00E+03 yr	
Receptor-Source Dose Summary.....	56
Dose by Pathway Detail.....	57
Dose by Nuclide Detail.....	58

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:45:31 Page: 2 **
 Title : SLDS DCGL Resident
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld

```

=====
=====
=====
RESRAD-BUILD Input Parameters
=====
=====
=====
    
```

```

Number of Sources : 5
Number of Receptors: 1
Total Time : 3.650000E+02 days
Fraction Inside : 6.390000E-01
    
```

```

Transformations data from: ICRP107
Cut off half life : 180.000000 days
Library information in the Dose Coefficients and Slope Factors report
    
```

```

===== Receptor Information =====
Receptor Room x y z FracTime Inhalation Ingestion(Dust)
           [m] [m] [m] [m3/day] [m2/hr]
1          1 5.000 5.000 1.000 1.000 1.48E+01 6.90E-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

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:45:31 Page: 3 **
Title : SLDS DCGL Resident
Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld

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

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

Height[m]	Air Exchanges [m3/hr]	
Area [m2]	*****	
	*	*
	*	*
	*	<=Q01: 0.00E+00
H1: 2.500	* Room 1	* Q10 : 0.00E+00
	* LAMBDA: 0.00E+00	*
Area 100.000	*	*
	*	*

Deposition velocity: 3.90E-04 [m/s] Resuspension Rate: 0.00E+00 [1/s]
Deposition velocity: 5.00E-07 [m/s] Resuspension Rate:

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:45:31 Page: 4 **
 Title : SLDS DCGL Resident
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld

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

Source: 1

Location:: Room : 1 x: 5.00 y: 5.00 z: 0.00[m]
 Geometry:: Type: Area Length[m]:1.00E+01 Width[m]:1.00E+01 Direction: z
 Pathway ::
 Direct Ingestion Rate: 0.000E+00 [1/hr]
 Fraction released to air: 7.000E-02
 Removable fraction: 1.000E-01
 Time to Remove: 1.000E+04 [day]

Radon Release Fraction: 1.000E-01

Contamination::

Nuclide Concentration

	[dpm/m2]
Ac-227	1.000E+00
Pa-231	1.000E+00
Pb-210	1.000E+00
Ra-226	1.000E+00
Ra-228	1.000E+00
Th-228	1.000E+00
Th-230	1.000E+00
Th-232	1.000E+00
U-234	1.000E+00
U-235	1.000E+00
U-238	1.000E+00

Source: 2

Location:: Room : 1 x: 10.00 y: 5.00 z: 1.00[m]
 Geometry:: Type: Area Length[m]:1.00E+01 Width[m]:2.00E+00 Direction: x
 Pathway ::
 Direct Ingestion Rate: 0.000E+00 [1/hr]
 Fraction released to air: 7.000E-02
 Removable fraction: 1.000E-01
 Time to Remove: 1.000E+04 [day]

Radon Release Fraction: 1.000E-01

Contamination::

Nuclide Concentration

	[dpm/m2]
Ac-227	1.000E+00
Pa-231	1.000E+00
Pb-210	1.000E+00
Ra-226	1.000E+00
Ra-228	1.000E+00
Th-228	1.000E+00
Th-230	1.000E+00
Th-232	1.000E+00
U-234	1.000E+00
U-235	1.000E+00
U-238	1.000E+00

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:45:31 Page: 5 **

Title : SLDS DCGL Resident

Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld

Source: 3

Location:: Room : 1 x: 5.00 y: 10.00 z: 1.00[m]
 Geometry:: Type: Area Length[m]:1.00E+01 Width[m]:2.00E+00 Direction: y
 Pathway ::
 Direct Ingestion Rate: 0.000E+00 [1/hr]
 Fraction released to air: 7.000E-02
 Removable fraction: 1.000E-01
 Time to Remove: 1.000E+04 [day]

 Radon Release Fraction: 1.000E-01

Contamination::

Nuclide Concentration

	[dpm/m2]
Ac-227	1.000E+00
Pa-231	1.000E+00
Pb-210	1.000E+00
Ra-226	1.000E+00
Ra-228	1.000E+00
Th-228	1.000E+00
Th-230	1.000E+00
Th-232	1.000E+00
U-234	1.000E+00
U-235	1.000E+00
U-238	1.000E+00

Source: 4

Location:: Room : 1 x: 0.00 y: 5.00 z: 1.00[m]
 Geometry:: Type: Area Length[m]:1.00E+01 Width[m]:2.00E+00 Direction: x
 Pathway ::
 Direct Ingestion Rate: 0.000E+00 [1/hr]
 Fraction released to air: 7.000E-02
 Removable fraction: 1.000E-01
 Time to Remove: 1.000E+04 [day]

 Radon Release Fraction: 1.000E-01

Contamination::

Nuclide Concentration

	[dpm/m2]
Ac-227	1.000E+00
Pa-231	1.000E+00
Pb-210	1.000E+00
Ra-226	1.000E+00
Ra-228	1.000E+00
Th-228	1.000E+00
Th-230	1.000E+00
Th-232	1.000E+00
U-234	1.000E+00
U-235	1.000E+00
U-238	1.000E+00

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:45:31 Page: 6 **
Title : SLDS DCGL Resident
Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld

Source: 5

Location:: Room : 1 x: 5.00 y: 0.00 z: 1.00[m]
Geometry:: Type: Area Length[m]:1.00E+01 Width[m]:2.00E+00 Direction: y
Pathway ::
Direct Ingestion Rate: 0.000E+00 [1/hr]
Fraction released to air: 7.000E-02
Removable fraction: 1.000E-01
Time to Remove: 1.000E+04 [day]

Radon Release Fraction: 1.000E-01

Contamination::

Nuclide Concentration

	[dpm/m2]
Ac-227	1.000E+00
Pa-231	1.000E+00
Pb-210	1.000E+00
Ra-226	1.000E+00
Ra-228	1.000E+00
Th-228	1.000E+00
Th-230	1.000E+00
Th-232	1.000E+00
U-234	1.000E+00
U-235	1.000E+00
U-238	1.000E+00

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:45:31 Page: 7 **
 Title : SLDS DCGL Resident
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld
 Temporal Summary

RESRAD-BUILD Temporal Dose Tables

Dose to Receptor over the Exposure Duration

(mrem)

Evaluation Time years	Receptor 1	Total
0.000000000	7.76E-04	7.76E-04
1.000000000	7.80E-04	7.80E-04
3.000000000	7.75E-04	7.75E-04
10.00000000	7.58E-04	7.58E-04
20.00000000	7.34E-04	7.34E-04
30.00000000	5.88E-04	5.88E-04
100.0000080	5.88E-04	5.88E-04
300.0000310	5.88E-04	5.88E-04
1000.000000	5.88E-04	5.88E-04

RESRAD-BUILD Dose Tables

```
[mrem]
```

	Source 1	Source 2	Source 3	Source 4	Source 5	Total
Receptor 1	4.48E-04	8.21E-05	8.21E-05	8.21E-05	8.21E-05	7.76E-04
Total	4.48E-04	8.21E-05	8.21E-05	8.21E-05	8.21E-05	7.76E-04

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:45:31 Page: 9 **

Title : SLDS DCGL Resident

Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld

Evaluation Time: 0.00000000E+00 years

Pathway Detail of Doses

[mrem]

Source: 1	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	5.10E-05	6.83E-05	5.21E-10	1.06E-10	7.74E-07	3.28E-04	0.00E+00	4.48E-04
Total	5.10E-05	6.83E-05	5.21E-10	1.06E-10	7.74E-07	3.28E-04	0.00E+00	4.48E-04
Source: 2	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	2.79E-06	1.37E-05	1.04E-10	2.11E-11	1.55E-07	6.55E-05	0.00E+00	8.21E-05
Total	2.79E-06	1.37E-05	1.04E-10	2.11E-11	1.55E-07	6.55E-05	0.00E+00	8.21E-05
Source: 3	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	2.79E-06	1.37E-05	1.04E-10	2.11E-11	1.55E-07	6.55E-05	0.00E+00	8.21E-05
Total	2.79E-06	1.37E-05	1.04E-10	2.11E-11	1.55E-07	6.55E-05	0.00E+00	8.21E-05
Source: 4	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	2.79E-06	1.37E-05	1.04E-10	2.11E-11	1.55E-07	6.55E-05	0.00E+00	8.21E-05
Total	2.79E-06	1.37E-05	1.04E-10	2.11E-11	1.55E-07	6.55E-05	0.00E+00	8.21E-05
Source: 5	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	2.79E-06	1.37E-05	1.04E-10	2.11E-11	1.55E-07	6.55E-05	0.00E+00	8.21E-05
Total	2.79E-06	1.37E-05	1.04E-10	2.11E-11	1.55E-07	6.55E-05	0.00E+00	8.21E-05

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:45:31 Page: 10 **
 Title : SLDS DCGL Resident
 Input File : C:\RESRAD Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld
 Evaluation Time: 0.00000000E+00 years

Nuclide Detail of Doses

[mrem]

Source: 1

Nuclide	Receptor 1	Total
Ac-227	2.15E-05	2.15E-05
Pa-231	2.18E-05	2.18E-05
Ac-227	3.54E-07	3.54E-07
Pb-210	1.77E-06	1.77E-06
Ra-226	2.32E-05	2.32E-05
Pb-210	2.88E-08	2.88E-08
Ra-228	1.02E-05	1.02E-05
Th-228	5.29E-05	5.29E-05
Th-228	2.87E-04	2.87E-04
Th-230	9.08E-06	9.08E-06
Ra-226	5.03E-09	5.03E-09
Pb-210	4.19E-12	4.19E-12
Th-232	1.08E-05	1.08E-05
Ra-228	6.34E-07	6.34E-07
Th-228	2.21E-06	2.21E-06
U-234	9.98E-07	9.98E-07
Th-230	4.33E-11	4.33E-11
Ra-226	1.54E-14	1.54E-14
Pb-210	9.66E-18	9.66E-18
U-235	2.89E-06	2.89E-06
Pa-231	2.39E-10	2.39E-10
Ac-227	2.51E-12	2.51E-12
U-238	2.20E-06	2.20E-06
U-234	1.46E-12	1.46E-12
Th-230	4.10E-17	4.10E-17
Ra-226	1.33E-20	1.33E-20
Pb-210	1.31E-22	1.31E-22

Source: 2

Nuclide	Receptor 1	Total
Ac-227	3.49E-06	3.49E-06
Pa-231	4.26E-06	4.26E-06
Ac-227	5.77E-08	5.77E-08
Pb-210	2.89E-07	2.89E-07
Ra-226	2.11E-06	2.11E-06
Pb-210	4.74E-09	4.74E-09

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:45:31 Page: 11 **

Title : SLDS DCGL Resident

Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld

Evaluation Time: 0.00000000E+00 years

Ra-228	8.16E-07	8.16E-07
Th-228	1.03E-05	1.03E-05
Th-228	5.57E-05	5.57E-05
Th-230	1.81E-06	1.81E-06
Ra-226	4.59E-10	4.59E-10
Pb-210	6.91E-13	6.91E-13
Th-232	2.15E-06	2.15E-06
Ra-228	5.11E-08	5.11E-08
Th-228	4.29E-07	4.29E-07
U-234	1.96E-07	1.96E-07
Th-230	8.64E-12	8.64E-12
Ra-226	1.41E-15	1.41E-15
Pb-210	1.59E-18	1.59E-18
U-235	2.68E-07	2.68E-07
Pa-231	4.67E-11	4.67E-11
Ac-227	4.10E-13	4.10E-13
U-238	2.41E-07	2.41E-07
U-234	2.87E-13	2.87E-13
Th-230	8.18E-18	8.18E-18
Ra-226	7.41E-22	7.41E-22
Pb-210	2.86E-24	2.86E-24

Source: 3

Nuclide	Receptor 1	Total
Ac-227	3.49E-06	3.49E-06
Pa-231	4.26E-06	4.26E-06
Ac-227	5.77E-08	5.77E-08
Pb-210	2.89E-07	2.89E-07
Ra-226	2.11E-06	2.11E-06
Pb-210	4.74E-09	4.74E-09
Ra-228	8.16E-07	8.16E-07
Th-228	1.03E-05	1.03E-05
Th-228	5.57E-05	5.57E-05
Th-230	1.81E-06	1.81E-06
Ra-226	4.59E-10	4.59E-10
Pb-210	6.91E-13	6.91E-13
Th-232	2.15E-06	2.15E-06
Ra-228	5.11E-08	5.11E-08
Th-228	4.29E-07	4.29E-07
U-234	1.96E-07	1.96E-07
Th-230	8.64E-12	8.64E-12
Ra-226	1.41E-15	1.41E-15
Pb-210	1.59E-18	1.59E-18
U-235	2.68E-07	2.68E-07
Pa-231	4.67E-11	4.67E-11
Ac-227	4.10E-13	4.10E-13
U-238	2.41E-07	2.41E-07
U-234	2.87E-13	2.87E-13

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:45:31 Page: 12 **
 Title : SLDS DCGL Resident
 Input File : C:\RESRAD Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld
 Evaluation Time: 0.0000000E+00 years

Th-230	8.18E-18	8.18E-18
Ra-226	7.41E-22	7.41E-22
Pb-210	2.86E-24	2.86E-24

Source: 4

Nuclide	Receptor	Total
	1	
Ac-227	3.49E-06	3.49E-06
Pa-231	4.26E-06	4.26E-06
Ac-227	5.77E-08	5.77E-08
Pb-210	2.89E-07	2.89E-07
Ra-226	2.11E-06	2.11E-06
Pb-210	4.74E-09	4.74E-09
Ra-228	8.16E-07	8.16E-07
Th-228	1.03E-05	1.03E-05
Th-228	5.57E-05	5.57E-05
Th-230	1.81E-06	1.81E-06
Ra-226	4.59E-10	4.59E-10
Pb-210	6.91E-13	6.91E-13
Th-232	2.15E-06	2.15E-06
Ra-228	5.11E-08	5.11E-08
Th-228	4.29E-07	4.29E-07
U-234	1.96E-07	1.96E-07
Th-230	8.64E-12	8.64E-12
Ra-226	1.41E-15	1.41E-15
Pb-210	1.59E-18	1.59E-18
U-235	2.68E-07	2.68E-07
Pa-231	4.67E-11	4.67E-11
Ac-227	4.10E-13	4.10E-13
U-238	2.41E-07	2.41E-07
U-234	2.87E-13	2.87E-13
Th-230	8.18E-18	8.18E-18
Ra-226	7.41E-22	7.41E-22
Pb-210	2.86E-24	2.86E-24

Source: 5

Nuclide	Receptor	Total
	1	
Ac-227	3.49E-06	3.49E-06
Pa-231	4.26E-06	4.26E-06
Ac-227	5.77E-08	5.77E-08
Pb-210	2.89E-07	2.89E-07
Ra-226	2.11E-06	2.11E-06

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:45:31 Page: 13 **
Title : SLDS DCGL Resident
Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld
Evaluation Time: 0.00000000E+00 years

Pb-210	4.74E-09	4.74E-09
Ra-228	8.16E-07	8.16E-07
Th-228	1.03E-05	1.03E-05
Th-228	5.57E-05	5.57E-05
Th-230	1.81E-06	1.81E-06
Ra-226	4.59E-10	4.59E-10
Pb-210	6.91E-13	6.91E-13
Th-232	2.15E-06	2.15E-06
Ra-228	5.11E-08	5.11E-08
Th-228	4.29E-07	4.29E-07
U-234	1.96E-07	1.96E-07
Th-230	8.64E-12	8.64E-12
Ra-226	1.41E-15	1.41E-15
Pb-210	1.59E-18	1.59E-18
U-235	2.68E-07	2.68E-07
Pa-231	4.67E-11	4.67E-11
Ac-227	4.10E-13	4.10E-13
U-238	2.41E-07	2.41E-07
U-234	2.87E-13	2.87E-13
Th-230	8.18E-18	8.18E-18
Ra-226	7.41E-22	7.41E-22
Pb-210	2.86E-24	2.86E-24

RESRAD-BUILD Dose Tables

```
[mrem]
```

	Source 1	Source 2	Source 3	Source 4	Source 5	Total
Receptor 1	4.50E-04	8.25E-05	8.25E-05	8.25E-05	8.25E-05	7.80E-04
Total	4.50E-04	8.25E-05	8.25E-05	8.25E-05	8.25E-05	7.80E-04

Final Status Survey Plan for Soil, Structures, and Sediment at the St. Louis FUSRAP Sites

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:45:31 Page: 15 **

Title : SLDS DCGL Resident

Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld

Evaluation Time: 1.00000000 years

Pathway Detail of Doses

[mrem]

Source: 1								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	5.08E-05	7.15E-05	5.85E-10	1.10E-10	8.68E-07	3.26E-04	0.00E+00	4.50E-04
Total	5.08E-05	7.15E-05	5.85E-10	1.10E-10	8.68E-07	3.26E-04	0.00E+00	4.50E-04
Source: 2								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	2.77E-06	1.43E-05	1.17E-10	2.21E-11	1.74E-07	6.53E-05	0.00E+00	8.25E-05
Total	2.77E-06	1.43E-05	1.17E-10	2.21E-11	1.74E-07	6.53E-05	0.00E+00	8.25E-05
Source: 3								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	2.77E-06	1.43E-05	1.17E-10	2.21E-11	1.74E-07	6.53E-05	0.00E+00	8.25E-05
Total	2.77E-06	1.43E-05	1.17E-10	2.21E-11	1.74E-07	6.53E-05	0.00E+00	8.25E-05
Source: 4								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	2.77E-06	1.43E-05	1.17E-10	2.21E-11	1.74E-07	6.53E-05	0.00E+00	8.25E-05
Total	2.77E-06	1.43E-05	1.17E-10	2.21E-11	1.74E-07	6.53E-05	0.00E+00	8.25E-05
Source: 5								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	2.77E-06	1.43E-05	1.17E-10	2.21E-11	1.74E-07	6.53E-05	0.00E+00	8.25E-05
Total	2.77E-06	1.43E-05	1.17E-10	2.21E-11	1.74E-07	6.53E-05	0.00E+00	8.25E-05

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:45:31 Page: 16 **
 Title : SLDS DCGL Resident
 Input File : C:\RESRAD Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld
 Evaluation Time: 1.00000000 years

Nuclide Detail of Doses

[mrem]

Source: 1

Nuclide	Receptor 1	Total
Ac-227	2.16E-05	2.16E-05
Pa-231	2.28E-05	2.28E-05
Ac-227	1.05E-06	1.05E-06
Pb-210	1.79E-06	1.79E-06
Ra-226	2.32E-05	2.32E-05
Pb-210	8.59E-08	8.59E-08
Ra-228	9.14E-06	9.14E-06
Th-228	1.28E-04	1.28E-04
Th-228	1.99E-04	1.99E-04
Th-230	9.51E-06	9.51E-06
Ra-226	1.51E-08	1.51E-08
Pb-210	2.92E-11	2.92E-11
Th-232	1.13E-05	1.13E-05
Ra-228	1.80E-06	1.80E-06
Th-228	1.35E-05	1.35E-05
U-234	1.04E-06	1.04E-06
Th-230	1.31E-10	1.31E-10
Ra-226	1.08E-13	1.08E-13
Pb-210	1.44E-16	1.44E-16
U-235	2.92E-06	2.92E-06
Pa-231	7.24E-10	7.24E-10
Ac-227	1.75E-11	1.75E-11
U-238	2.23E-06	2.23E-06
U-234	4.42E-12	4.42E-12
Th-230	2.88E-16	2.88E-16
Ra-226	1.64E-19	1.64E-19
Pb-210	2.59E-22	2.59E-22

Source: 2

Nuclide	Receptor 1	Total
Ac-227	3.53E-06	3.53E-06
Pa-231	4.46E-06	4.46E-06
Ac-227	1.72E-07	1.72E-07
Pb-210	2.96E-07	2.96E-07
Ra-226	2.12E-06	2.12E-06
Pb-210	1.42E-08	1.42E-08

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:45:31 Page: 17 **

Title : SLDS DCGL Resident

Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld

Evaluation Time: 1.00000000 years

Ra-228	7.40E-07	7.40E-07
Th-228	2.49E-05	2.49E-05
Th-228	3.86E-05	3.86E-05
Th-230	1.90E-06	1.90E-06
Ra-226	1.37E-09	1.37E-09
Pb-210	4.82E-12	4.82E-12
Th-232	2.25E-06	2.25E-06
Ra-228	1.46E-07	1.46E-07
Th-228	2.62E-06	2.62E-06
U-234	2.05E-07	2.05E-07
Th-230	2.62E-11	2.62E-11
Ra-226	9.83E-15	9.83E-15
Pb-210	2.38E-17	2.38E-17
U-235	2.76E-07	2.76E-07
Pa-231	1.42E-10	1.42E-10
Ac-227	2.86E-12	2.86E-12
U-238	2.49E-07	2.49E-07
U-234	8.69E-13	8.69E-13
Th-230	5.75E-17	5.75E-17
Ra-226	1.45E-20	1.45E-20
Pb-210	5.41E-23	5.41E-23

Source: 3

Nuclide	Receptor 1	Total
Ac-227	3.53E-06	3.53E-06
Pa-231	4.46E-06	4.46E-06
Ac-227	1.72E-07	1.72E-07
Pb-210	2.96E-07	2.96E-07
Ra-226	2.12E-06	2.12E-06
Pb-210	1.42E-08	1.42E-08
Ra-228	7.40E-07	7.40E-07
Th-228	2.49E-05	2.49E-05
Th-228	3.86E-05	3.86E-05
Th-230	1.90E-06	1.90E-06
Ra-226	1.37E-09	1.37E-09
Pb-210	4.82E-12	4.82E-12
Th-232	2.25E-06	2.25E-06
Ra-228	1.46E-07	1.46E-07
Th-228	2.62E-06	2.62E-06
U-234	2.05E-07	2.05E-07
Th-230	2.62E-11	2.62E-11
Ra-226	9.83E-15	9.83E-15
Pb-210	2.38E-17	2.38E-17
U-235	2.76E-07	2.76E-07
Pa-231	1.42E-10	1.42E-10
Ac-227	2.86E-12	2.86E-12
U-238	2.49E-07	2.49E-07
U-234	8.69E-13	8.69E-13

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:45:31 Page: 18 **

Title : SLDS DCGL Resident

Input File : C:\RESRAD Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld

Evaluation Time: 1.00000000 years

Th-230	5.75E-17	5.75E-17
Ra-226	1.45E-20	1.45E-20
Pb-210	5.41E-23	5.41E-23

Source: 4

Nuclide	Receptor 1	Total
Ac-227	3.53E-06	3.53E-06
Pa-231	4.46E-06	4.46E-06
Ac-227	1.72E-07	1.72E-07
Pb-210	2.96E-07	2.96E-07
Ra-226	2.12E-06	2.12E-06
Pb-210	1.42E-08	1.42E-08
Ra-228	7.40E-07	7.40E-07
Th-228	2.49E-05	2.49E-05
Th-228	3.86E-05	3.86E-05
Th-230	1.90E-06	1.90E-06
Ra-226	1.37E-09	1.37E-09
Pb-210	4.82E-12	4.82E-12
Th-232	2.25E-06	2.25E-06
Ra-228	1.46E-07	1.46E-07
Th-228	2.62E-06	2.62E-06
U-234	2.05E-07	2.05E-07
Th-230	2.62E-11	2.62E-11
Ra-226	9.83E-15	9.83E-15
Pb-210	2.38E-17	2.38E-17
U-235	2.76E-07	2.76E-07
Pa-231	1.42E-10	1.42E-10
Ac-227	2.86E-12	2.86E-12
U-238	2.49E-07	2.49E-07
U-234	8.69E-13	8.69E-13
Th-230	5.75E-17	5.75E-17
Ra-226	1.45E-20	1.45E-20
Pb-210	5.41E-23	5.41E-23

Source: 5

Nuclide	Receptor 1	Total
Ac-227	3.53E-06	3.53E-06
Pa-231	4.46E-06	4.46E-06
Ac-227	1.72E-07	1.72E-07
Pb-210	2.96E-07	2.96E-07
Ra-226	2.12E-06	2.12E-06

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:45:31 Page: 19 **
Title : SLDS DCGL Resident
Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld
Evaluation Time: 1.00000000 years

Pb-210	1.42E-08	1.42E-08
Ra-228	7.40E-07	7.40E-07
Th-228	2.49E-05	2.49E-05
Th-228	3.86E-05	3.86E-05
Th-230	1.90E-06	1.90E-06
Ra-226	1.37E-09	1.37E-09
Pb-210	4.82E-12	4.82E-12
Th-232	2.25E-06	2.25E-06
Ra-228	1.46E-07	1.46E-07
Th-228	2.62E-06	2.62E-06
U-234	2.05E-07	2.05E-07
Th-230	2.62E-11	2.62E-11
Ra-226	9.83E-15	9.83E-15
Pb-210	2.38E-17	2.38E-17
U-235	2.76E-07	2.76E-07
Pa-231	1.42E-10	1.42E-10
Ac-227	2.86E-12	2.86E-12
U-238	2.49E-07	2.49E-07
U-234	8.69E-13	8.69E-13
Th-230	5.75E-17	5.75E-17
Ra-226	1.45E-20	1.45E-20
Pb-210	5.41E-23	5.41E-23

RESRAD-BUILD Dose Tables

Source Contributions to Receptor Doses

```
[mrem]
```

	Source 1	Source 2	Source 3	Source 4	Source 5	Total
Receptor 1	4.47E-04	8.20E-05	8.20E-05	8.20E-05	8.20E-05	7.75E-04
Total	4.47E-04	8.20E-05	8.20E-05	8.20E-05	8.20E-05	7.75E-04

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:45:31 Page: 21 **

Title : SLDS DCGL Resident

Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld

Evaluation Time: 3.00000000 years

Pathway Detail of Doses

[mrem]

Source: 1	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	5.04E-05	7.15E-05	5.85E-10	1.10E-10	8.68E-07	3.24E-04	0.00E+00	4.47E-04
Total	5.04E-05	7.15E-05	5.85E-10	1.10E-10	8.68E-07	3.24E-04	0.00E+00	4.47E-04

Source: 2	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	2.75E-06	1.43E-05	1.17E-10	2.21E-11	1.74E-07	6.48E-05	0.00E+00	8.20E-05
Total	2.75E-06	1.43E-05	1.17E-10	2.21E-11	1.74E-07	6.48E-05	0.00E+00	8.20E-05

Source: 3	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	2.75E-06	1.43E-05	1.17E-10	2.21E-11	1.74E-07	6.48E-05	0.00E+00	8.20E-05
Total	2.75E-06	1.43E-05	1.17E-10	2.21E-11	1.74E-07	6.48E-05	0.00E+00	8.20E-05

Source: 4	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	2.75E-06	1.43E-05	1.17E-10	2.21E-11	1.74E-07	6.48E-05	0.00E+00	8.20E-05
Total	2.75E-06	1.43E-05	1.17E-10	2.21E-11	1.74E-07	6.48E-05	0.00E+00	8.20E-05

Source: 5	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	2.75E-06	1.43E-05	1.17E-10	2.21E-11	1.74E-07	6.48E-05	0.00E+00	8.20E-05
Total	2.75E-06	1.43E-05	1.17E-10	2.21E-11	1.74E-07	6.48E-05	0.00E+00	8.20E-05

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:45:31 Page: 22 **
 Title : SLDS DCGL Resident
 Input File : C:\RESRAD Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld
 Evaluation Time: 3.00000000 years

Nuclide Detail of Doses

[mrem]

Source: 1

Nuclide	Receptor 1	Total
Ac-227	2.02E-05	2.02E-05
Pa-231	2.28E-05	2.28E-05
Ac-227	2.38E-06	2.38E-06
Pb-210	1.68E-06	1.68E-06
Ra-226	2.30E-05	2.30E-05
Pb-210	1.94E-07	1.94E-07
Ra-228	7.14E-06	7.14E-06
Th-228	1.89E-04	1.89E-04
Th-228	9.57E-05	9.57E-05
Th-230	9.51E-06	9.51E-06
Ra-226	3.49E-08	3.49E-08
Pb-210	1.51E-10	1.51E-10
Th-232	1.13E-05	1.13E-05
Ra-228	3.74E-06	3.74E-06
Th-228	5.34E-05	5.34E-05
U-234	1.04E-06	1.04E-06
Th-230	3.06E-10	3.06E-10
Ra-226	5.66E-13	5.66E-13
Pb-210	1.65E-15	1.65E-15
U-235	2.91E-06	2.91E-06
Pa-231	1.69E-09	1.69E-09
Ac-227	9.03E-11	9.03E-11
U-238	2.22E-06	2.22E-06
U-234	1.03E-11	1.03E-11
Th-230	1.52E-15	1.52E-15
Ra-226	1.89E-18	1.89E-18
Pb-210	4.33E-21	4.33E-21

Source: 2

Nuclide	Receptor 1	Total
Ac-227	3.31E-06	3.31E-06
Pa-231	4.46E-06	4.46E-06
Ac-227	3.90E-07	3.90E-07
Pb-210	2.78E-07	2.78E-07
Ra-226	2.10E-06	2.10E-06
Pb-210	3.21E-08	3.21E-08

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:45:31 Page: 23 **

Title : SLDS DCGL Resident

Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld

Evaluation Time: 3.00000000 years

Ra-228	5.79E-07	5.79E-07
Th-228	3.68E-05	3.68E-05
Th-228	1.86E-05	1.86E-05
Th-230	1.90E-06	1.90E-06
Ra-226	3.19E-09	3.19E-09
Pb-210	2.49E-11	2.49E-11
Th-232	2.25E-06	2.25E-06
Ra-228	3.03E-07	3.03E-07
Th-228	1.04E-05	1.04E-05
U-234	2.05E-07	2.05E-07
Th-230	6.11E-11	6.11E-11
Ra-226	5.16E-14	5.16E-14
Pb-210	2.74E-16	2.74E-16
U-235	2.75E-07	2.75E-07
Pa-231	3.30E-10	3.30E-10
Ac-227	1.48E-11	1.48E-11
U-238	2.48E-07	2.48E-07
U-234	2.03E-12	2.03E-12
Th-230	3.04E-16	3.04E-16
Ra-226	1.72E-19	1.72E-19
Pb-210	6.83E-22	6.83E-22

Source: 3

Nuclide	Receptor 1	Total
Ac-227	3.31E-06	3.31E-06
Pa-231	4.46E-06	4.46E-06
Ac-227	3.90E-07	3.90E-07
Pb-210	2.78E-07	2.78E-07
Ra-226	2.10E-06	2.10E-06
Pb-210	3.21E-08	3.21E-08
Ra-228	5.79E-07	5.79E-07
Th-228	3.68E-05	3.68E-05
Th-228	1.86E-05	1.86E-05
Th-230	1.90E-06	1.90E-06
Ra-226	3.19E-09	3.19E-09
Pb-210	2.49E-11	2.49E-11
Th-232	2.25E-06	2.25E-06
Ra-228	3.03E-07	3.03E-07
Th-228	1.04E-05	1.04E-05
U-234	2.05E-07	2.05E-07
Th-230	6.11E-11	6.11E-11
Ra-226	5.16E-14	5.16E-14
Pb-210	2.74E-16	2.74E-16
U-235	2.75E-07	2.75E-07
Pa-231	3.30E-10	3.30E-10
Ac-227	1.48E-11	1.48E-11
U-238	2.48E-07	2.48E-07
U-234	2.03E-12	2.03E-12

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:45:31 Page: 24 **

Title : SLDS DCGL Resident

Input File : C:\RESRAD Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld

Evaluation Time: 3.00000000 years

Th-230	3.04E-16	3.04E-16
Ra-226	1.72E-19	1.72E-19
Pb-210	6.83E-22	6.83E-22

Source: 4

Nuclide	Receptor	Total
	1	
Ac-227	3.31E-06	3.31E-06
Pa-231	4.46E-06	4.46E-06
Ac-227	3.90E-07	3.90E-07
Pb-210	2.78E-07	2.78E-07
Ra-226	2.10E-06	2.10E-06
Pb-210	3.21E-08	3.21E-08
Ra-228	5.79E-07	5.79E-07
Th-228	3.68E-05	3.68E-05
Th-228	1.86E-05	1.86E-05
Th-230	1.90E-06	1.90E-06
Ra-226	3.19E-09	3.19E-09
Pb-210	2.49E-11	2.49E-11
Th-232	2.25E-06	2.25E-06
Ra-228	3.03E-07	3.03E-07
Th-228	1.04E-05	1.04E-05
U-234	2.05E-07	2.05E-07
Th-230	6.11E-11	6.11E-11
Ra-226	5.16E-14	5.16E-14
Pb-210	2.74E-16	2.74E-16
U-235	2.75E-07	2.75E-07
Pa-231	3.30E-10	3.30E-10
Ac-227	1.48E-11	1.48E-11
U-238	2.48E-07	2.48E-07
U-234	2.03E-12	2.03E-12
Th-230	3.04E-16	3.04E-16
Ra-226	1.72E-19	1.72E-19
Pb-210	6.83E-22	6.83E-22

Source: 5

Nuclide	Receptor	Total
	1	
Ac-227	3.31E-06	3.31E-06
Pa-231	4.46E-06	4.46E-06
Ac-227	3.90E-07	3.90E-07
Pb-210	2.78E-07	2.78E-07
Ra-226	2.10E-06	2.10E-06

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:45:31 Page: 25 **

Title : SLDS DCGL Resident

Input File : C:\RESRAD Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld

Evaluation Time: 3.00000000 years

Pb-210	3.21E-08	3.21E-08
Ra-228	5.79E-07	5.79E-07
Th-228	3.68E-05	3.68E-05
Th-228	1.86E-05	1.86E-05
Th-230	1.90E-06	1.90E-06
Ra-226	3.19E-09	3.19E-09
Pb-210	2.49E-11	2.49E-11
Th-232	2.25E-06	2.25E-06
Ra-228	3.03E-07	3.03E-07
Th-228	1.04E-05	1.04E-05
U-234	2.05E-07	2.05E-07
Th-230	6.11E-11	6.11E-11
Ra-226	5.16E-14	5.16E-14
Pb-210	2.74E-16	2.74E-16
U-235	2.75E-07	2.75E-07
Pa-231	3.30E-10	3.30E-10
Ac-227	1.48E-11	1.48E-11
U-238	2.48E-07	2.48E-07
U-234	2.03E-12	2.03E-12
Th-230	3.04E-16	3.04E-16
Ra-226	1.72E-19	1.72E-19
Pb-210	6.83E-22	6.83E-22

RESRAD-BUILD Dose Tables

```
[mrem]
```

	Source 1	Source 2	Source 3	Source 4	Source 5	Total
Receptor 1	4.37E-04	8.03E-05	8.03E-05	8.03E-05	8.03E-05	7.58E-04
Total	4.37E-04	8.03E-05	8.03E-05	8.03E-05	8.03E-05	7.58E-04

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:45:31 Page: 27 **
 Title : SLDS DCGL Resident
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld
 Evaluation Time: 10.0000000 years

Pathway Detail of Doses

[mrem]

Source: 1	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	4.91E-05	7.15E-05	5.85E-10	1.10E-10	8.68E-07	3.16E-04	0.00E+00	4.37E-04
Total	4.91E-05	7.15E-05	5.85E-10	1.10E-10	8.68E-07	3.16E-04	0.00E+00	4.37E-04

Source: 2	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	2.68E-06	1.43E-05	1.17E-10	2.21E-11	1.74E-07	6.31E-05	0.00E+00	8.03E-05
Total	2.68E-06	1.43E-05	1.17E-10	2.21E-11	1.74E-07	6.31E-05	0.00E+00	8.03E-05

Source: 3	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	2.68E-06	1.43E-05	1.17E-10	2.21E-11	1.74E-07	6.31E-05	0.00E+00	8.03E-05
Total	2.68E-06	1.43E-05	1.17E-10	2.21E-11	1.74E-07	6.31E-05	0.00E+00	8.03E-05

Source: 4	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	2.68E-06	1.43E-05	1.17E-10	2.21E-11	1.74E-07	6.31E-05	0.00E+00	8.03E-05
Total	2.68E-06	1.43E-05	1.17E-10	2.21E-11	1.74E-07	6.31E-05	0.00E+00	8.03E-05

Source: 5	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	2.68E-06	1.43E-05	1.17E-10	2.21E-11	1.74E-07	6.31E-05	0.00E+00	8.03E-05
Total	2.68E-06	1.43E-05	1.17E-10	2.21E-11	1.74E-07	6.31E-05	0.00E+00	8.03E-05

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:45:31 Page: 28 **
 Title : SLDS DCGL Resident
 Input File : C:\RESRAD Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld
 Evaluation Time: 10.0000000 years

Nuclide Detail of Doses

[mrem]

Source: 1

Nuclide	Receptor 1	Total
Ac-227	1.61E-05	1.61E-05
Pa-231	2.28E-05	2.28E-05
Ac-227	6.37E-06	6.37E-06
Pb-210	1.34E-06	1.34E-06
Ra-226	2.24E-05	2.24E-05
Pb-210	5.20E-07	5.20E-07
Ra-228	3.00E-06	3.00E-06
Th-228	1.28E-04	1.28E-04
Th-228	7.37E-06	7.37E-06
Th-230	9.51E-06	9.51E-06
Ra-226	1.02E-07	1.02E-07
Pb-210	1.25E-09	1.25E-09
Th-232	1.13E-05	1.13E-05
Ra-228	7.64E-06	7.64E-06
Th-228	1.94E-04	1.94E-04
U-234	1.04E-06	1.04E-06
Th-230	9.18E-10	9.18E-10
Ra-226	4.93E-12	4.93E-12
Pb-210	4.14E-14	4.14E-14
U-235	2.86E-06	2.86E-06
Pa-231	5.07E-09	5.07E-09
Ac-227	7.48E-10	7.48E-10
U-238	2.19E-06	2.19E-06
U-234	3.09E-11	3.09E-11
Th-230	1.36E-14	1.36E-14
Ra-226	4.88E-17	4.88E-17
Pb-210	3.13E-19	3.13E-19

Source: 2

Nuclide	Receptor 1	Total
Ac-227	2.64E-06	2.64E-06
Pa-231	4.46E-06	4.46E-06
Ac-227	1.05E-06	1.05E-06
Pb-210	2.23E-07	2.23E-07
Ra-226	2.05E-06	2.05E-06
Pb-210	8.64E-08	8.64E-08

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:45:31 Page: 29 **

Title : SLDS DCGL Resident

Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld

Evaluation Time: 10.0000000 years

Ra-228	2.46E-07	2.46E-07
Th-228	2.49E-05	2.49E-05
Th-228	1.43E-06	1.43E-06
Th-230	1.90E-06	1.90E-06
Ra-226	9.32E-09	9.32E-09
Pb-210	2.08E-10	2.08E-10
Th-232	2.25E-06	2.25E-06
Ra-228	6.24E-07	6.24E-07
Th-228	3.77E-05	3.77E-05
U-234	2.05E-07	2.05E-07
Th-230	1.83E-10	1.83E-10
Ra-226	4.51E-13	4.51E-13
Pb-210	6.87E-15	6.87E-15
U-235	2.73E-07	2.73E-07
Pa-231	9.91E-10	9.91E-10
Ac-227	1.23E-10	1.23E-10
U-238	2.46E-07	2.46E-07
U-234	6.09E-12	6.09E-12
Th-230	2.72E-15	2.72E-15
Ra-226	4.46E-18	4.46E-18
Pb-210	5.19E-20	5.19E-20

Source: 3

Nuclide	Receptor 1	Total
Ac-227	2.64E-06	2.64E-06
Pa-231	4.46E-06	4.46E-06
Ac-227	1.05E-06	1.05E-06
Pb-210	2.23E-07	2.23E-07
Ra-226	2.05E-06	2.05E-06
Pb-210	8.64E-08	8.64E-08
Ra-228	2.46E-07	2.46E-07
Th-228	2.49E-05	2.49E-05
Th-228	1.43E-06	1.43E-06
Th-230	1.90E-06	1.90E-06
Ra-226	9.32E-09	9.32E-09
Pb-210	2.08E-10	2.08E-10
Th-232	2.25E-06	2.25E-06
Ra-228	6.24E-07	6.24E-07
Th-228	3.77E-05	3.77E-05
U-234	2.05E-07	2.05E-07
Th-230	1.83E-10	1.83E-10
Ra-226	4.51E-13	4.51E-13
Pb-210	6.87E-15	6.87E-15
U-235	2.73E-07	2.73E-07
Pa-231	9.91E-10	9.91E-10
Ac-227	1.23E-10	1.23E-10
U-238	2.46E-07	2.46E-07
U-234	6.09E-12	6.09E-12

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:45:31 Page: 30 **

Title : SLDS DCGL Resident

Input File : C:\RESRAD Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld

Evaluation Time: 10.0000000 years

Th-230	2.72E-15	2.72E-15
Ra-226	4.46E-18	4.46E-18
Pb-210	5.19E-20	5.19E-20

Source: 4

Nuclide	Receptor	Total
	1	
Ac-227	2.64E-06	2.64E-06
Pa-231	4.46E-06	4.46E-06
Ac-227	1.05E-06	1.05E-06
Pb-210	2.23E-07	2.23E-07
Ra-226	2.05E-06	2.05E-06
Pb-210	8.64E-08	8.64E-08
Ra-228	2.46E-07	2.46E-07
Th-228	2.49E-05	2.49E-05
Th-228	1.43E-06	1.43E-06
Th-230	1.90E-06	1.90E-06
Ra-226	9.32E-09	9.32E-09
Pb-210	2.08E-10	2.08E-10
Th-232	2.25E-06	2.25E-06
Ra-228	6.24E-07	6.24E-07
Th-228	3.77E-05	3.77E-05
U-234	2.05E-07	2.05E-07
Th-230	1.83E-10	1.83E-10
Ra-226	4.51E-13	4.51E-13
Pb-210	6.87E-15	6.87E-15
U-235	2.73E-07	2.73E-07
Pa-231	9.91E-10	9.91E-10
Ac-227	1.23E-10	1.23E-10
U-238	2.46E-07	2.46E-07
U-234	6.09E-12	6.09E-12
Th-230	2.72E-15	2.72E-15
Ra-226	4.46E-18	4.46E-18
Pb-210	5.19E-20	5.19E-20

Source: 5

Nuclide	Receptor	Total
	1	
Ac-227	2.64E-06	2.64E-06
Pa-231	4.46E-06	4.46E-06
Ac-227	1.05E-06	1.05E-06
Pb-210	2.23E-07	2.23E-07
Ra-226	2.05E-06	2.05E-06

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:45:31 Page: 31 **
Title : SLDS DCGL Resident
Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld
Evaluation Time: 10.0000000 years

Pb-210	8.64E-08	8.64E-08
Ra-228	2.46E-07	2.46E-07
Th-228	2.49E-05	2.49E-05
Th-228	1.43E-06	1.43E-06
Th-230	1.90E-06	1.90E-06
Ra-226	9.32E-09	9.32E-09
Pb-210	2.08E-10	2.08E-10
Th-232	2.25E-06	2.25E-06
Ra-228	6.24E-07	6.24E-07
Th-228	3.77E-05	3.77E-05
U-234	2.05E-07	2.05E-07
Th-230	1.83E-10	1.83E-10
Ra-226	4.51E-13	4.51E-13
Pb-210	6.87E-15	6.87E-15
U-235	2.73E-07	2.73E-07
Pa-231	9.91E-10	9.91E-10
Ac-227	1.23E-10	1.23E-10
U-238	2.46E-07	2.46E-07
U-234	6.09E-12	6.09E-12
Th-230	2.72E-15	2.72E-15
Ra-226	4.46E-18	4.46E-18
Pb-210	5.19E-20	5.19E-20

RESRAD-BUILD Dose Tables

```
[mrem]
```

	Source 1	Source 2	Source 3	Source 4	Source 5	Total
Receptor 1	4.23E-04	7.78E-05	7.78E-05	7.78E-05	7.78E-05	7.34E-04
Total	4.23E-04	7.78E-05	7.78E-05	7.78E-05	7.78E-05	7.34E-04

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:45:31 Page: 33 **

Title : SLDS DCGL Resident

Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld

Evaluation Time: 20.0000000 years

Pathway Detail of Doses

[mrem]

Source: 1	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	4.73E-05	7.15E-05	5.85E-10	1.10E-10	8.68E-07	3.04E-04	0.00E+00	4.23E-04
Total	4.73E-05	7.15E-05	5.85E-10	1.10E-10	8.68E-07	3.04E-04	0.00E+00	4.23E-04
Source: 2	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	2.58E-06	1.43E-05	1.17E-10	2.21E-11	1.74E-07	6.07E-05	0.00E+00	7.78E-05
Total	2.58E-06	1.43E-05	1.17E-10	2.21E-11	1.74E-07	6.07E-05	0.00E+00	7.78E-05
Source: 3	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	2.58E-06	1.43E-05	1.17E-10	2.21E-11	1.74E-07	6.07E-05	0.00E+00	7.78E-05
Total	2.58E-06	1.43E-05	1.17E-10	2.21E-11	1.74E-07	6.07E-05	0.00E+00	7.78E-05
Source: 4	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	2.58E-06	1.43E-05	1.17E-10	2.21E-11	1.74E-07	6.07E-05	0.00E+00	7.78E-05
Total	2.58E-06	1.43E-05	1.17E-10	2.21E-11	1.74E-07	6.07E-05	0.00E+00	7.78E-05
Source: 5	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	2.58E-06	1.43E-05	1.17E-10	2.21E-11	1.74E-07	6.07E-05	0.00E+00	7.78E-05
Total	2.58E-06	1.43E-05	1.17E-10	2.21E-11	1.74E-07	6.07E-05	0.00E+00	7.78E-05

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:45:31 Page: 34 **
 Title : SLDS DCGL Resident
 Input File : C:\RESRAD Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld
 Evaluation Time: 20.0000000 years

Nuclide Detail of Doses

[mrem]

Source: 1

Nuclide	Receptor 1	Total
Ac-227	1.16E-05	1.16E-05
Pa-231	2.28E-05	2.28E-05
Ac-227	1.06E-05	1.06E-05
Pb-210	9.75E-07	9.75E-07
Ra-226	2.15E-05	2.15E-05
Pb-210	8.70E-07	8.70E-07
Ra-228	8.72E-07	8.72E-07
Th-228	3.99E-05	3.99E-05
Th-228	1.89E-07	1.89E-07
Th-230	9.50E-06	9.50E-06
Ra-226	1.92E-07	1.92E-07
Pb-210	4.28E-09	4.28E-09
Th-232	1.13E-05	1.13E-05
Ra-228	9.44E-06	9.44E-06
Th-228	2.78E-04	2.78E-04
U-234	1.04E-06	1.04E-06
Th-230	1.79E-09	1.79E-09
Ra-226	1.81E-11	1.81E-11
Pb-210	2.83E-13	2.83E-13
U-235	2.78E-06	2.78E-06
Pa-231	9.88E-09	9.88E-09
Ac-227	2.56E-09	2.56E-09
U-238	2.14E-06	2.14E-06
U-234	6.04E-11	6.04E-11
Th-230	5.19E-14	5.19E-14
Ra-226	3.49E-16	3.49E-16
Pb-210	4.22E-18	4.22E-18

Source: 2

Nuclide	Receptor 1	Total
Ac-227	1.92E-06	1.92E-06
Pa-231	4.46E-06	4.46E-06
Ac-227	1.76E-06	1.76E-06
Pb-210	1.63E-07	1.63E-07
Ra-226	1.97E-06	1.97E-06
Pb-210	1.45E-07	1.45E-07

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:45:31 Page: 35 **

Title : SLDS DCGL Resident

Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld

Evaluation Time: 20.0000000 years

Ra-228	7.20E-08	7.20E-08
Th-228	7.75E-06	7.75E-06
Th-228	3.66E-08	3.66E-08
Th-230	1.90E-06	1.90E-06
Ra-226	1.75E-08	1.75E-08
Pb-210	7.15E-10	7.15E-10
Th-232	2.25E-06	2.25E-06
Ra-228	7.80E-07	7.80E-07
Th-228	5.38E-05	5.38E-05
U-234	2.05E-07	2.05E-07
Th-230	3.58E-10	3.58E-10
Ra-226	1.66E-12	1.66E-12
Pb-210	4.73E-14	4.73E-14
U-235	2.69E-07	2.69E-07
Pa-231	1.93E-09	1.93E-09
Ac-227	4.24E-10	4.24E-10
U-238	2.44E-07	2.44E-07
U-234	1.19E-11	1.19E-11
Th-230	1.04E-14	1.04E-14
Ra-226	3.20E-17	3.20E-17
Pb-210	7.06E-19	7.06E-19

Source: 3

Nuclide	Receptor 1	Total
Ac-227	1.92E-06	1.92E-06
Pa-231	4.46E-06	4.46E-06
Ac-227	1.76E-06	1.76E-06
Pb-210	1.63E-07	1.63E-07
Ra-226	1.97E-06	1.97E-06
Pb-210	1.45E-07	1.45E-07
Ra-228	7.20E-08	7.20E-08
Th-228	7.75E-06	7.75E-06
Th-228	3.66E-08	3.66E-08
Th-230	1.90E-06	1.90E-06
Ra-226	1.75E-08	1.75E-08
Pb-210	7.15E-10	7.15E-10
Th-232	2.25E-06	2.25E-06
Ra-228	7.80E-07	7.80E-07
Th-228	5.38E-05	5.38E-05
U-234	2.05E-07	2.05E-07
Th-230	3.58E-10	3.58E-10
Ra-226	1.66E-12	1.66E-12
Pb-210	4.73E-14	4.73E-14
U-235	2.69E-07	2.69E-07
Pa-231	1.93E-09	1.93E-09
Ac-227	4.24E-10	4.24E-10
U-238	2.44E-07	2.44E-07
U-234	1.19E-11	1.19E-11

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:45:31 Page: 36 **

Title : SLDS DCGL Resident

Input File : C:\RESRAD Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld

Evaluation Time: 20.0000000 years

Th-230	1.04E-14	1.04E-14
Ra-226	3.20E-17	3.20E-17
Pb-210	7.06E-19	7.06E-19

Source: 4

Nuclide	Receptor	Total
	1	
Ac-227	1.92E-06	1.92E-06
Pa-231	4.46E-06	4.46E-06
Ac-227	1.76E-06	1.76E-06
Pb-210	1.63E-07	1.63E-07
Ra-226	1.97E-06	1.97E-06
Pb-210	1.45E-07	1.45E-07
Ra-228	7.20E-08	7.20E-08
Th-228	7.75E-06	7.75E-06
Th-228	3.66E-08	3.66E-08
Th-230	1.90E-06	1.90E-06
Ra-226	1.75E-08	1.75E-08
Pb-210	7.15E-10	7.15E-10
Th-232	2.25E-06	2.25E-06
Ra-228	7.80E-07	7.80E-07
Th-228	5.38E-05	5.38E-05
U-234	2.05E-07	2.05E-07
Th-230	3.58E-10	3.58E-10
Ra-226	1.66E-12	1.66E-12
Pb-210	4.73E-14	4.73E-14
U-235	2.69E-07	2.69E-07
Pa-231	1.93E-09	1.93E-09
Ac-227	4.24E-10	4.24E-10
U-238	2.44E-07	2.44E-07
U-234	1.19E-11	1.19E-11
Th-230	1.04E-14	1.04E-14
Ra-226	3.20E-17	3.20E-17
Pb-210	7.06E-19	7.06E-19

Source: 5

Nuclide	Receptor	Total
	1	
Ac-227	1.92E-06	1.92E-06
Pa-231	4.46E-06	4.46E-06
Ac-227	1.76E-06	1.76E-06
Pb-210	1.63E-07	1.63E-07
Ra-226	1.97E-06	1.97E-06

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:45:31 Page: 37 **
Title : SLDS DCGL Resident
Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld
Evaluation Time: 20.0000000 years

Pb-210	1.45E-07	1.45E-07
Ra-228	7.20E-08	7.20E-08
Th-228	7.75E-06	7.75E-06
Th-228	3.66E-08	3.66E-08
Th-230	1.90E-06	1.90E-06
Ra-226	1.75E-08	1.75E-08
Pb-210	7.15E-10	7.15E-10
Th-232	2.25E-06	2.25E-06
Ra-228	7.80E-07	7.80E-07
Th-228	5.38E-05	5.38E-05
U-234	2.05E-07	2.05E-07
Th-230	3.58E-10	3.58E-10
Ra-226	1.66E-12	1.66E-12
Pb-210	4.73E-14	4.73E-14
U-235	2.69E-07	2.69E-07
Pa-231	1.93E-09	1.93E-09
Ac-227	4.24E-10	4.24E-10
U-238	2.44E-07	2.44E-07
U-234	1.19E-11	1.19E-11
Th-230	1.04E-14	1.04E-14
Ra-226	3.20E-17	3.20E-17
Pb-210	7.06E-19	7.06E-19

RESRAD-BUILD Dose Tables

```
[mrem]
```

	Source 1	Source 2	Source 3	Source 4	Source 5	Total
Receptor 1	3.41E-04	6.16E-05	6.16E-05	6.16E-05	6.16E-05	5.88E-04
Total	3.41E-04	6.16E-05	6.16E-05	6.16E-05	6.16E-05	5.88E-04

Final Status Survey Plan for Soil, Structures, and Sediment at the St. Louis FUSRAP Sites

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:45:31 Page: 39 **

Title : SLDS DCGL Resident

Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld

Evaluation Time: 30.0000000 years

Pathway Detail of Doses

[mrem]

Source: 1								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	4.60E-05	9.01E-17	1.78E-21	1.39E-22	2.65E-18	2.95E-04	0.00E+00	3.41E-04
Total	4.60E-05	9.01E-17	1.78E-21	1.39E-22	2.65E-18	2.95E-04	0.00E+00	3.41E-04
Source: 2								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	2.51E-06	1.80E-17	3.57E-22	2.78E-23	5.30E-19	5.91E-05	0.00E+00	6.16E-05
Total	2.51E-06	1.80E-17	3.57E-22	2.78E-23	5.30E-19	5.91E-05	0.00E+00	6.16E-05
Source: 3								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	2.51E-06	1.80E-17	3.57E-22	2.78E-23	5.30E-19	5.91E-05	0.00E+00	6.16E-05
Total	2.51E-06	1.80E-17	3.57E-22	2.78E-23	5.30E-19	5.91E-05	0.00E+00	6.16E-05
Source: 4								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	2.51E-06	1.80E-17	3.57E-22	2.78E-23	5.30E-19	5.91E-05	0.00E+00	6.16E-05
Total	2.51E-06	1.80E-17	3.57E-22	2.78E-23	5.30E-19	5.91E-05	0.00E+00	6.16E-05
Source: 5								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	2.51E-06	1.80E-17	3.57E-22	2.78E-23	5.30E-19	5.91E-05	0.00E+00	6.16E-05
Total	2.51E-06	1.80E-17	3.57E-22	2.78E-23	5.30E-19	5.91E-05	0.00E+00	6.16E-05

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:45:31 Page: 40 **
 Title : SLDS DCGL Resident
 Input File : C:\RESRAD Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld
 Evaluation Time: 30.0000000 years

Nuclide Detail of Doses

[mrem]

Source: 1

Nuclide	Receptor 1	Total
Ac-227	1.90E-06	1.90E-06
Pa-231	5.58E-07	5.58E-07
Ac-227	3.12E-06	3.12E-06
Pb-210	1.53E-07	1.53E-07
Ra-226	1.97E-05	1.97E-05
Pb-210	2.41E-07	2.41E-07
Ra-228	2.06E-07	2.06E-07
Th-228	1.15E-05	1.15E-05
Th-228	4.81E-09	4.81E-09
Th-230	1.61E-08	1.61E-08
Ra-226	2.63E-07	2.63E-07
Pb-210	1.85E-09	1.85E-09
Th-232	1.28E-08	1.28E-08
Ra-228	7.94E-06	7.94E-06
Th-228	2.93E-04	2.93E-04
U-234	1.68E-08	1.68E-08
Th-230	4.52E-12	4.52E-12
Ra-226	3.69E-11	3.69E-11
Pb-210	1.86E-13	1.86E-13
U-235	1.81E-06	1.81E-06
Pa-231	3.60E-10	3.60E-10
Ac-227	1.17E-09	1.17E-09
U-238	1.22E-06	1.22E-06
U-234	1.44E-12	1.44E-12
Th-230	1.95E-16	1.95E-16
Ra-226	1.06E-15	1.06E-15
Pb-210	4.17E-18	4.17E-18

Source: 2

Nuclide	Receptor 1	Total
Ac-227	9.82E-08	9.82E-08
Pa-231	1.62E-08	1.62E-08
Ac-227	1.61E-07	1.61E-07
Pb-210	7.66E-09	7.66E-09
Ra-226	1.70E-06	1.70E-06
Pb-210	1.21E-08	1.21E-08

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:45:31 Page: 41 **

Title : SLDS DCGL Resident

Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld

Evaluation Time: 30.0000000 years

Ra-228	1.14E-08	1.14E-08
Th-228	2.24E-06	2.24E-06
Th-228	9.33E-10	9.33E-10
Th-230	2.04E-10	2.04E-10
Ra-226	2.25E-08	2.25E-08
Pb-210	9.27E-11	9.27E-11
Th-232	1.82E-10	1.82E-10
Ra-228	4.40E-07	4.40E-07
Th-228	5.67E-05	5.67E-05
U-234	1.98E-10	1.98E-10
Th-230	5.73E-14	5.73E-14
Ra-226	3.17E-12	3.17E-12
Pb-210	9.32E-15	9.32E-15
U-235	8.19E-08	8.19E-08
Pa-231	1.04E-11	1.04E-11
Ac-227	6.03E-11	6.03E-11
U-238	6.60E-08	6.60E-08
U-234	1.70E-14	1.70E-14
Th-230	2.47E-18	2.47E-18
Ra-226	9.11E-17	9.11E-17
Pb-210	2.10E-19	2.10E-19

Source: 3

Nuclide	Receptor 1	Total
Ac-227	9.82E-08	9.82E-08
Pa-231	1.62E-08	1.62E-08
Ac-227	1.61E-07	1.61E-07
Pb-210	7.66E-09	7.66E-09
Ra-226	1.70E-06	1.70E-06
Pb-210	1.21E-08	1.21E-08
Ra-228	1.14E-08	1.14E-08
Th-228	2.24E-06	2.24E-06
Th-228	9.33E-10	9.33E-10
Th-230	2.04E-10	2.04E-10
Ra-226	2.25E-08	2.25E-08
Pb-210	9.27E-11	9.27E-11
Th-232	1.82E-10	1.82E-10
Ra-228	4.40E-07	4.40E-07
Th-228	5.67E-05	5.67E-05
U-234	1.98E-10	1.98E-10
Th-230	5.73E-14	5.73E-14
Ra-226	3.17E-12	3.17E-12
Pb-210	9.32E-15	9.32E-15
U-235	8.19E-08	8.19E-08
Pa-231	1.04E-11	1.04E-11
Ac-227	6.03E-11	6.03E-11
U-238	6.60E-08	6.60E-08
U-234	1.70E-14	1.70E-14

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:45:31 Page: 42 **

Title : SLDS DCGL Resident

Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld

Evaluation Time: 30.0000000 years

Th-230	2.47E-18	2.47E-18
Ra-226	9.11E-17	9.11E-17
Pb-210	2.10E-19	2.10E-19

Source: 4

Nuclide	Receptor	Total
	1	
Ac-227	9.82E-08	9.82E-08
Pa-231	1.62E-08	1.62E-08
Ac-227	1.61E-07	1.61E-07
Pb-210	7.66E-09	7.66E-09
Ra-226	1.70E-06	1.70E-06
Pb-210	1.21E-08	1.21E-08
Ra-228	1.14E-08	1.14E-08
Th-228	2.24E-06	2.24E-06
Th-228	9.33E-10	9.33E-10
Th-230	2.04E-10	2.04E-10
Ra-226	2.25E-08	2.25E-08
Pb-210	9.27E-11	9.27E-11
Th-232	1.82E-10	1.82E-10
Ra-228	4.40E-07	4.40E-07
Th-228	5.67E-05	5.67E-05
U-234	1.98E-10	1.98E-10
Th-230	5.73E-14	5.73E-14
Ra-226	3.17E-12	3.17E-12
Pb-210	9.32E-15	9.32E-15
U-235	8.19E-08	8.19E-08
Pa-231	1.04E-11	1.04E-11
Ac-227	6.03E-11	6.03E-11
U-238	6.60E-08	6.60E-08
U-234	1.70E-14	1.70E-14
Th-230	2.47E-18	2.47E-18
Ra-226	9.11E-17	9.11E-17
Pb-210	2.10E-19	2.10E-19

Source: 5

Nuclide	Receptor	Total
	1	
Ac-227	9.82E-08	9.82E-08
Pa-231	1.62E-08	1.62E-08
Ac-227	1.61E-07	1.61E-07
Pb-210	7.66E-09	7.66E-09
Ra-226	1.70E-06	1.70E-06

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:45:31 Page: 43 **

Title : SLDS DCGL Resident

Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld

Evaluation Time: 30.0000000 years

Pb-210 1.21E-08 1.21E-08

Ra-228 1.14E-08 1.14E-08

Th-228 2.24E-06 2.24E-06

Th-228 9.33E-10 9.33E-10

Th-230 2.04E-10 2.04E-10

Ra-226 2.25E-08 2.25E-08

Pb-210 9.27E-11 9.27E-11

Th-232 1.82E-10 1.82E-10

Ra-228 4.40E-07 4.40E-07

Th-228 5.67E-05 5.67E-05

U-234 1.98E-10 1.98E-10

Th-230 5.73E-14 5.73E-14

Ra-226 3.17E-12 3.17E-12

Pb-210 9.32E-15 9.32E-15

U-235 8.19E-08 8.19E-08

Pa-231 1.04E-11 1.04E-11

Ac-227 6.03E-11 6.03E-11

U-238 6.60E-08 6.60E-08

U-234 1.70E-14 1.70E-14

Th-230 2.47E-18 2.47E-18

Ra-226 9.11E-17 9.11E-17

Pb-210 2.10E-19 2.10E-19

RESRAD-BUILD Dose Tables

```
[mrem]
```

	Source 1	Source 2	Source 3	Source 4	Source 5	Total
Receptor 1	3.41E-04	6.16E-05	6.16E-05	6.16E-05	6.16E-05	5.88E-04
Total	3.41E-04	6.16E-05	6.16E-05	6.16E-05	6.16E-05	5.88E-04

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:45:31 Page: 45 **

Title : SLDS DCGL Resident

Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld

Evaluation Time: 100.000008 years

Pathway Detail of Doses

[mrem]

Source: 1	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	4.60E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.95E-04	0.00E+00	3.41E-04
Total	4.60E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.95E-04	0.00E+00	3.41E-04

Source: 2	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	2.51E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.91E-05	0.00E+00	6.16E-05
Total	2.51E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.91E-05	0.00E+00	6.16E-05

Source: 3	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	2.51E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.91E-05	0.00E+00	6.16E-05
Total	2.51E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.91E-05	0.00E+00	6.16E-05

Source: 4	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	2.51E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.91E-05	0.00E+00	6.16E-05
Total	2.51E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.91E-05	0.00E+00	6.16E-05

Source: 5	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	2.51E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.91E-05	0.00E+00	6.16E-05
Total	2.51E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.91E-05	0.00E+00	6.16E-05

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:45:31 Page: 46 **
Title : SLDS DCGL Resident
Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld
Evaluation Time: 100.000008 years

Nuclide Detail of Doses

[mrem]

Source: 1

Nuclide	Receptor 1	Total
Ac-227	2.05E-07	2.05E-07
Pa-231	5.57E-07	5.57E-07
Ac-227	4.81E-06	4.81E-06
Pb-210	1.71E-08	1.71E-08
Ra-226	1.92E-05	1.92E-05
Pb-210	3.66E-07	3.66E-07
Ra-228	4.46E-11	4.46E-11
Th-228	2.50E-09	2.50E-09
Th-228	4.56E-20	4.56E-20
Th-230	1.61E-08	1.61E-08
Ra-226	8.52E-07	8.52E-07
Pb-210	1.18E-08	1.18E-08
Th-232	1.28E-08	1.28E-08
Ra-228	8.15E-06	8.15E-06
Th-228	3.04E-04	3.04E-04
U-234	1.68E-08	1.68E-08
Th-230	1.49E-11	1.49E-11
Ra-226	3.97E-10	3.97E-10
Pb-210	4.37E-12	4.37E-12
U-235	1.81E-06	1.81E-06
Pa-231	1.19E-09	1.19E-09
Ac-227	7.47E-09	7.47E-09
U-238	1.22E-06	1.22E-06
U-234	4.76E-12	4.76E-12
Th-230	2.11E-15	2.11E-15
Ra-226	3.77E-14	3.77E-14
Pb-210	3.48E-16	3.48E-16

Source: 2

Nuclide	Receptor 1	Total
Ac-227	1.06E-08	1.06E-08
Pa-231	1.62E-08	1.62E-08
Ac-227	2.48E-07	2.48E-07
Pb-210	8.61E-10	8.61E-10
Ra-226	1.64E-06	1.64E-06
Pb-210	1.84E-08	1.84E-08

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:45:31 Page: 47 **

Title : SLDS DCGL Resident

Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld

Evaluation Time: 100.000008 years

Ra-228	2.47E-12	2.47E-12
Th-228	4.84E-10	4.84E-10
Th-228	8.84E-21	8.84E-21
Th-230	2.04E-10	2.04E-10
Ra-226	7.32E-08	7.32E-08
Pb-210	5.90E-10	5.90E-10
Th-232	1.82E-10	1.82E-10
Ra-228	4.51E-07	4.51E-07
Th-228	5.90E-05	5.90E-05
U-234	1.98E-10	1.98E-10
Th-230	1.89E-13	1.89E-13
Ra-226	3.40E-11	3.40E-11
Pb-210	2.20E-13	2.20E-13
U-235	8.19E-08	8.19E-08
Pa-231	3.44E-11	3.44E-11
Ac-227	3.86E-10	3.86E-10
U-238	6.60E-08	6.60E-08
U-234	5.61E-14	5.61E-14
Th-230	2.68E-17	2.68E-17
Ra-226	3.23E-15	3.23E-15
Pb-210	1.75E-17	1.75E-17

Source: 3

Nuclide	Receptor 1	Total
Ac-227	1.06E-08	1.06E-08
Pa-231	1.62E-08	1.62E-08
Ac-227	2.48E-07	2.48E-07
Pb-210	8.61E-10	8.61E-10
Ra-226	1.64E-06	1.64E-06
Pb-210	1.84E-08	1.84E-08
Ra-228	2.47E-12	2.47E-12
Th-228	4.84E-10	4.84E-10
Th-228	8.84E-21	8.84E-21
Th-230	2.04E-10	2.04E-10
Ra-226	7.32E-08	7.32E-08
Pb-210	5.90E-10	5.90E-10
Th-232	1.82E-10	1.82E-10
Ra-228	4.51E-07	4.51E-07
Th-228	5.90E-05	5.90E-05
U-234	1.98E-10	1.98E-10
Th-230	1.89E-13	1.89E-13
Ra-226	3.40E-11	3.40E-11
Pb-210	2.20E-13	2.20E-13
U-235	8.19E-08	8.19E-08
Pa-231	3.44E-11	3.44E-11
Ac-227	3.86E-10	3.86E-10
U-238	6.60E-08	6.60E-08
U-234	5.61E-14	5.61E-14

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:45:31 Page: 48 **

Title : SLDS DCGL Resident

Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld

Evaluation Time: 100.000008 years

Th-230	2.68E-17	2.68E-17
Ra-226	3.23E-15	3.23E-15
Pb-210	1.75E-17	1.75E-17

Source: 4

Nuclide	Receptor	Total
	1	
Ac-227	1.06E-08	1.06E-08
Pa-231	1.62E-08	1.62E-08
Ac-227	2.48E-07	2.48E-07
Pb-210	8.61E-10	8.61E-10
Ra-226	1.64E-06	1.64E-06
Pb-210	1.84E-08	1.84E-08
Ra-228	2.47E-12	2.47E-12
Th-228	4.84E-10	4.84E-10
Th-228	8.84E-21	8.84E-21
Th-230	2.04E-10	2.04E-10
Ra-226	7.32E-08	7.32E-08
Pb-210	5.90E-10	5.90E-10
Th-232	1.82E-10	1.82E-10
Ra-228	4.51E-07	4.51E-07
Th-228	5.90E-05	5.90E-05
U-234	1.98E-10	1.98E-10
Th-230	1.89E-13	1.89E-13
Ra-226	3.40E-11	3.40E-11
Pb-210	2.20E-13	2.20E-13
U-235	8.19E-08	8.19E-08
Pa-231	3.44E-11	3.44E-11
Ac-227	3.86E-10	3.86E-10
U-238	6.60E-08	6.60E-08
U-234	5.61E-14	5.61E-14
Th-230	2.68E-17	2.68E-17
Ra-226	3.23E-15	3.23E-15
Pb-210	1.75E-17	1.75E-17

Source: 5

Nuclide	Receptor	Total
	1	
Ac-227	1.06E-08	1.06E-08
Pa-231	1.62E-08	1.62E-08
Ac-227	2.48E-07	2.48E-07
Pb-210	8.61E-10	8.61E-10
Ra-226	1.64E-06	1.64E-06

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:45:31 Page: 49 **

Title : SLDS DCGL Resident

Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld

Evaluation Time: 100.000008 years

Pb-210 1.84E-08 1.84E-08

Ra-228 2.47E-12 2.47E-12

Th-228 4.84E-10 4.84E-10

Th-228 8.84E-21 8.84E-21

Th-230 2.04E-10 2.04E-10

Ra-226 7.32E-08 7.32E-08

Pb-210 5.90E-10 5.90E-10

Th-232 1.82E-10 1.82E-10

Ra-228 4.51E-07 4.51E-07

Th-228 5.90E-05 5.90E-05

U-234 1.98E-10 1.98E-10

Th-230 1.89E-13 1.89E-13

Ra-226 3.40E-11 3.40E-11

Pb-210 2.20E-13 2.20E-13

U-235 8.19E-08 8.19E-08

Pa-231 3.44E-11 3.44E-11

Ac-227 3.86E-10 3.86E-10

U-238 6.60E-08 6.60E-08

U-234 5.61E-14 5.61E-14

Th-230 2.68E-17 2.68E-17

Ra-226 3.23E-15 3.23E-15

Pb-210 1.75E-17 1.75E-17

RESRAD-BUILD Dose Tables

```
[mrem]
```

	Source 1	Source 2	Source 3	Source 4	Source 5	Total
Receptor 1	3.41E-04	6.16E-05	6.16E-05	6.16E-05	6.16E-05	5.88E-04
Total	3.41E-04	6.16E-05	6.16E-05	6.16E-05	6.16E-05	5.88E-04

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:45:31 Page: 51 **

Title : SLDS DCGL Resident

Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld

Evaluation Time: 300.000031 years

Pathway Detail of Doses

[mrem]

Source: 1	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	4.60E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.95E-04	0.00E+00	3.41E-04
Total	4.60E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.95E-04	0.00E+00	3.41E-04
Source: 2	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	2.51E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.91E-05	0.00E+00	6.16E-05
Total	2.51E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.91E-05	0.00E+00	6.16E-05
Source: 3	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	2.51E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.91E-05	0.00E+00	6.16E-05
Total	2.51E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.91E-05	0.00E+00	6.16E-05
Source: 4	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	2.51E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.91E-05	0.00E+00	6.16E-05
Total	2.51E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.91E-05	0.00E+00	6.16E-05
Source: 5	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	2.51E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.91E-05	0.00E+00	6.16E-05
Total	2.51E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.91E-05	0.00E+00	6.16E-05

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:45:31 Page: 52 **
 Title : SLDS DCGL Resident
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld
 Evaluation Time: 300.000031 years

Nuclide Detail of Doses

[mrem]

Source: 1

Nuclide	Receptor 1	Total
Ac-227	3.52E-10	3.52E-10
Pa-231	5.55E-07	5.55E-07
Ac-227	4.99E-06	4.99E-06
Pb-210	3.33E-11	3.33E-11
Ra-226	1.76E-05	1.76E-05
Pb-210	3.52E-07	3.52E-07
Ra-228	1.51E-21	1.51E-21
Th-228	8.45E-20	8.45E-20
Th-228	0.00E+00	0.00E+00
Th-230	1.61E-08	1.61E-08
Ra-226	2.44E-06	2.44E-06
Pb-210	4.33E-08	4.33E-08
Th-232	1.28E-08	1.28E-08
Ra-228	8.15E-06	8.15E-06
Th-228	3.04E-04	3.04E-04
U-234	1.68E-08	1.68E-08
Th-230	4.45E-11	4.45E-11
Ra-226	3.44E-09	3.44E-09
Pb-210	5.53E-11	5.53E-11
U-235	1.81E-06	1.81E-06
Pa-231	3.54E-09	3.54E-09
Ac-227	2.85E-08	2.85E-08
U-238	1.22E-06	1.22E-06
U-234	1.42E-11	1.42E-11
Th-230	1.89E-14	1.89E-14
Ra-226	9.85E-13	9.85E-13
Pb-210	1.45E-14	1.45E-14

Source: 2

Nuclide	Receptor 1	Total
Ac-227	1.82E-11	1.82E-11
Pa-231	1.61E-08	1.61E-08
Ac-227	2.58E-07	2.58E-07
Pb-210	1.67E-12	1.67E-12
Ra-226	1.51E-06	1.51E-06
Pb-210	1.77E-08	1.77E-08

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:45:31 Page: 53 **

Title : SLDS DCGL Resident

Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld

Evaluation Time: 300.000031 years

Ra-228	8.36E-23	8.36E-23
Th-228	1.64E-20	1.64E-20
Th-228	0.00E+00	0.00E+00
Th-230	2.04E-10	2.04E-10
Ra-226	2.09E-07	2.09E-07
Pb-210	2.17E-09	2.17E-09
Th-232	1.82E-10	1.82E-10
Ra-228	4.51E-07	4.51E-07
Th-228	5.90E-05	5.90E-05
U-234	1.98E-10	1.98E-10
Th-230	5.63E-13	5.63E-13
Ra-226	2.96E-10	2.96E-10
Pb-210	2.78E-12	2.78E-12
U-235	8.19E-08	8.19E-08
Pa-231	1.03E-10	1.03E-10
Ac-227	1.47E-09	1.47E-09
U-238	6.60E-08	6.60E-08
U-234	1.68E-13	1.68E-13
Th-230	2.39E-16	2.39E-16
Ra-226	8.45E-14	8.45E-14
Pb-210	7.26E-16	7.26E-16

Source: 3

Nuclide	Receptor	Total
	1	
Ac-227	1.82E-11	1.82E-11
Pa-231	1.61E-08	1.61E-08
Ac-227	2.58E-07	2.58E-07
Pb-210	1.67E-12	1.67E-12
Ra-226	1.51E-06	1.51E-06
Pb-210	1.77E-08	1.77E-08
Ra-228	8.36E-23	8.36E-23
Th-228	1.64E-20	1.64E-20
Th-228	0.00E+00	0.00E+00
Th-230	2.04E-10	2.04E-10
Ra-226	2.09E-07	2.09E-07
Pb-210	2.17E-09	2.17E-09
Th-232	1.82E-10	1.82E-10
Ra-228	4.51E-07	4.51E-07
Th-228	5.90E-05	5.90E-05
U-234	1.98E-10	1.98E-10
Th-230	5.63E-13	5.63E-13
Ra-226	2.96E-10	2.96E-10
Pb-210	2.78E-12	2.78E-12
U-235	8.19E-08	8.19E-08
Pa-231	1.03E-10	1.03E-10
Ac-227	1.47E-09	1.47E-09
U-238	6.60E-08	6.60E-08
U-234	1.68E-13	1.68E-13

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:45:31 Page: 54 **

Title : SLDS DCGL Resident

Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld

Evaluation Time: 300.000031 years

Th-230	2.39E-16	2.39E-16
Ra-226	8.45E-14	8.45E-14
Pb-210	7.26E-16	7.26E-16

Source: 4

Nuclide	Receptor	Total
	1	
Ac-227	1.82E-11	1.82E-11
Pa-231	1.61E-08	1.61E-08
Ac-227	2.58E-07	2.58E-07
Pb-210	1.67E-12	1.67E-12
Ra-226	1.51E-06	1.51E-06
Pb-210	1.77E-08	1.77E-08
Ra-228	8.36E-23	8.36E-23
Th-228	1.64E-20	1.64E-20
Th-228	0.00E+00	0.00E+00
Th-230	2.04E-10	2.04E-10
Ra-226	2.09E-07	2.09E-07
Pb-210	2.17E-09	2.17E-09
Th-232	1.82E-10	1.82E-10
Ra-228	4.51E-07	4.51E-07
Th-228	5.90E-05	5.90E-05
U-234	1.98E-10	1.98E-10
Th-230	5.63E-13	5.63E-13
Ra-226	2.96E-10	2.96E-10
Pb-210	2.78E-12	2.78E-12
U-235	8.19E-08	8.19E-08
Pa-231	1.03E-10	1.03E-10
Ac-227	1.47E-09	1.47E-09
U-238	6.60E-08	6.60E-08
U-234	1.68E-13	1.68E-13
Th-230	2.39E-16	2.39E-16
Ra-226	8.45E-14	8.45E-14
Pb-210	7.26E-16	7.26E-16

Source: 5

Nuclide	Receptor	Total
	1	
Ac-227	1.82E-11	1.82E-11
Pa-231	1.61E-08	1.61E-08
Ac-227	2.58E-07	2.58E-07
Pb-210	1.67E-12	1.67E-12
Ra-226	1.51E-06	1.51E-06

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:45:31 Page: 55 **

Title : SLDS DCGL Resident

Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld

Evaluation Time: 300.000031 years

Pb-210 1.77E-08 1.77E-08

Ra-228 8.36E-23 8.36E-23

Th-228 1.64E-20 1.64E-20

Th-228 0.00E+00 0.00E+00

Th-230 2.04E-10 2.04E-10

Ra-226 2.09E-07 2.09E-07

Pb-210 2.17E-09 2.17E-09

Th-232 1.82E-10 1.82E-10

Ra-228 4.51E-07 4.51E-07

Th-228 5.90E-05 5.90E-05

U-234 1.98E-10 1.98E-10

Th-230 5.63E-13 5.63E-13

Ra-226 2.96E-10 2.96E-10

Pb-210 2.78E-12 2.78E-12

U-235 8.19E-08 8.19E-08

Pa-231 1.03E-10 1.03E-10

Ac-227 1.47E-09 1.47E-09

U-238 6.60E-08 6.60E-08

U-234 1.68E-13 1.68E-13

Th-230 2.39E-16 2.39E-16

Ra-226 8.45E-14 8.45E-14

Pb-210 7.26E-16 7.26E-16

RESRAD-BUILD Dose Tables

```
[mrem]
```

	Source 1	Source 2	Source 3	Source 4	Source 5	Total
Receptor 1	3.41E-04	6.16E-05	6.16E-05	6.16E-05	6.16E-05	5.88E-04
Total	3.41E-04	6.16E-05	6.16E-05	6.16E-05	6.16E-05	5.88E-04

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:45:31 Page: 57 **

Title : SLDS DCGL Resident

Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld

Evaluation Time: 1000.00000 years

Pathway Detail of Doses

[mrem]

Source: 1	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	4.60E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.95E-04	0.00E+00	3.41E-04
Total	4.60E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.95E-04	0.00E+00	3.41E-04
Source: 2	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	2.51E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.91E-05	0.00E+00	6.16E-05
Total	2.51E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.91E-05	0.00E+00	6.16E-05
Source: 3	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	2.51E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.91E-05	0.00E+00	6.16E-05
Total	2.51E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.91E-05	0.00E+00	6.16E-05
Source: 4	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	2.51E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.91E-05	0.00E+00	6.16E-05
Total	2.51E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.91E-05	0.00E+00	6.16E-05
Source: 5	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	2.51E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.91E-05	0.00E+00	6.16E-05
Total	2.51E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.91E-05	0.00E+00	6.16E-05

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:45:31 Page: 58 **
 Title : SLDS DCGL Resident
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld
 Evaluation Time: 1000.00000 years

Nuclide Detail of Doses

[mrem]

Source: 1

Nuclide	Receptor 1	Total
Ac-227	7.37E-20	7.37E-20
Pa-231	5.47E-07	5.47E-07
Ac-227	4.92E-06	4.92E-06
Pb-210	1.07E-20	1.07E-20
Ra-226	1.30E-05	1.30E-05
Pb-210	2.60E-07	2.60E-07
Ra-228	0.00E+00	0.00E+00
Th-228	0.00E+00	0.00E+00
Th-228	0.00E+00	0.00E+00
Th-230	1.60E-08	1.60E-08
Ra-226	7.00E-06	7.00E-06
Pb-210	1.35E-07	1.35E-07
Th-232	1.28E-08	1.28E-08
Ra-228	8.15E-06	8.15E-06
Th-228	3.04E-04	3.04E-04
U-234	1.67E-08	1.67E-08
Th-230	1.47E-10	1.47E-10
Ra-226	3.46E-08	3.46E-08
Pb-210	6.43E-10	6.43E-10
U-235	1.81E-06	1.81E-06
Pa-231	1.17E-08	1.17E-08
Ac-227	1.02E-07	1.02E-07
U-238	1.22E-06	1.22E-06
U-234	4.73E-11	4.73E-11
Th-230	2.09E-13	2.09E-13
Ra-226	3.37E-11	3.37E-11
Pb-210	6.08E-13	6.08E-13

Source: 2

Nuclide	Receptor 1	Total
Ac-227	3.81E-21	3.81E-21
Pa-231	1.59E-08	1.59E-08
Ac-227	2.54E-07	2.54E-07
Pb-210	5.38E-22	5.38E-22
Ra-226	1.11E-06	1.11E-06
Pb-210	1.30E-08	1.30E-08

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:45:31 Page: 59 **

Title : SLDS DCGL Resident

Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld

Evaluation Time: 1000.00000 years

Ra-228	0.00E+00	0.00E+00
Th-228	0.00E+00	0.00E+00
Th-228	0.00E+00	0.00E+00
Th-230	2.02E-10	2.02E-10
Ra-226	6.01E-07	6.01E-07
Pb-210	6.77E-09	6.77E-09
Th-232	1.82E-10	1.82E-10
Ra-228	4.51E-07	4.51E-07
Th-228	5.90E-05	5.90E-05
U-234	1.97E-10	1.97E-10
Th-230	1.87E-12	1.87E-12
Ra-226	2.97E-09	2.97E-09
Pb-210	3.23E-11	3.23E-11
U-235	8.19E-08	8.19E-08
Pa-231	3.39E-10	3.39E-10
Ac-227	5.26E-09	5.26E-09
U-238	6.60E-08	6.60E-08
U-234	5.58E-13	5.58E-13
Th-230	2.64E-15	2.64E-15
Ra-226	2.89E-12	2.89E-12
Pb-210	3.05E-14	3.05E-14

Source: 3

Nuclide	Receptor 1	Total
Ac-227	3.81E-21	3.81E-21
Pa-231	1.59E-08	1.59E-08
Ac-227	2.54E-07	2.54E-07
Pb-210	5.38E-22	5.38E-22
Ra-226	1.11E-06	1.11E-06
Pb-210	1.30E-08	1.30E-08
Ra-228	0.00E+00	0.00E+00
Th-228	0.00E+00	0.00E+00
Th-228	0.00E+00	0.00E+00
Th-230	2.02E-10	2.02E-10
Ra-226	6.01E-07	6.01E-07
Pb-210	6.77E-09	6.77E-09
Th-232	1.82E-10	1.82E-10
Ra-228	4.51E-07	4.51E-07
Th-228	5.90E-05	5.90E-05
U-234	1.97E-10	1.97E-10
Th-230	1.87E-12	1.87E-12
Ra-226	2.97E-09	2.97E-09
Pb-210	3.23E-11	3.23E-11
U-235	8.19E-08	8.19E-08
Pa-231	3.39E-10	3.39E-10
Ac-227	5.26E-09	5.26E-09
U-238	6.60E-08	6.60E-08
U-234	5.58E-13	5.58E-13

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:45:31 Page: 60 **

Title : SLDS DCGL Resident

Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld

Evaluation Time: 1000.00000 years

Th-230	2.64E-15	2.64E-15
Ra-226	2.89E-12	2.89E-12
Pb-210	3.05E-14	3.05E-14

Source: 4

Nuclide	Receptor 1	Total
Ac-227	3.81E-21	3.81E-21
Pa-231	1.59E-08	1.59E-08
Ac-227	2.54E-07	2.54E-07
Pb-210	5.38E-22	5.38E-22
Ra-226	1.11E-06	1.11E-06
Pb-210	1.30E-08	1.30E-08
Ra-228	0.00E+00	0.00E+00
Th-228	0.00E+00	0.00E+00
Th-228	0.00E+00	0.00E+00
Th-230	2.02E-10	2.02E-10
Ra-226	6.01E-07	6.01E-07
Pb-210	6.77E-09	6.77E-09
Th-232	1.82E-10	1.82E-10
Ra-228	4.51E-07	4.51E-07
Th-228	5.90E-05	5.90E-05
U-234	1.97E-10	1.97E-10
Th-230	1.87E-12	1.87E-12
Ra-226	2.97E-09	2.97E-09
Pb-210	3.23E-11	3.23E-11
U-235	8.19E-08	8.19E-08
Pa-231	3.39E-10	3.39E-10
Ac-227	5.26E-09	5.26E-09
U-238	6.60E-08	6.60E-08
U-234	5.58E-13	5.58E-13
Th-230	2.64E-15	2.64E-15
Ra-226	2.89E-12	2.89E-12
Pb-210	3.05E-14	3.05E-14

Source: 5

Nuclide	Receptor 1	Total
Ac-227	3.81E-21	3.81E-21
Pa-231	1.59E-08	1.59E-08
Ac-227	2.54E-07	2.54E-07
Pb-210	5.38E-22	5.38E-22
Ra-226	1.11E-06	1.11E-06

** RESRAD-BUILD Dose Program Output, Version 4.0 07/12/23 10:45:31 Page: 61 **

Title : SLDS DCGL Resident

Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld

Evaluation Time: 1000.00000 years

Pb-210 1.30E-08 1.30E-08

Ra-228 0.00E+00 0.00E+00

Th-228 0.00E+00 0.00E+00

Th-228 0.00E+00 0.00E+00

Th-230 2.02E-10 2.02E-10

Ra-226 6.01E-07 6.01E-07

Pb-210 6.77E-09 6.77E-09

Th-232 1.82E-10 1.82E-10

Ra-228 4.51E-07 4.51E-07

Th-228 5.90E-05 5.90E-05

U-234 1.97E-10 1.97E-10

Th-230 1.87E-12 1.87E-12

Ra-226 2.97E-09 2.97E-09

Pb-210 3.23E-11 3.23E-11

U-235 8.19E-08 8.19E-08

Pa-231 3.39E-10 3.39E-10

Ac-227 5.26E-09 5.26E-09

U-238 6.60E-08 6.60E-08

U-234 5.58E-13 5.58E-13

Th-230 2.64E-15 2.64E-15

Ra-226 2.89E-12 2.89E-12

Pb-210 3.05E-14 3.05E-14

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:45:01 Page: 1 **
 Title : SLDS DCGL Resident
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld

RESRAD-BUILD Table of Contents	

RESRAD-BUILD Input Parameters.....	2
Building Information.....	3
Source Information.....	4
Temporal Risk Summary.....	7
For time = 0.00E+00 yr	
Receptor-Source Risk Summary.....	8
Risk by Pathway Detail.....	9
Risk by Nuclide Detail.....	10
For time = 1.00E+00 yr	
Receptor-Source Risk Summary.....	14
Risk by Pathway Detail.....	15
Risk by Nuclide Detail.....	16
For time = 3.00E+00 yr	
Receptor-Source Risk Summary.....	20
Risk by Pathway Detail.....	21
Risk by Nuclide Detail.....	22
For time = 1.00E+01 yr	
Receptor-Source Risk Summary.....	26
Risk by Pathway Detail.....	27
Risk by Nuclide Detail.....	28
For time = 2.00E+01 yr	
Receptor-Source Risk Summary.....	32
Risk by Pathway Detail.....	33
Risk by Nuclide Detail.....	34
For time = 3.00E+01 yr	
Receptor-Source Risk Summary.....	38
Risk by Pathway Detail.....	39
Risk by Nuclide Detail.....	40
For time = 1.00E+02 yr	
Receptor-Source Risk Summary.....	44
Risk by Pathway Detail.....	45
Risk by Nuclide Detail.....	46
For time = 3.00E+02 yr	
Receptor-Source Risk Summary.....	50
Risk by Pathway Detail.....	51
Risk by Nuclide Detail.....	52
For time = 1.00E+03 yr	
Receptor-Source Risk Summary.....	56
Risk by Pathway Detail.....	57
Risk by Nuclide Detail.....	58

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:45:01 Page: 2 **
 Title : SLDS DCGL Resident
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld

```

=====
=====
=====
RESRAD-BUILD Input Parameters
=====
=====
    
```

```

Number of Sources : 5
Number of Receptors: 1
Total Time : 1.095000E+04 days
Fraction Inside : 6.390000E-01
    
```

```

Transformations data from: ICRP107
Cut off half life : 180.000000 days
Library information in the Dose Coefficients and Slope Factors report
    
```

```

===== Receptor Information =====
Receptor Room x y z FracTime Inhalation Ingestion(Dust)
           [m] [m] [m] [m3/day] [m2/hr]
1         1 5.000 5.000 1.000 1.000 1.48E+01 6.90E-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

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:45:01 Page: 3 **
 Title : SLDS DCGL Resident
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld

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

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

Height[m]	Air Exchanges [m3/hr]	
Area [m2]		

	*	*
	*	*
	*	<=Q01: 0.00E+00
H1: 2.500	* Room 1	* Q10 : 0.00E+00
	* LAMBDA: 0.00E+00	*
Area 100.000	*	*
	*	*

Deposition velocity: 3.90E-04 [m/s] Resuspension Rate: 0.00E+00 [1/s]
 Deposition velocity: 5.00E-07 [m/s] Resuspension Rate:

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:45:01 Page: 4 **
 Title : SLDS DCGL Resident
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld

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

Source: 1

Location:: Room : 1 x: 5.00 y: 5.00 z: 0.00[m]
 Geometry:: Type: Area Length[m]:1.00E+01 Width[m]:1.00E+01 Direction: z
 Pathway ::
 Direct Ingestion Rate: 0.000E+00 [1/hr]
 Fraction released to air: 7.000E-02
 Removable fraction: 1.000E-01
 Time to Remove: 1.000E+04 [day]

Radon Release Fraction: 1.000E-01

Contamination::

Nuclide Concentration

	[dpm/m2]
Ac-227	1.000E+00
Pa-231	1.000E+00
Pb-210	1.000E+00
Ra-226	1.000E+00
Ra-228	1.000E+00
Th-228	1.000E+00
Th-230	1.000E+00
Th-232	1.000E+00
U-234	1.000E+00
U-235	1.000E+00
U-238	1.000E+00

Source: 2

Location:: Room : 1 x: 10.00 y: 5.00 z: 1.00[m]
 Geometry:: Type: Area Length[m]:1.00E+01 Width[m]:2.00E+00 Direction: x
 Pathway ::
 Direct Ingestion Rate: 0.000E+00 [1/hr]
 Fraction released to air: 7.000E-02
 Removable fraction: 1.000E-01
 Time to Remove: 1.000E+04 [day]

Radon Release Fraction: 1.000E-01

Contamination::

Nuclide Concentration

	[dpm/m2]
Ac-227	1.000E+00
Pa-231	1.000E+00
Pb-210	1.000E+00
Ra-226	1.000E+00
Ra-228	1.000E+00
Th-228	1.000E+00
Th-230	1.000E+00
Th-232	1.000E+00
U-234	1.000E+00
U-235	1.000E+00
U-238	1.000E+00

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:45:01 Page: 5 **

Title : SLDS DCGL Resident

Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld

Source: 3

Location:: Room : 1 x: 5.00 y: 10.00 z: 1.00[m]
 Geometry:: Type: Area Length[m]:1.00E+01 Width[m]:2.00E+00 Direction: y
 Pathway ::
 Direct Ingestion Rate: 0.000E+00 [1/hr]
 Fraction released to air: 7.000E-02
 Removable fraction: 1.000E-01
 Time to Remove: 1.000E+04 [day]

 Radon Release Fraction: 1.000E-01

Contamination::

Nuclide Concentration

	[dpm/m2]
Ac-227	1.000E+00
Pa-231	1.000E+00
Pb-210	1.000E+00
Ra-226	1.000E+00
Ra-228	1.000E+00
Th-228	1.000E+00
Th-230	1.000E+00
Th-232	1.000E+00
U-234	1.000E+00
U-235	1.000E+00
U-238	1.000E+00

Source: 4

Location:: Room : 1 x: 0.00 y: 5.00 z: 1.00[m]
 Geometry:: Type: Area Length[m]:1.00E+01 Width[m]:2.00E+00 Direction: x
 Pathway ::
 Direct Ingestion Rate: 0.000E+00 [1/hr]
 Fraction released to air: 7.000E-02
 Removable fraction: 1.000E-01
 Time to Remove: 1.000E+04 [day]

 Radon Release Fraction: 1.000E-01

Contamination::

Nuclide Concentration

	[dpm/m2]
Ac-227	1.000E+00
Pa-231	1.000E+00
Pb-210	1.000E+00
Ra-226	1.000E+00
Ra-228	1.000E+00
Th-228	1.000E+00
Th-230	1.000E+00
Th-232	1.000E+00
U-234	1.000E+00
U-235	1.000E+00
U-238	1.000E+00

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:45:01 Page: 6 **
Title : SLDS DCGL Resident
Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld

Source: 5

Location:: Room : 1 x: 5.00 y: 0.00 z: 1.00[m]
Geometry:: Type: Area Length[m]:1.00E+01 Width[m]:2.00E+00 Direction: y
Pathway ::
Direct Ingestion Rate: 0.000E+00 [1/hr]
Fraction released to air: 7.000E-02
Removable fraction: 1.000E-01
Time to Remove: 1.000E+04 [day]

Radon Release Fraction: 1.000E-01

Contamination::

Nuclide Concentration

	[dpm/m2]
Ac-227	1.000E+00
Pa-231	1.000E+00
Pb-210	1.000E+00
Ra-226	1.000E+00
Ra-228	1.000E+00
Th-228	1.000E+00
Th-230	1.000E+00
Th-232	1.000E+00
U-234	1.000E+00
U-235	1.000E+00
U-238	1.000E+00

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:45:01 Page: 7 **
 Title : SLDS DCGL Resident
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld
 Temporal Summary

RESRAD-BUILD Temporal Risk Tables

Risk to Receptor over the Exposure Duration

(Risk)		
Evaluation Time years	Receptor 1	Total
0.000000000	6.73E-09	6.73E-09
1.000000000	6.69E-09	6.69E-09
3.000000000	6.59E-09	6.59E-09
10.00000000	6.28E-09	6.28E-09
20.00000000	5.90E-09	5.90E-09
30.00000000	5.67E-09	5.67E-09
100.0000080	5.67E-09	5.67E-09
300.0000310	5.67E-09	5.67E-09
1000.000000	5.67E-09	5.67E-09

RESRAD-BUILD Risk Tables

[Risk]

	Source 1	Source 2	Source 3	Source 4	Source 5	Total
Receptor 1	4.11E-09	6.55E-10	6.55E-10	6.55E-10	6.55E-10	6.73E-09
Total	4.11E-09	6.55E-10	6.55E-10	6.55E-10	6.55E-10	6.73E-09

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:45:01 Page: 9 **

Title : SLDS DCGL Resident

Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld

Evaluation Time: 0.00000000E+00 years

Pathway Detail of Risks

[Risk]

Source: 1	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	1.15E-09	4.29E-10	1.27E-14	2.41E-15	3.93E-12	2.53E-09	0.00E+00	4.11E-09
Total	1.15E-09	4.29E-10	1.27E-14	2.41E-15	3.93E-12	2.53E-09	0.00E+00	4.11E-09
Source: 2	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	6.29E-11	8.58E-11	2.54E-15	4.83E-16	7.86E-13	5.06E-10	0.00E+00	6.55E-10
Total	6.29E-11	8.58E-11	2.54E-15	4.83E-16	7.86E-13	5.06E-10	0.00E+00	6.55E-10
Source: 3	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	6.29E-11	8.58E-11	2.54E-15	4.83E-16	7.86E-13	5.06E-10	0.00E+00	6.55E-10
Total	6.29E-11	8.58E-11	2.54E-15	4.83E-16	7.86E-13	5.06E-10	0.00E+00	6.55E-10
Source: 4	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	6.29E-11	8.58E-11	2.54E-15	4.83E-16	7.86E-13	5.06E-10	0.00E+00	6.55E-10
Total	6.29E-11	8.58E-11	2.54E-15	4.83E-16	7.86E-13	5.06E-10	0.00E+00	6.55E-10
Source: 5	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	6.29E-11	8.58E-11	2.54E-15	4.83E-16	7.86E-13	5.06E-10	0.00E+00	6.55E-10
Total	6.29E-11	8.58E-11	2.54E-15	4.83E-16	7.86E-13	5.06E-10	0.00E+00	6.55E-10

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:45:01 Page: 10 **
 Title : SLDS DCGL Resident
 Input File : C:\RESRAD Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld
 Evaluation Time: 0.00000000E+00 years

Nuclide Detail of Risks

[Risk]

Source: 1

Nuclide	Receptor 1	Total
Ac-227	1.68E-10	1.68E-10
Pa-231	6.14E-11	6.14E-11
Ac-227	8.72E-11	8.72E-11
Pb-210	1.85E-11	1.85E-11
Ra-226	5.31E-10	5.31E-10
Pb-210	9.18E-12	9.18E-12
Ra-228	6.50E-11	6.50E-11
Th-228	7.67E-10	7.67E-10
Th-228	2.73E-10	2.73E-10
Th-230	2.16E-11	2.16E-11
Ra-226	3.39E-12	3.39E-12
Pb-210	3.97E-14	3.97E-14
Th-232	2.73E-11	2.73E-11
Ra-228	1.68E-10	1.68E-10
Th-228	1.79E-09	1.79E-09
U-234	1.77E-11	1.77E-11
Th-230	2.73E-15	2.73E-15
Ra-226	3.08E-16	3.08E-16
Pb-210	2.67E-18	2.67E-18
U-235	6.02E-11	6.02E-11
Pa-231	1.81E-14	1.81E-14
Ac-227	1.88E-14	1.88E-14
U-238	4.28E-11	4.28E-11
U-234	6.88E-16	6.88E-16
Th-230	7.07E-20	7.07E-20
Ra-226	6.46E-21	6.46E-21
Pb-210	4.35E-23	4.35E-23

Source: 2

Nuclide	Receptor 1	Total
Ac-227	2.18E-11	2.18E-11
Pa-231	9.89E-12	9.89E-12
Ac-227	1.11E-11	1.11E-11
Pb-210	3.03E-12	3.03E-12
Ra-226	4.89E-11	4.89E-11
Pb-210	1.49E-12	1.49E-12

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:45:01 Page: 11 **

Title : SLDS DCGL Resident

Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld

Evaluation Time: 0.0000000E+00 years

Ra-228	4.77E-12	4.77E-12
Th-228	1.41E-10	1.41E-10
Th-228	5.00E-11	5.00E-11
Th-230	4.25E-12	4.25E-12
Ra-226	3.11E-13	3.11E-13
Pb-210	6.33E-15	6.33E-15
Th-232	5.40E-12	5.40E-12
Ra-228	1.22E-11	1.22E-11
Th-228	3.28E-10	3.28E-10
U-234	3.47E-12	3.47E-12
Th-230	5.37E-16	5.37E-16
Ra-226	2.82E-17	2.82E-17
Pb-210	4.18E-19	4.18E-19
U-235	5.14E-12	5.14E-12
Pa-231	2.88E-15	2.88E-15
Ac-227	2.33E-15	2.33E-15
U-238	4.46E-12	4.46E-12
U-234	1.35E-16	1.35E-16
Th-230	1.39E-20	1.39E-20
Ra-226	5.90E-22	5.90E-22
Pb-210	6.71E-24	6.71E-24

Source: 3

Nuclide	Receptor 1	Total
Ac-227	2.18E-11	2.18E-11
Pa-231	9.89E-12	9.89E-12
Ac-227	1.11E-11	1.11E-11
Pb-210	3.03E-12	3.03E-12
Ra-226	4.89E-11	4.89E-11
Pb-210	1.49E-12	1.49E-12
Ra-228	4.77E-12	4.77E-12
Th-228	1.41E-10	1.41E-10
Th-228	5.00E-11	5.00E-11
Th-230	4.25E-12	4.25E-12
Ra-226	3.11E-13	3.11E-13
Pb-210	6.33E-15	6.33E-15
Th-232	5.40E-12	5.40E-12
Ra-228	1.22E-11	1.22E-11
Th-228	3.28E-10	3.28E-10
U-234	3.47E-12	3.47E-12
Th-230	5.37E-16	5.37E-16
Ra-226	2.82E-17	2.82E-17
Pb-210	4.18E-19	4.18E-19
U-235	5.14E-12	5.14E-12
Pa-231	2.88E-15	2.88E-15
Ac-227	2.33E-15	2.33E-15
U-238	4.46E-12	4.46E-12
U-234	1.35E-16	1.35E-16

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:45:01 Page: 12 **

Title : SLDS DCGL Resident

Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld

Evaluation Time: 0.0000000E+00 years

Th-230	1.39E-20	1.39E-20
Ra-226	5.90E-22	5.90E-22
Pb-210	6.71E-24	6.71E-24

Source: 4

Nuclide	Receptor	Total
	1	
Ac-227	2.18E-11	2.18E-11
Pa-231	9.89E-12	9.89E-12
Ac-227	1.11E-11	1.11E-11
Pb-210	3.03E-12	3.03E-12
Ra-226	4.89E-11	4.89E-11
Pb-210	1.49E-12	1.49E-12
Ra-228	4.77E-12	4.77E-12
Th-228	1.41E-10	1.41E-10
Th-228	5.00E-11	5.00E-11
Th-230	4.25E-12	4.25E-12
Ra-226	3.11E-13	3.11E-13
Pb-210	6.33E-15	6.33E-15
Th-232	5.40E-12	5.40E-12
Ra-228	1.22E-11	1.22E-11
Th-228	3.28E-10	3.28E-10
U-234	3.47E-12	3.47E-12
Th-230	5.37E-16	5.37E-16
Ra-226	2.82E-17	2.82E-17
Pb-210	4.18E-19	4.18E-19
U-235	5.14E-12	5.14E-12
Pa-231	2.88E-15	2.88E-15
Ac-227	2.33E-15	2.33E-15
U-238	4.46E-12	4.46E-12
U-234	1.35E-16	1.35E-16
Th-230	1.39E-20	1.39E-20
Ra-226	5.90E-22	5.90E-22
Pb-210	6.71E-24	6.71E-24

Source: 5

Nuclide	Receptor	Total
	1	
Ac-227	2.18E-11	2.18E-11
Pa-231	9.89E-12	9.89E-12
Ac-227	1.11E-11	1.11E-11
Pb-210	3.03E-12	3.03E-12
Ra-226	4.89E-11	4.89E-11

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:45:01 Page: 13 **
Title : SLDS DCGL Resident
Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld
Evaluation Time: 0.00000000E+00 years

Pb-210	1.49E-12	1.49E-12
Ra-228	4.77E-12	4.77E-12
Th-228	1.41E-10	1.41E-10
Th-228	5.00E-11	5.00E-11
Th-230	4.25E-12	4.25E-12
Ra-226	3.11E-13	3.11E-13
Pb-210	6.33E-15	6.33E-15
Th-232	5.40E-12	5.40E-12
Ra-228	1.22E-11	1.22E-11
Th-228	3.28E-10	3.28E-10
U-234	3.47E-12	3.47E-12
Th-230	5.37E-16	5.37E-16
Ra-226	2.82E-17	2.82E-17
Pb-210	4.18E-19	4.18E-19
U-235	5.14E-12	5.14E-12
Pa-231	2.88E-15	2.88E-15
Ac-227	2.33E-15	2.33E-15
U-238	4.46E-12	4.46E-12
U-234	1.35E-16	1.35E-16
Th-230	1.39E-20	1.39E-20
Ra-226	5.90E-22	5.90E-22
Pb-210	6.71E-24	6.71E-24

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:45:01 Page: 14 **
 Title : SLDS DCGL Resident
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld
 Evaluation Time: 1.00000000 years

RESRAD-BUILD Risk Tables

Source Contributions to Receptor Risks

[Risk]						
	Source 1	Source 2	Source 3	Source 4	Source 5	Total
Receptor 1	4.08E-09	6.50E-10	6.50E-10	6.50E-10	6.50E-10	6.69E-09
Total	4.08E-09	6.50E-10	6.50E-10	6.50E-10	6.50E-10	6.69E-09

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:45:01 Page: 15 **

Title : SLDS DCGL Resident

Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld

Evaluation Time: 1.00000000 years

Pathway Detail of Risks

[Risk]								
Source: 1	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	1.15E-09	4.14E-10	1.23E-14	2.33E-15	3.80E-12	2.52E-09	0.00E+00	4.08E-09
Total	1.15E-09	4.14E-10	1.23E-14	2.33E-15	3.80E-12	2.52E-09	0.00E+00	4.08E-09
Source: 2	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	6.27E-11	8.28E-11	2.46E-15	4.66E-16	7.61E-13	5.04E-10	0.00E+00	6.50E-10
Total	6.27E-11	8.28E-11	2.46E-15	4.66E-16	7.61E-13	5.04E-10	0.00E+00	6.50E-10
Source: 3	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	6.27E-11	8.28E-11	2.46E-15	4.66E-16	7.61E-13	5.04E-10	0.00E+00	6.50E-10
Total	6.27E-11	8.28E-11	2.46E-15	4.66E-16	7.61E-13	5.04E-10	0.00E+00	6.50E-10
Source: 4	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	6.27E-11	8.28E-11	2.46E-15	4.66E-16	7.61E-13	5.04E-10	0.00E+00	6.50E-10
Total	6.27E-11	8.28E-11	2.46E-15	4.66E-16	7.61E-13	5.04E-10	0.00E+00	6.50E-10
Source: 5	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	6.27E-11	8.28E-11	2.46E-15	4.66E-16	7.61E-13	5.04E-10	0.00E+00	6.50E-10
Total	6.27E-11	8.28E-11	2.46E-15	4.66E-16	7.61E-13	5.04E-10	0.00E+00	6.50E-10

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:45:01 Page: 16 **
 Title : SLDS DCGL Resident
 Input File : C:\RESRAD Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld
 Evaluation Time: 1.00000000 years

Nuclide Detail of Risks

[Risk]

Source: 1

Nuclide	Receptor 1	Total
Ac-227	1.61E-10	1.61E-10
Pa-231	5.97E-11	5.97E-11
Ac-227	8.95E-11	8.95E-11
Pb-210	1.76E-11	1.76E-11
Ra-226	5.29E-10	5.29E-10
Pb-210	9.30E-12	9.30E-12
Ra-228	5.75E-11	5.75E-11
Th-228	7.55E-10	7.55E-10
Th-228	1.89E-10	1.89E-10
Th-230	2.09E-11	2.09E-11
Ra-226	3.60E-12	3.60E-12
Pb-210	4.07E-14	4.07E-14
Th-232	2.63E-11	2.63E-11
Ra-228	1.74E-10	1.74E-10
Th-228	1.87E-09	1.87E-09
U-234	1.71E-11	1.71E-11
Th-230	2.73E-15	2.73E-15
Ra-226	3.38E-16	3.38E-16
Pb-210	2.77E-18	2.77E-18
U-235	5.95E-11	5.95E-11
Pa-231	1.84E-14	1.84E-14
Ac-227	1.97E-14	1.97E-14
U-238	4.22E-11	4.22E-11
U-234	6.88E-16	6.88E-16
Th-230	7.08E-20	7.08E-20
Ra-226	7.33E-21	7.33E-21
Pb-210	4.58E-23	4.58E-23

Source: 2

Nuclide	Receptor 1	Total
Ac-227	2.08E-11	2.08E-11
Pa-231	9.56E-12	9.56E-12
Ac-227	1.12E-11	1.12E-11
Pb-210	2.88E-12	2.88E-12
Ra-226	4.86E-11	4.86E-11
Pb-210	1.49E-12	1.49E-12

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:45:01 Page: 17 **

Title : SLDS DCGL Resident

Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld

Evaluation Time: 1.00000000 years

Ra-228	4.22E-12	4.22E-12
Th-228	1.39E-10	1.39E-10
Th-228	3.47E-11	3.47E-11
Th-230	4.10E-12	4.10E-12
Ra-226	3.29E-13	3.29E-13
Pb-210	6.38E-15	6.38E-15
Th-232	5.21E-12	5.21E-12
Ra-228	1.25E-11	1.25E-11
Th-228	3.43E-10	3.43E-10
U-234	3.35E-12	3.35E-12
Th-230	5.36E-16	5.36E-16
Ra-226	3.08E-17	3.08E-17
Pb-210	4.23E-19	4.23E-19
U-235	5.03E-12	5.03E-12
Pa-231	2.89E-15	2.89E-15
Ac-227	2.37E-15	2.37E-15
U-238	4.35E-12	4.35E-12
U-234	1.34E-16	1.34E-16
Th-230	1.39E-20	1.39E-20
Ra-226	6.67E-22	6.67E-22
Pb-210	6.82E-24	6.82E-24

Source: 3

Nuclide	Receptor	Total
	1	
Ac-227	2.08E-11	2.08E-11
Pa-231	9.56E-12	9.56E-12
Ac-227	1.12E-11	1.12E-11
Pb-210	2.88E-12	2.88E-12
Ra-226	4.86E-11	4.86E-11
Pb-210	1.49E-12	1.49E-12
Ra-228	4.22E-12	4.22E-12
Th-228	1.39E-10	1.39E-10
Th-228	3.47E-11	3.47E-11
Th-230	4.10E-12	4.10E-12
Ra-226	3.29E-13	3.29E-13
Pb-210	6.38E-15	6.38E-15
Th-232	5.21E-12	5.21E-12
Ra-228	1.25E-11	1.25E-11
Th-228	3.43E-10	3.43E-10
U-234	3.35E-12	3.35E-12
Th-230	5.36E-16	5.36E-16
Ra-226	3.08E-17	3.08E-17
Pb-210	4.23E-19	4.23E-19
U-235	5.03E-12	5.03E-12
Pa-231	2.89E-15	2.89E-15
Ac-227	2.37E-15	2.37E-15
U-238	4.35E-12	4.35E-12
U-234	1.34E-16	1.34E-16

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:45:01 Page: 18 **

Title : SLDS DCGL Resident

Input File : C:\RESRAD Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld

Evaluation Time: 1.00000000 years

Th-230	1.39E-20	1.39E-20
Ra-226	6.67E-22	6.67E-22
Pb-210	6.82E-24	6.82E-24

Source: 4

Nuclide	Receptor	Total
	1	
Ac-227	2.08E-11	2.08E-11
Pa-231	9.56E-12	9.56E-12
Ac-227	1.12E-11	1.12E-11
Pb-210	2.88E-12	2.88E-12
Ra-226	4.86E-11	4.86E-11
Pb-210	1.49E-12	1.49E-12
Ra-228	4.22E-12	4.22E-12
Th-228	1.39E-10	1.39E-10
Th-228	3.47E-11	3.47E-11
Th-230	4.10E-12	4.10E-12
Ra-226	3.29E-13	3.29E-13
Pb-210	6.38E-15	6.38E-15
Th-232	5.21E-12	5.21E-12
Ra-228	1.25E-11	1.25E-11
Th-228	3.43E-10	3.43E-10
U-234	3.35E-12	3.35E-12
Th-230	5.36E-16	5.36E-16
Ra-226	3.08E-17	3.08E-17
Pb-210	4.23E-19	4.23E-19
U-235	5.03E-12	5.03E-12
Pa-231	2.89E-15	2.89E-15
Ac-227	2.37E-15	2.37E-15
U-238	4.35E-12	4.35E-12
U-234	1.34E-16	1.34E-16
Th-230	1.39E-20	1.39E-20
Ra-226	6.67E-22	6.67E-22
Pb-210	6.82E-24	6.82E-24

Source: 5

Nuclide	Receptor	Total
	1	
Ac-227	2.08E-11	2.08E-11
Pa-231	9.56E-12	9.56E-12
Ac-227	1.12E-11	1.12E-11
Pb-210	2.88E-12	2.88E-12
Ra-226	4.86E-11	4.86E-11

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:45:01 Page: 19 **
Title : SLDS DCGL Resident
Input File : C:\RESRAD Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld
Evaluation Time: 1.00000000 years

Pb-210	1.49E-12	1.49E-12
Ra-228	4.22E-12	4.22E-12
Th-228	1.39E-10	1.39E-10
Th-228	3.47E-11	3.47E-11
Th-230	4.10E-12	4.10E-12
Ra-226	3.29E-13	3.29E-13
Pb-210	6.38E-15	6.38E-15
Th-232	5.21E-12	5.21E-12
Ra-228	1.25E-11	1.25E-11
Th-228	3.43E-10	3.43E-10
U-234	3.35E-12	3.35E-12
Th-230	5.36E-16	5.36E-16
Ra-226	3.08E-17	3.08E-17
Pb-210	4.23E-19	4.23E-19
U-235	5.03E-12	5.03E-12
Pa-231	2.89E-15	2.89E-15
Ac-227	2.37E-15	2.37E-15
U-238	4.35E-12	4.35E-12
U-234	1.34E-16	1.34E-16
Th-230	1.39E-20	1.39E-20
Ra-226	6.67E-22	6.67E-22
Pb-210	6.82E-24	6.82E-24

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:45:01 Page: 20 **
 Title : SLDS DCGL Resident
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld
 Evaluation Time: 3.00000000 years

RESRAD-BUILD Risk Tables

Source Contributions to Receptor Risks

[Risk]						
	Source 1	Source 2	Source 3	Source 4	Source 5	Total
Receptor 1	4.03E-09	6.40E-10	6.40E-10	6.40E-10	6.40E-10	6.59E-09
Total	4.03E-09	6.40E-10	6.40E-10	6.40E-10	6.40E-10	6.59E-09

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:45:01 Page: 21 **

Title : SLDS DCGL Resident

Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld

Evaluation Time: 3.00000000 years

Pathway Detail of Risks

[Risk]

Source: 1	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	1.14E-09	3.83E-10	1.14E-14	2.15E-15	3.52E-12	2.50E-09	0.00E+00	4.03E-09
Total	1.14E-09	3.83E-10	1.14E-14	2.15E-15	3.52E-12	2.50E-09	0.00E+00	4.03E-09
Source: 2	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	6.23E-11	7.65E-11	2.27E-15	4.30E-16	7.03E-13	5.01E-10	0.00E+00	6.40E-10
Total	6.23E-11	7.65E-11	2.27E-15	4.30E-16	7.03E-13	5.01E-10	0.00E+00	6.40E-10
Source: 3	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	6.23E-11	7.65E-11	2.27E-15	4.30E-16	7.03E-13	5.01E-10	0.00E+00	6.40E-10
Total	6.23E-11	7.65E-11	2.27E-15	4.30E-16	7.03E-13	5.01E-10	0.00E+00	6.40E-10
Source: 4	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	6.23E-11	7.65E-11	2.27E-15	4.30E-16	7.03E-13	5.01E-10	0.00E+00	6.40E-10
Total	6.23E-11	7.65E-11	2.27E-15	4.30E-16	7.03E-13	5.01E-10	0.00E+00	6.40E-10
Source: 5	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	6.23E-11	7.65E-11	2.27E-15	4.30E-16	7.03E-13	5.01E-10	0.00E+00	6.40E-10
Total	6.23E-11	7.65E-11	2.27E-15	4.30E-16	7.03E-13	5.01E-10	0.00E+00	6.40E-10

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:45:01 Page: 22 **
 Title : SLDS DCGL Resident
 Input File : C:\RESRAD Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld
 Evaluation Time: 3.00000000 years

Nuclide Detail of Risks

[Risk]

Source: 1

Nuclide	Receptor 1	Total
Ac-227	1.47E-10	1.47E-10
Pa-231	5.61E-11	5.61E-11
Ac-227	9.34E-11	9.34E-11
Pb-210	1.59E-11	1.59E-11
Ra-226	5.24E-10	5.24E-10
Pb-210	9.44E-12	9.44E-12
Ra-228	4.48E-11	4.48E-11
Th-228	6.74E-10	6.74E-10
Th-228	9.10E-11	9.10E-11
Th-230	1.93E-11	1.93E-11
Ra-226	4.02E-12	4.02E-12
Pb-210	4.28E-14	4.28E-14
Th-232	2.44E-11	2.44E-11
Ra-228	1.84E-10	1.84E-10
Th-228	2.03E-09	2.03E-09
U-234	1.58E-11	1.58E-11
Th-230	2.71E-15	2.71E-15
Ra-226	4.04E-16	4.04E-16
Pb-210	2.99E-18	2.99E-18
U-235	5.80E-11	5.80E-11
Pa-231	1.88E-14	1.88E-14
Ac-227	2.16E-14	2.16E-14
U-238	4.09E-11	4.09E-11
U-234	6.83E-16	6.83E-16
Th-230	7.10E-20	7.10E-20
Ra-226	9.34E-21	9.34E-21
Pb-210	5.11E-23	5.11E-23

Source: 2

Nuclide	Receptor 1	Total
Ac-227	1.87E-11	1.87E-11
Pa-231	8.87E-12	8.87E-12
Ac-227	1.13E-11	1.13E-11
Pb-210	2.58E-12	2.58E-12
Ra-226	4.80E-11	4.80E-11
Pb-210	1.48E-12	1.48E-12

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:45:01 Page: 23 **

Title : SLDS DCGL Resident

Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld

Evaluation Time: 3.00000000 years

Ra-228	3.29E-12	3.29E-12
Th-228	1.24E-10	1.24E-10
Th-228	1.67E-11	1.67E-11
Th-230	3.79E-12	3.79E-12
Ra-226	3.66E-13	3.66E-13
Pb-210	6.47E-15	6.47E-15
Th-232	4.82E-12	4.82E-12
Ra-228	1.30E-11	1.30E-11
Th-228	3.72E-10	3.72E-10
U-234	3.10E-12	3.10E-12
Th-230	5.31E-16	5.31E-16
Ra-226	3.67E-17	3.67E-17
Pb-210	4.34E-19	4.34E-19
U-235	4.79E-12	4.79E-12
Pa-231	2.88E-15	2.88E-15
Ac-227	2.47E-15	2.47E-15
U-238	4.13E-12	4.13E-12
U-234	1.33E-16	1.33E-16
Th-230	1.38E-20	1.38E-20
Ra-226	8.44E-22	8.44E-22
Pb-210	7.08E-24	7.08E-24

Source: 3

Nuclide	Receptor	Total
	1	
Ac-227	1.87E-11	1.87E-11
Pa-231	8.87E-12	8.87E-12
Ac-227	1.13E-11	1.13E-11
Pb-210	2.58E-12	2.58E-12
Ra-226	4.80E-11	4.80E-11
Pb-210	1.48E-12	1.48E-12
Ra-228	3.29E-12	3.29E-12
Th-228	1.24E-10	1.24E-10
Th-228	1.67E-11	1.67E-11
Th-230	3.79E-12	3.79E-12
Ra-226	3.66E-13	3.66E-13
Pb-210	6.47E-15	6.47E-15
Th-232	4.82E-12	4.82E-12
Ra-228	1.30E-11	1.30E-11
Th-228	3.72E-10	3.72E-10
U-234	3.10E-12	3.10E-12
Th-230	5.31E-16	5.31E-16
Ra-226	3.67E-17	3.67E-17
Pb-210	4.34E-19	4.34E-19
U-235	4.79E-12	4.79E-12
Pa-231	2.88E-15	2.88E-15
Ac-227	2.47E-15	2.47E-15
U-238	4.13E-12	4.13E-12
U-234	1.33E-16	1.33E-16

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:45:01 Page: 24 **

Title : SLDS DCGL Resident

Input File : C:\RESRAD Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld

Evaluation Time: 3.00000000 years

Th-230	1.38E-20	1.38E-20
Ra-226	8.44E-22	8.44E-22
Pb-210	7.08E-24	7.08E-24

Source: 4

Nuclide	Receptor	Total
	1	
Ac-227	1.87E-11	1.87E-11
Pa-231	8.87E-12	8.87E-12
Ac-227	1.13E-11	1.13E-11
Pb-210	2.58E-12	2.58E-12
Ra-226	4.80E-11	4.80E-11
Pb-210	1.48E-12	1.48E-12
Ra-228	3.29E-12	3.29E-12
Th-228	1.24E-10	1.24E-10
Th-228	1.67E-11	1.67E-11
Th-230	3.79E-12	3.79E-12
Ra-226	3.66E-13	3.66E-13
Pb-210	6.47E-15	6.47E-15
Th-232	4.82E-12	4.82E-12
Ra-228	1.30E-11	1.30E-11
Th-228	3.72E-10	3.72E-10
U-234	3.10E-12	3.10E-12
Th-230	5.31E-16	5.31E-16
Ra-226	3.67E-17	3.67E-17
Pb-210	4.34E-19	4.34E-19
U-235	4.79E-12	4.79E-12
Pa-231	2.88E-15	2.88E-15
Ac-227	2.47E-15	2.47E-15
U-238	4.13E-12	4.13E-12
U-234	1.33E-16	1.33E-16
Th-230	1.38E-20	1.38E-20
Ra-226	8.44E-22	8.44E-22
Pb-210	7.08E-24	7.08E-24

Source: 5

Nuclide	Receptor	Total
	1	
Ac-227	1.87E-11	1.87E-11
Pa-231	8.87E-12	8.87E-12
Ac-227	1.13E-11	1.13E-11
Pb-210	2.58E-12	2.58E-12
Ra-226	4.80E-11	4.80E-11

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:45:01 Page: 25 **
Title : SLDS DCGL Resident
Input File : C:\RESRAD Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld
Evaluation Time: 3.00000000 years

Pb-210	1.48E-12	1.48E-12
Ra-228	3.29E-12	3.29E-12
Th-228	1.24E-10	1.24E-10
Th-228	1.67E-11	1.67E-11
Th-230	3.79E-12	3.79E-12
Ra-226	3.66E-13	3.66E-13
Pb-210	6.47E-15	6.47E-15
Th-232	4.82E-12	4.82E-12
Ra-228	1.30E-11	1.30E-11
Th-228	3.72E-10	3.72E-10
U-234	3.10E-12	3.10E-12
Th-230	5.31E-16	5.31E-16
Ra-226	3.67E-17	3.67E-17
Pb-210	4.34E-19	4.34E-19
U-235	4.79E-12	4.79E-12
Pa-231	2.88E-15	2.88E-15
Ac-227	2.47E-15	2.47E-15
U-238	4.13E-12	4.13E-12
U-234	1.33E-16	1.33E-16
Th-230	1.38E-20	1.38E-20
Ra-226	8.44E-22	8.44E-22
Pb-210	7.08E-24	7.08E-24

RESRAD-BUILD Risk Tables

[Risk]

	Source 1	Source 2	Source 3	Source 4	Source 5	Total
Receptor 1	3.85E-09	6.07E-10	6.07E-10	6.07E-10	6.07E-10	6.28E-09
Total	3.85E-09	6.07E-10	6.07E-10	6.07E-10	6.07E-10	6.28E-09

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:45:01 Page: 27 **

Title : SLDS DCGL Resident

Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld

Evaluation Time: 10.0000000 years

Pathway Detail of Risks

[Risk]

Source: 1								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	1.12E-09	2.73E-10	8.12E-15	1.54E-15	2.51E-12	2.46E-09	0.00E+00	3.85E-09
Total	1.12E-09	2.73E-10	8.12E-15	1.54E-15	2.51E-12	2.46E-09	0.00E+00	3.85E-09
Source: 2								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	6.11E-11	5.46E-11	1.62E-15	3.07E-16	5.02E-13	4.91E-10	0.00E+00	6.07E-10
Total	6.11E-11	5.46E-11	1.62E-15	3.07E-16	5.02E-13	4.91E-10	0.00E+00	6.07E-10
Source: 3								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	6.11E-11	5.46E-11	1.62E-15	3.07E-16	5.02E-13	4.91E-10	0.00E+00	6.07E-10
Total	6.11E-11	5.46E-11	1.62E-15	3.07E-16	5.02E-13	4.91E-10	0.00E+00	6.07E-10
Source: 4								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	6.11E-11	5.46E-11	1.62E-15	3.07E-16	5.02E-13	4.91E-10	0.00E+00	6.07E-10
Total	6.11E-11	5.46E-11	1.62E-15	3.07E-16	5.02E-13	4.91E-10	0.00E+00	6.07E-10
Source: 5								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	6.11E-11	5.46E-11	1.62E-15	3.07E-16	5.02E-13	4.91E-10	0.00E+00	6.07E-10
Total	6.11E-11	5.46E-11	1.62E-15	3.07E-16	5.02E-13	4.91E-10	0.00E+00	6.07E-10

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:45:01 Page: 28 **
 Title : SLDS DCGL Resident
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld
 Evaluation Time: 10.0000000 years

Nuclide Detail of Risks

[Risk]

Source: 1

Nuclide	Receptor	Total
	1	
Ac-227	1.03E-10	1.03E-10
Pa-231	4.37E-11	4.37E-11
Ac-227	1.00E-10	1.00E-10
Pb-210	1.07E-11	1.07E-11
Ra-226	5.08E-10	5.08E-10
Pb-210	9.17E-12	9.17E-12
Ra-228	1.87E-11	1.87E-11
Th-228	3.29E-10	3.29E-10
Th-228	7.01E-12	7.01E-12
Th-230	1.39E-11	1.39E-11
Ra-226	5.45E-12	5.45E-12
Pb-210	5.02E-14	5.02E-14
Th-232	1.75E-11	1.75E-11
Ra-228	1.99E-10	1.99E-10
Th-228	2.38E-09	2.38E-09
U-234	1.14E-11	1.14E-11
Th-230	2.41E-15	2.41E-15
Ra-226	6.96E-16	6.96E-16
Pb-210	4.10E-18	4.10E-18
U-235	5.32E-11	5.32E-11
Pa-231	1.91E-14	1.91E-14
Ac-227	2.93E-14	2.93E-14
U-238	3.66E-11	3.66E-11
U-234	6.09E-16	6.09E-16
Th-230	6.92E-20	6.92E-20
Ra-226	1.98E-20	1.98E-20
Pb-210	8.25E-23	8.25E-23

Source: 2

Nuclide	Receptor	Total
	1	
Ac-227	1.23E-11	1.23E-11
Pa-231	6.43E-12	6.43E-12
Ac-227	1.07E-11	1.07E-11
Pb-210	1.66E-12	1.66E-12
Ra-226	4.61E-11	4.61E-11
Pb-210	1.32E-12	1.32E-12

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:45:01 Page: 29 **

Title : SLDS DCGL Resident

Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld

Evaluation Time: 10.0000000 years

Ra-228	1.36E-12	1.36E-12
Th-228	6.03E-11	6.03E-11
Th-228	1.29E-12	1.29E-12
Th-230	2.71E-12	2.71E-12
Ra-226	4.92E-13	4.92E-13
Pb-210	6.59E-15	6.59E-15
Th-232	3.44E-12	3.44E-12
Ra-228	1.33E-11	1.33E-11
Th-228	4.37E-10	4.37E-10
U-234	2.21E-12	2.21E-12
Th-230	4.66E-16	4.66E-16
Ra-226	6.24E-17	6.24E-17
Pb-210	4.82E-19	4.82E-19
U-235	3.95E-12	3.95E-12
Pa-231	2.60E-15	2.60E-15
Ac-227	2.80E-15	2.80E-15
U-238	3.34E-12	3.34E-12
U-234	1.17E-16	1.17E-16
Th-230	1.32E-20	1.32E-20
Ra-226	1.76E-21	1.76E-21
Pb-210	8.55E-24	8.55E-24

Source: 3

Nuclide	Receptor	Total
	1	
Ac-227	1.23E-11	1.23E-11
Pa-231	6.43E-12	6.43E-12
Ac-227	1.07E-11	1.07E-11
Pb-210	1.66E-12	1.66E-12
Ra-226	4.61E-11	4.61E-11
Pb-210	1.32E-12	1.32E-12
Ra-228	1.36E-12	1.36E-12
Th-228	6.03E-11	6.03E-11
Th-228	1.29E-12	1.29E-12
Th-230	2.71E-12	2.71E-12
Ra-226	4.92E-13	4.92E-13
Pb-210	6.59E-15	6.59E-15
Th-232	3.44E-12	3.44E-12
Ra-228	1.33E-11	1.33E-11
Th-228	4.37E-10	4.37E-10
U-234	2.21E-12	2.21E-12
Th-230	4.66E-16	4.66E-16
Ra-226	6.24E-17	6.24E-17
Pb-210	4.82E-19	4.82E-19
U-235	3.95E-12	3.95E-12
Pa-231	2.60E-15	2.60E-15
Ac-227	2.80E-15	2.80E-15
U-238	3.34E-12	3.34E-12
U-234	1.17E-16	1.17E-16

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:45:01 Page: 30 **
 Title : SLDS DCGL Resident
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld
 Evaluation Time: 10.0000000 years

Th-230	1.32E-20	1.32E-20
Ra-226	1.76E-21	1.76E-21
Pb-210	8.55E-24	8.55E-24

Source: 4

Nuclide	Receptor	Total
	1	
Ac-227	1.23E-11	1.23E-11
Pa-231	6.43E-12	6.43E-12
Ac-227	1.07E-11	1.07E-11
Pb-210	1.66E-12	1.66E-12
Ra-226	4.61E-11	4.61E-11
Pb-210	1.32E-12	1.32E-12
Ra-228	1.36E-12	1.36E-12
Th-228	6.03E-11	6.03E-11
Th-228	1.29E-12	1.29E-12
Th-230	2.71E-12	2.71E-12
Ra-226	4.92E-13	4.92E-13
Pb-210	6.59E-15	6.59E-15
Th-232	3.44E-12	3.44E-12
Ra-228	1.33E-11	1.33E-11
Th-228	4.37E-10	4.37E-10
U-234	2.21E-12	2.21E-12
Th-230	4.66E-16	4.66E-16
Ra-226	6.24E-17	6.24E-17
Pb-210	4.82E-19	4.82E-19
U-235	3.95E-12	3.95E-12
Pa-231	2.60E-15	2.60E-15
Ac-227	2.80E-15	2.80E-15
U-238	3.34E-12	3.34E-12
U-234	1.17E-16	1.17E-16
Th-230	1.32E-20	1.32E-20
Ra-226	1.76E-21	1.76E-21
Pb-210	8.55E-24	8.55E-24

Source: 5

Nuclide	Receptor	Total
	1	
Ac-227	1.23E-11	1.23E-11
Pa-231	6.43E-12	6.43E-12
Ac-227	1.07E-11	1.07E-11
Pb-210	1.66E-12	1.66E-12
Ra-226	4.61E-11	4.61E-11

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:45:01 Page: 31 **
Title : SLDS DCGL Resident
Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld
Evaluation Time: 10.0000000 years

Pb-210	1.32E-12	1.32E-12
Ra-228	1.36E-12	1.36E-12
Th-228	6.03E-11	6.03E-11
Th-228	1.29E-12	1.29E-12
Th-230	2.71E-12	2.71E-12
Ra-226	4.92E-13	4.92E-13
Pb-210	6.59E-15	6.59E-15
Th-232	3.44E-12	3.44E-12
Ra-228	1.33E-11	1.33E-11
Th-228	4.37E-10	4.37E-10
U-234	2.21E-12	2.21E-12
Th-230	4.66E-16	4.66E-16
Ra-226	6.24E-17	6.24E-17
Pb-210	4.82E-19	4.82E-19
U-235	3.95E-12	3.95E-12
Pa-231	2.60E-15	2.60E-15
Ac-227	2.80E-15	2.80E-15
U-238	3.34E-12	3.34E-12
U-234	1.17E-16	1.17E-16
Th-230	1.32E-20	1.32E-20
Ra-226	1.76E-21	1.76E-21
Pb-210	8.55E-24	8.55E-24

RESRAD-BUILD Risk Tables

[Risk]

	Source 1	Source 2	Source 3	Source 4	Source 5	Total
Receptor 1	3.63E-09	5.67E-10	5.67E-10	5.67E-10	5.67E-10	5.90E-09
Total	3.63E-09	5.67E-10	5.67E-10	5.67E-10	5.67E-10	5.90E-09

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:45:01 Page: 33 **

Title : SLDS DCGL Resident

Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld

Evaluation Time: 20.0000000 years

Pathway Detail of Risks

[Risk]

Source: 1	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	1.10E-09	1.16E-10	3.48E-15	6.54E-16	1.08E-12	2.42E-09	0.00E+00	3.63E-09
Total	1.10E-09	1.16E-10	3.48E-15	6.54E-16	1.08E-12	2.42E-09	0.00E+00	3.63E-09
Source: 2	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	6.01E-11	2.33E-11	6.95E-16	1.31E-16	2.15E-13	4.83E-10	0.00E+00	5.67E-10
Total	6.01E-11	2.33E-11	6.95E-16	1.31E-16	2.15E-13	4.83E-10	0.00E+00	5.67E-10
Source: 3	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	6.01E-11	2.33E-11	6.95E-16	1.31E-16	2.15E-13	4.83E-10	0.00E+00	5.67E-10
Total	6.01E-11	2.33E-11	6.95E-16	1.31E-16	2.15E-13	4.83E-10	0.00E+00	5.67E-10
Source: 4	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	6.01E-11	2.33E-11	6.95E-16	1.31E-16	2.15E-13	4.83E-10	0.00E+00	5.67E-10
Total	6.01E-11	2.33E-11	6.95E-16	1.31E-16	2.15E-13	4.83E-10	0.00E+00	5.67E-10
Source: 5	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	6.01E-11	2.33E-11	6.95E-16	1.31E-16	2.15E-13	4.83E-10	0.00E+00	5.67E-10
Total	6.01E-11	2.33E-11	6.95E-16	1.31E-16	2.15E-13	4.83E-10	0.00E+00	5.67E-10

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:45:01 Page: 34 **
 Title : SLDS DCGL Resident
 Input File : C:\RESRAD Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld
 Evaluation Time: 20.0000000 years

Nuclide Detail of Risks

[Risk]

Source: 1

Nuclide	Receptor 1	Total
Ac-227	5.70E-11	5.70E-11
Pa-231	2.62E-11	2.62E-11
Ac-227	9.62E-11	9.62E-11
Pb-210	4.95E-12	4.95E-12
Ra-226	4.91E-10	4.91E-10
Pb-210	7.09E-12	7.09E-12
Ra-228	5.22E-12	5.22E-12
Th-228	9.73E-11	9.73E-11
Th-228	1.79E-13	1.79E-13
Th-230	6.13E-12	6.13E-12
Ra-226	7.46E-12	7.46E-12
Pb-210	5.60E-14	5.60E-14
Th-232	7.60E-12	7.60E-12
Ra-228	1.99E-10	1.99E-10
Th-228	2.54E-09	2.54E-09
U-234	5.07E-12	5.07E-12
Th-230	1.37E-15	1.37E-15
Ra-226	1.27E-15	1.27E-15
Pb-210	6.35E-18	6.35E-18
U-235	4.68E-11	4.68E-11
Pa-231	1.63E-14	1.63E-14
Ac-227	4.08E-14	4.08E-14
U-238	3.08E-11	3.08E-11
U-234	3.51E-16	3.51E-16
Th-230	4.86E-20	4.86E-20
Ra-226	4.67E-20	4.67E-20
Pb-210	1.74E-22	1.74E-22

Source: 2

Nuclide	Receptor 1	Total
Ac-227	5.46E-12	5.46E-12
Pa-231	2.96E-12	2.96E-12
Ac-227	7.79E-12	7.79E-12
Pb-210	6.52E-13	6.52E-13
Ra-226	4.39E-11	4.39E-11
Pb-210	7.90E-13	7.90E-13

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:45:01 Page: 35 **

Title : SLDS DCGL Resident

Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld

Evaluation Time: 20.0000000 years

Ra-228	3.54E-13	3.54E-13
Th-228	1.78E-11	1.78E-11
Th-228	3.29E-14	3.29E-14
Th-230	1.16E-12	1.16E-12
Ra-226	6.65E-13	6.65E-13
Pb-210	5.31E-15	5.31E-15
Th-232	1.47E-12	1.47E-12
Ra-228	1.20E-11	1.20E-11
Th-228	4.66E-10	4.66E-10
U-234	9.44E-13	9.44E-13
Th-230	2.53E-16	2.53E-16
Ra-226	1.13E-16	1.13E-16
Pb-210	5.10E-19	5.10E-19
U-235	2.78E-12	2.78E-12
Pa-231	1.58E-15	1.58E-15
Ac-227	2.90E-15	2.90E-15
U-238	2.24E-12	2.24E-12
U-234	6.34E-17	6.34E-17
Th-230	8.55E-21	8.55E-21
Ra-226	4.14E-21	4.14E-21
Pb-210	1.20E-23	1.20E-23

Source: 3

Nuclide	Receptor	Total
	1	
Ac-227	5.46E-12	5.46E-12
Pa-231	2.96E-12	2.96E-12
Ac-227	7.79E-12	7.79E-12
Pb-210	6.52E-13	6.52E-13
Ra-226	4.39E-11	4.39E-11
Pb-210	7.90E-13	7.90E-13
Ra-228	3.54E-13	3.54E-13
Th-228	1.78E-11	1.78E-11
Th-228	3.29E-14	3.29E-14
Th-230	1.16E-12	1.16E-12
Ra-226	6.65E-13	6.65E-13
Pb-210	5.31E-15	5.31E-15
Th-232	1.47E-12	1.47E-12
Ra-228	1.20E-11	1.20E-11
Th-228	4.66E-10	4.66E-10
U-234	9.44E-13	9.44E-13
Th-230	2.53E-16	2.53E-16
Ra-226	1.13E-16	1.13E-16
Pb-210	5.10E-19	5.10E-19
U-235	2.78E-12	2.78E-12
Pa-231	1.58E-15	1.58E-15
Ac-227	2.90E-15	2.90E-15
U-238	2.24E-12	2.24E-12
U-234	6.34E-17	6.34E-17

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:45:01 Page: 36 **

Title : SLDS DCGL Resident

Input File : C:\RESRAD Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld

Evaluation Time: 20.0000000 years

Th-230	8.55E-21	8.55E-21
Ra-226	4.14E-21	4.14E-21
Pb-210	1.20E-23	1.20E-23

Source: 4

Nuclide	Receptor	Total
	1	
Ac-227	5.46E-12	5.46E-12
Pa-231	2.96E-12	2.96E-12
Ac-227	7.79E-12	7.79E-12
Pb-210	6.52E-13	6.52E-13
Ra-226	4.39E-11	4.39E-11
Pb-210	7.90E-13	7.90E-13
Ra-228	3.54E-13	3.54E-13
Th-228	1.78E-11	1.78E-11
Th-228	3.29E-14	3.29E-14
Th-230	1.16E-12	1.16E-12
Ra-226	6.65E-13	6.65E-13
Pb-210	5.31E-15	5.31E-15
Th-232	1.47E-12	1.47E-12
Ra-228	1.20E-11	1.20E-11
Th-228	4.66E-10	4.66E-10
U-234	9.44E-13	9.44E-13
Th-230	2.53E-16	2.53E-16
Ra-226	1.13E-16	1.13E-16
Pb-210	5.10E-19	5.10E-19
U-235	2.78E-12	2.78E-12
Pa-231	1.58E-15	1.58E-15
Ac-227	2.90E-15	2.90E-15
U-238	2.24E-12	2.24E-12
U-234	6.34E-17	6.34E-17
Th-230	8.55E-21	8.55E-21
Ra-226	4.14E-21	4.14E-21
Pb-210	1.20E-23	1.20E-23

Source: 5

Nuclide	Receptor	Total
	1	
Ac-227	5.46E-12	5.46E-12
Pa-231	2.96E-12	2.96E-12
Ac-227	7.79E-12	7.79E-12
Pb-210	6.52E-13	6.52E-13
Ra-226	4.39E-11	4.39E-11

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:45:01 Page: 37 **
Title : SLDS DCGL Resident
Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld
Evaluation Time: 20.0000000 years

Pb-210	7.90E-13	7.90E-13
Ra-228	3.54E-13	3.54E-13
Th-228	1.78E-11	1.78E-11
Th-228	3.29E-14	3.29E-14
Th-230	1.16E-12	1.16E-12
Ra-226	6.65E-13	6.65E-13
Pb-210	5.31E-15	5.31E-15
Th-232	1.47E-12	1.47E-12
Ra-228	1.20E-11	1.20E-11
Th-228	4.66E-10	4.66E-10
U-234	9.44E-13	9.44E-13
Th-230	2.53E-16	2.53E-16
Ra-226	1.13E-16	1.13E-16
Pb-210	5.10E-19	5.10E-19
U-235	2.78E-12	2.78E-12
Pa-231	1.58E-15	1.58E-15
Ac-227	2.90E-15	2.90E-15
U-238	2.24E-12	2.24E-12
U-234	6.34E-17	6.34E-17
Th-230	8.55E-21	8.55E-21
Ra-226	4.14E-21	4.14E-21
Pb-210	1.20E-23	1.20E-23

RESRAD-BUILD Risk Tables

[Risk]

	Source 1	Source 2	Source 3	Source 4	Source 5	Total
Receptor 1	3.50E-09	5.41E-10	5.41E-10	5.41E-10	5.41E-10	5.67E-09
Total	3.50E-09	5.41E-10	5.41E-10	5.41E-10	5.41E-10	5.67E-09

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:45:01 Page: 39 **

Title : SLDS DCGL Resident

Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld

Evaluation Time: 30.0000000 years

Pathway Detail of Risks

[Risk]

Source: 1	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	1.10E-09	1.97E-23	1.42E-27	1.11E-28	4.38E-25	2.41E-09	0.00E+00	3.50E-09
Total	1.10E-09	1.97E-23	1.42E-27	1.11E-28	4.38E-25	2.41E-09	0.00E+00	3.50E-09
Source: 2	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	5.99E-11	3.95E-24	2.83E-28	2.22E-29	8.76E-26	4.81E-10	0.00E+00	5.41E-10
Total	5.99E-11	3.95E-24	2.83E-28	2.22E-29	8.76E-26	4.81E-10	0.00E+00	5.41E-10
Source: 3	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	5.99E-11	3.95E-24	2.83E-28	2.22E-29	8.76E-26	4.81E-10	0.00E+00	5.41E-10
Total	5.99E-11	3.95E-24	2.83E-28	2.22E-29	8.76E-26	4.81E-10	0.00E+00	5.41E-10
Source: 4	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	5.99E-11	3.95E-24	2.83E-28	2.22E-29	8.76E-26	4.81E-10	0.00E+00	5.41E-10
Total	5.99E-11	3.95E-24	2.83E-28	2.22E-29	8.76E-26	4.81E-10	0.00E+00	5.41E-10
Source: 5	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	5.99E-11	3.95E-24	2.83E-28	2.22E-29	8.76E-26	4.81E-10	0.00E+00	5.41E-10
Total	5.99E-11	3.95E-24	2.83E-28	2.22E-29	8.76E-26	4.81E-10	0.00E+00	5.41E-10

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:45:01 Page: 40 **
Title : SLDS DCGL Resident
Input File : C:\RESRAD Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld
Evaluation Time: 30.0000000 years

Nuclide Detail of Risks

[Risk]

Source: 1

Nuclide	Receptor 1	Total
Ac-227	2.90E-11	2.90E-11
Pa-231	1.33E-11	1.33E-11
Ac-227	8.78E-11	8.78E-11
Pb-210	1.62E-12	1.62E-12
Ra-226	4.83E-10	4.83E-10
Pb-210	4.69E-12	4.69E-12
Ra-228	1.42E-12	1.42E-12
Th-228	2.83E-11	2.83E-11
Th-228	4.53E-15	4.53E-15
Th-230	3.70E-13	3.70E-13
Ra-226	9.49E-12	9.49E-12
Pb-210	5.78E-14	5.78E-14
Th-232	2.88E-13	2.88E-13
Ra-228	1.94E-10	1.94E-10
Th-228	2.58E-09	2.58E-09
U-234	3.69E-13	3.69E-13
Th-230	1.53E-16	1.53E-16
Ra-226	2.04E-15	2.04E-15
Pb-210	9.42E-18	9.42E-18
U-235	4.24E-11	4.24E-11
Pa-231	1.26E-14	1.26E-14
Ac-227	5.28E-14	5.28E-14
U-238	2.67E-11	2.67E-11
U-234	4.69E-17	4.69E-17
Th-230	1.01E-20	1.01E-20
Ra-226	9.28E-20	9.28E-20
Pb-210	3.50E-22	3.50E-22

Source: 2

Nuclide	Receptor 1	Total
Ac-227	1.49E-12	1.49E-12
Pa-231	3.84E-13	3.84E-13
Ac-227	4.53E-12	4.53E-12
Pb-210	7.79E-14	7.79E-14
Ra-226	4.26E-11	4.26E-11
Pb-210	2.25E-13	2.25E-13

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:45:01 Page: 41 **

Title : SLDS DCGL Resident

Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld

Evaluation Time: 30.0000000 years

Ra-228	7.84E-14	7.84E-14
Th-228	5.17E-12	5.17E-12
Th-228	8.28E-16	8.28E-16
Th-230	4.68E-15	4.68E-15
Ra-226	8.38E-13	8.38E-13
Pb-210	2.78E-15	2.78E-15
Th-232	4.10E-15	4.10E-15
Ra-228	1.08E-11	1.08E-11
Th-228	4.72E-10	4.72E-10
U-234	4.35E-15	4.35E-15
Th-230	1.94E-18	1.94E-18
Ra-226	1.80E-16	1.80E-16
Pb-210	4.53E-19	4.53E-19
U-235	1.93E-12	1.93E-12
Pa-231	3.66E-16	3.66E-16
Ac-227	2.72E-15	2.72E-15
U-238	1.43E-12	1.43E-12
U-234	5.52E-19	5.52E-19
Th-230	1.28E-22	1.28E-22
Ra-226	8.20E-21	8.20E-21
Pb-210	1.68E-23	1.68E-23

Source: 3

Nuclide	Receptor	Total
	1	
Ac-227	1.49E-12	1.49E-12
Pa-231	3.84E-13	3.84E-13
Ac-227	4.53E-12	4.53E-12
Pb-210	7.79E-14	7.79E-14
Ra-226	4.26E-11	4.26E-11
Pb-210	2.25E-13	2.25E-13
Ra-228	7.84E-14	7.84E-14
Th-228	5.17E-12	5.17E-12
Th-228	8.28E-16	8.28E-16
Th-230	4.68E-15	4.68E-15
Ra-226	8.38E-13	8.38E-13
Pb-210	2.78E-15	2.78E-15
Th-232	4.10E-15	4.10E-15
Ra-228	1.08E-11	1.08E-11
Th-228	4.72E-10	4.72E-10
U-234	4.35E-15	4.35E-15
Th-230	1.94E-18	1.94E-18
Ra-226	1.80E-16	1.80E-16
Pb-210	4.53E-19	4.53E-19
U-235	1.93E-12	1.93E-12
Pa-231	3.66E-16	3.66E-16
Ac-227	2.72E-15	2.72E-15
U-238	1.43E-12	1.43E-12
U-234	5.52E-19	5.52E-19

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:45:01 Page: 42 **

Title : SLDS DCGL Resident

Input File : C:\RESRAD Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld

Evaluation Time: 30.0000000 years

Th-230	1.28E-22	1.28E-22
Ra-226	8.20E-21	8.20E-21
Pb-210	1.68E-23	1.68E-23

Source: 4

Nuclide	Receptor	Total
	1	
Ac-227	1.49E-12	1.49E-12
Pa-231	3.84E-13	3.84E-13
Ac-227	4.53E-12	4.53E-12
Pb-210	7.79E-14	7.79E-14
Ra-226	4.26E-11	4.26E-11
Pb-210	2.25E-13	2.25E-13
Ra-228	7.84E-14	7.84E-14
Th-228	5.17E-12	5.17E-12
Th-228	8.28E-16	8.28E-16
Th-230	4.68E-15	4.68E-15
Ra-226	8.38E-13	8.38E-13
Pb-210	2.78E-15	2.78E-15
Th-232	4.10E-15	4.10E-15
Ra-228	1.08E-11	1.08E-11
Th-228	4.72E-10	4.72E-10
U-234	4.35E-15	4.35E-15
Th-230	1.94E-18	1.94E-18
Ra-226	1.80E-16	1.80E-16
Pb-210	4.53E-19	4.53E-19
U-235	1.93E-12	1.93E-12
Pa-231	3.66E-16	3.66E-16
Ac-227	2.72E-15	2.72E-15
U-238	1.43E-12	1.43E-12
U-234	5.52E-19	5.52E-19
Th-230	1.28E-22	1.28E-22
Ra-226	8.20E-21	8.20E-21
Pb-210	1.68E-23	1.68E-23

Source: 5

Nuclide	Receptor	Total
	1	
Ac-227	1.49E-12	1.49E-12
Pa-231	3.84E-13	3.84E-13
Ac-227	4.53E-12	4.53E-12
Pb-210	7.79E-14	7.79E-14
Ra-226	4.26E-11	4.26E-11

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:45:01 Page: 43 **

Title : SLDS DCGL Resident

Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld

Evaluation Time: 30.0000000 years

Pb-210	2.25E-13	2.25E-13
Ra-228	7.84E-14	7.84E-14
Th-228	5.17E-12	5.17E-12
Th-228	8.28E-16	8.28E-16
Th-230	4.68E-15	4.68E-15
Ra-226	8.38E-13	8.38E-13
Pb-210	2.78E-15	2.78E-15
Th-232	4.10E-15	4.10E-15
Ra-228	1.08E-11	1.08E-11
Th-228	4.72E-10	4.72E-10
U-234	4.35E-15	4.35E-15
Th-230	1.94E-18	1.94E-18
Ra-226	1.80E-16	1.80E-16
Pb-210	4.53E-19	4.53E-19
U-235	1.93E-12	1.93E-12
Pa-231	3.66E-16	3.66E-16
Ac-227	2.72E-15	2.72E-15
U-238	1.43E-12	1.43E-12
U-234	5.52E-19	5.52E-19
Th-230	1.28E-22	1.28E-22
Ra-226	8.20E-21	8.20E-21
Pb-210	1.68E-23	1.68E-23

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:45:01 Page: 44 **
 Title : SLDS DCGL Resident
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld
 Evaluation Time: 100.000008 years

RESRAD-BUILD Risk Tables

Source Contributions to Receptor Risks

		[Risk]					
		Source 1	Source 2	Source 3	Source 4	Source 5	Total
Receptor	1	3.50E-09	5.41E-10	5.41E-10	5.41E-10	5.41E-10	5.67E-09
Total		3.50E-09	5.41E-10	5.41E-10	5.41E-10	5.41E-10	5.67E-09

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:45:01 Page: 45 **

Title : SLDS DCGL Resident

Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld

Evaluation Time: 100.000008 years

Pathway Detail of Risks

[Risk]

Source: 1								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	1.10E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.41E-09	0.00E+00	3.50E-09
Total	1.10E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.41E-09	0.00E+00	3.50E-09
Source: 2								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	5.99E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.81E-10	0.00E+00	5.41E-10
Total	5.99E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.81E-10	0.00E+00	5.41E-10
Source: 3								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	5.99E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.81E-10	0.00E+00	5.41E-10
Total	5.99E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.81E-10	0.00E+00	5.41E-10
Source: 4								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	5.99E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.81E-10	0.00E+00	5.41E-10
Total	5.99E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.81E-10	0.00E+00	5.41E-10
Source: 5								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	5.99E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.81E-10	0.00E+00	5.41E-10
Total	5.99E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.81E-10	0.00E+00	5.41E-10

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:45:01 Page: 46 **
 Title : SLDS DCGL Resident
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld
 Evaluation Time: 100.000008 years

Nuclide Detail of Risks

[Risk]

Source: 1

Nuclide	Receptor 1	Total
Ac-227	3.12E-12	3.12E-12
Pa-231	1.32E-11	1.32E-11
Ac-227	1.13E-10	1.13E-10
Pb-210	1.82E-13	1.82E-13
Ra-226	4.68E-10	4.68E-10
Pb-210	5.96E-12	5.96E-12
Ra-228	3.06E-16	3.06E-16
Th-228	6.12E-15	6.12E-15
Th-228	4.29E-26	4.29E-26
Th-230	3.69E-13	3.69E-13
Ra-226	2.39E-11	2.39E-11
Pb-210	2.27E-13	2.27E-13
Th-232	2.88E-13	2.88E-13
Ra-228	1.96E-10	1.96E-10
Th-228	2.61E-09	2.61E-09
U-234	3.69E-13	3.69E-13
Th-230	3.91E-16	3.91E-16
Ra-226	1.28E-14	1.28E-14
Pb-210	9.91E-17	9.91E-17
U-235	4.24E-11	4.24E-11
Pa-231	3.22E-14	3.22E-14
Ac-227	2.08E-13	2.08E-13
U-238	2.67E-11	2.67E-11
U-234	1.20E-16	1.20E-16
Th-230	6.38E-20	6.38E-20
Ra-226	1.41E-18	1.41E-18
Pb-210	9.27E-21	9.27E-21

Source: 2

Nuclide	Receptor 1	Total
Ac-227	1.61E-13	1.61E-13
Pa-231	3.84E-13	3.84E-13
Ac-227	5.85E-12	5.85E-12
Pb-210	8.76E-15	8.76E-15
Ra-226	4.13E-11	4.13E-11
Pb-210	2.87E-13	2.87E-13

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:45:01 Page: 47 **

Title : SLDS DCGL Resident

Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld

Evaluation Time: 100.000008 years

Ra-228	1.70E-17	1.70E-17
Th-228	1.12E-15	1.12E-15
Th-228	7.84E-27	7.84E-27
Th-230	4.68E-15	4.68E-15
Ra-226	2.11E-12	2.11E-12
Pb-210	1.09E-14	1.09E-14
Th-232	4.10E-15	4.10E-15
Ra-228	1.08E-11	1.08E-11
Th-228	4.77E-10	4.77E-10
U-234	4.35E-15	4.35E-15
Th-230	4.95E-18	4.95E-18
Ra-226	1.13E-15	1.13E-15
Pb-210	4.76E-18	4.76E-18
U-235	1.93E-12	1.93E-12
Pa-231	9.35E-16	9.35E-16
Ac-227	1.07E-14	1.07E-14
U-238	1.43E-12	1.43E-12
U-234	1.41E-18	1.41E-18
Th-230	8.08E-22	8.08E-22
Ra-226	1.24E-19	1.24E-19
Pb-210	4.45E-22	4.45E-22

Source: 3

Nuclide	Receptor	Total
	1	
Ac-227	1.61E-13	1.61E-13
Pa-231	3.84E-13	3.84E-13
Ac-227	5.85E-12	5.85E-12
Pb-210	8.76E-15	8.76E-15
Ra-226	4.13E-11	4.13E-11
Pb-210	2.87E-13	2.87E-13
Ra-228	1.70E-17	1.70E-17
Th-228	1.12E-15	1.12E-15
Th-228	7.84E-27	7.84E-27
Th-230	4.68E-15	4.68E-15
Ra-226	2.11E-12	2.11E-12
Pb-210	1.09E-14	1.09E-14
Th-232	4.10E-15	4.10E-15
Ra-228	1.08E-11	1.08E-11
Th-228	4.77E-10	4.77E-10
U-234	4.35E-15	4.35E-15
Th-230	4.95E-18	4.95E-18
Ra-226	1.13E-15	1.13E-15
Pb-210	4.76E-18	4.76E-18
U-235	1.93E-12	1.93E-12
Pa-231	9.35E-16	9.35E-16
Ac-227	1.07E-14	1.07E-14
U-238	1.43E-12	1.43E-12
U-234	1.41E-18	1.41E-18

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:45:01 Page: 48 **

Title : SLDS DCGL Resident

Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld

Evaluation Time: 100.000008 years

Th-230	8.08E-22	8.08E-22
Ra-226	1.24E-19	1.24E-19
Pb-210	4.45E-22	4.45E-22

Source: 4

Nuclide	Receptor	Total
	1	
Ac-227	1.61E-13	1.61E-13
Pa-231	3.84E-13	3.84E-13
Ac-227	5.85E-12	5.85E-12
Pb-210	8.76E-15	8.76E-15
Ra-226	4.13E-11	4.13E-11
Pb-210	2.87E-13	2.87E-13
Ra-228	1.70E-17	1.70E-17
Th-228	1.12E-15	1.12E-15
Th-228	7.84E-27	7.84E-27
Th-230	4.68E-15	4.68E-15
Ra-226	2.11E-12	2.11E-12
Pb-210	1.09E-14	1.09E-14
Th-232	4.10E-15	4.10E-15
Ra-228	1.08E-11	1.08E-11
Th-228	4.77E-10	4.77E-10
U-234	4.35E-15	4.35E-15
Th-230	4.95E-18	4.95E-18
Ra-226	1.13E-15	1.13E-15
Pb-210	4.76E-18	4.76E-18
U-235	1.93E-12	1.93E-12
Pa-231	9.35E-16	9.35E-16
Ac-227	1.07E-14	1.07E-14
U-238	1.43E-12	1.43E-12
U-234	1.41E-18	1.41E-18
Th-230	8.08E-22	8.08E-22
Ra-226	1.24E-19	1.24E-19
Pb-210	4.45E-22	4.45E-22

Source: 5

Nuclide	Receptor	Total
	1	
Ac-227	1.61E-13	1.61E-13
Pa-231	3.84E-13	3.84E-13
Ac-227	5.85E-12	5.85E-12
Pb-210	8.76E-15	8.76E-15
Ra-226	4.13E-11	4.13E-11

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:45:01 Page: 49 **

Title : SLDS DCGL Resident

Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld

Evaluation Time: 100.000008 years

Pb-210 2.87E-13 2.87E-13

Ra-228 1.70E-17 1.70E-17

Th-228 1.12E-15 1.12E-15

Th-228 7.84E-27 7.84E-27

Th-230 4.68E-15 4.68E-15

Ra-226 2.11E-12 2.11E-12

Pb-210 1.09E-14 1.09E-14

Th-232 4.10E-15 4.10E-15

Ra-228 1.08E-11 1.08E-11

Th-228 4.77E-10 4.77E-10

U-234 4.35E-15 4.35E-15

Th-230 4.95E-18 4.95E-18

Ra-226 1.13E-15 1.13E-15

Pb-210 4.76E-18 4.76E-18

U-235 1.93E-12 1.93E-12

Pa-231 9.35E-16 9.35E-16

Ac-227 1.07E-14 1.07E-14

U-238 1.43E-12 1.43E-12

U-234 1.41E-18 1.41E-18

Th-230 8.08E-22 8.08E-22

Ra-226 1.24E-19 1.24E-19

Pb-210 4.45E-22 4.45E-22

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:45:01 Page: 50 **
 Title : SLDS DCGL Resident
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld
 Evaluation Time: 300.000031 years

RESRAD-BUILD Risk Tables

Source Contributions to Receptor Risks

[Risk]						
	Source 1	Source 2	Source 3	Source 4	Source 5	Total
Receptor 1	3.50E-09	5.41E-10	5.41E-10	5.41E-10	5.41E-10	5.67E-09
Total	3.50E-09	5.41E-10	5.41E-10	5.41E-10	5.41E-10	5.67E-09

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:45:01 Page: 51 **

Title : SLDS DCGL Resident

Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld

Evaluation Time: 300.000031 years

Pathway Detail of Risks

[Risk]

Source: 1								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	1.10E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.41E-09	0.00E+00	3.50E-09
Total	1.10E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.41E-09	0.00E+00	3.50E-09
Source: 2								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	5.99E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.81E-10	0.00E+00	5.41E-10
Total	5.99E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.81E-10	0.00E+00	5.41E-10
Source: 3								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	5.99E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.81E-10	0.00E+00	5.41E-10
Total	5.99E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.81E-10	0.00E+00	5.41E-10
Source: 4								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	5.99E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.81E-10	0.00E+00	5.41E-10
Total	5.99E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.81E-10	0.00E+00	5.41E-10
Source: 5								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	5.99E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.81E-10	0.00E+00	5.41E-10
Total	5.99E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.81E-10	0.00E+00	5.41E-10

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:45:01 Page: 52 **
 Title : SLDS DCGL Resident
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld
 Evaluation Time: 300.000031 years

Nuclide Detail of Risks

[Risk]

Source: 1

Nuclide	Receptor 1	Total
Ac-227	5.35E-15	5.35E-15
Pa-231	1.32E-11	1.32E-11
Ac-227	1.16E-10	1.16E-10
Pb-210	3.54E-16	3.54E-16
Ra-226	4.29E-10	4.29E-10
Pb-210	5.64E-12	5.64E-12
Ra-228	1.04E-26	1.04E-26
Th-228	2.07E-25	2.07E-25
Th-228	0.00E+00	0.00E+00
Th-230	3.69E-13	3.69E-13
Ra-226	6.27E-11	6.27E-11
Pb-210	7.34E-13	7.34E-13
Th-232	2.88E-13	2.88E-13
Ra-228	1.96E-10	1.96E-10
Th-228	2.61E-09	2.61E-09
U-234	3.69E-13	3.69E-13
Th-230	1.07E-15	1.07E-15
Ra-226	9.29E-14	9.29E-14
Pb-210	9.87E-16	9.87E-16
U-235	4.24E-11	4.24E-11
Pa-231	8.81E-14	8.81E-14
Ac-227	6.99E-13	6.99E-13
U-238	2.67E-11	2.67E-11
U-234	3.28E-16	3.28E-16
Th-230	4.76E-19	4.76E-19
Ra-226	2.79E-17	2.79E-17
Pb-210	2.72E-19	2.72E-19

Source: 2

Nuclide	Receptor 1	Total
Ac-227	2.76E-16	2.76E-16
Pa-231	3.82E-13	3.82E-13
Ac-227	5.98E-12	5.98E-12
Pb-210	1.70E-17	1.70E-17
Ra-226	3.79E-11	3.79E-11
Pb-210	2.71E-13	2.71E-13

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:45:01 Page: 53 **

Title : SLDS DCGL Resident

Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld

Evaluation Time: 300.000031 years

Ra-228	5.74E-28	5.74E-28
Th-228	3.79E-26	3.79E-26
Th-228	0.00E+00	0.00E+00
Th-230	4.67E-15	4.67E-15
Ra-226	5.54E-12	5.54E-12
Pb-210	3.52E-14	3.52E-14
Th-232	4.10E-15	4.10E-15
Ra-228	1.08E-11	1.08E-11
Th-228	4.77E-10	4.77E-10
U-234	4.35E-15	4.35E-15
Th-230	1.35E-17	1.35E-17
Ra-226	8.21E-15	8.21E-15
Pb-210	4.74E-17	4.74E-17
U-235	1.93E-12	1.93E-12
Pa-231	2.56E-15	2.56E-15
Ac-227	3.60E-14	3.60E-14
U-238	1.43E-12	1.43E-12
U-234	3.87E-18	3.87E-18
Th-230	6.03E-21	6.03E-21
Ra-226	2.46E-18	2.46E-18
Pb-210	1.31E-20	1.31E-20

Source: 3

Nuclide	Receptor 1	Total
Ac-227	2.76E-16	2.76E-16
Pa-231	3.82E-13	3.82E-13
Ac-227	5.98E-12	5.98E-12
Pb-210	1.70E-17	1.70E-17
Ra-226	3.79E-11	3.79E-11
Pb-210	2.71E-13	2.71E-13
Ra-228	5.74E-28	5.74E-28
Th-228	3.79E-26	3.79E-26
Th-228	0.00E+00	0.00E+00
Th-230	4.67E-15	4.67E-15
Ra-226	5.54E-12	5.54E-12
Pb-210	3.52E-14	3.52E-14
Th-232	4.10E-15	4.10E-15
Ra-228	1.08E-11	1.08E-11
Th-228	4.77E-10	4.77E-10
U-234	4.35E-15	4.35E-15
Th-230	1.35E-17	1.35E-17
Ra-226	8.21E-15	8.21E-15
Pb-210	4.74E-17	4.74E-17
U-235	1.93E-12	1.93E-12
Pa-231	2.56E-15	2.56E-15
Ac-227	3.60E-14	3.60E-14
U-238	1.43E-12	1.43E-12
U-234	3.87E-18	3.87E-18

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:45:01 Page: 54 **

Title : SLDS DCGL Resident

Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld

Evaluation Time: 300.000031 years

Th-230	6.03E-21	6.03E-21
Ra-226	2.46E-18	2.46E-18
Pb-210	1.31E-20	1.31E-20

Source: 4

Nuclide	Receptor	Total
	1	
Ac-227	2.76E-16	2.76E-16
Pa-231	3.82E-13	3.82E-13
Ac-227	5.98E-12	5.98E-12
Pb-210	1.70E-17	1.70E-17
Ra-226	3.79E-11	3.79E-11
Pb-210	2.71E-13	2.71E-13
Ra-228	5.74E-28	5.74E-28
Th-228	3.79E-26	3.79E-26
Th-228	0.00E+00	0.00E+00
Th-230	4.67E-15	4.67E-15
Ra-226	5.54E-12	5.54E-12
Pb-210	3.52E-14	3.52E-14
Th-232	4.10E-15	4.10E-15
Ra-228	1.08E-11	1.08E-11
Th-228	4.77E-10	4.77E-10
U-234	4.35E-15	4.35E-15
Th-230	1.35E-17	1.35E-17
Ra-226	8.21E-15	8.21E-15
Pb-210	4.74E-17	4.74E-17
U-235	1.93E-12	1.93E-12
Pa-231	2.56E-15	2.56E-15
Ac-227	3.60E-14	3.60E-14
U-238	1.43E-12	1.43E-12
U-234	3.87E-18	3.87E-18
Th-230	6.03E-21	6.03E-21
Ra-226	2.46E-18	2.46E-18
Pb-210	1.31E-20	1.31E-20

Source: 5

Nuclide	Receptor	Total
	1	
Ac-227	2.76E-16	2.76E-16
Pa-231	3.82E-13	3.82E-13
Ac-227	5.98E-12	5.98E-12
Pb-210	1.70E-17	1.70E-17
Ra-226	3.79E-11	3.79E-11

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:45:01 Page: 55 **

Title : SLDS DCGL Resident

Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld

Evaluation Time: 300.000031 years

Pb-210 2.71E-13 2.71E-13

Ra-228 5.74E-28 5.74E-28

Th-228 3.79E-26 3.79E-26

Th-228 0.00E+00 0.00E+00

Th-230 4.67E-15 4.67E-15

Ra-226 5.54E-12 5.54E-12

Pb-210 3.52E-14 3.52E-14

Th-232 4.10E-15 4.10E-15

Ra-228 1.08E-11 1.08E-11

Th-228 4.77E-10 4.77E-10

U-234 4.35E-15 4.35E-15

Th-230 1.35E-17 1.35E-17

Ra-226 8.21E-15 8.21E-15

Pb-210 4.74E-17 4.74E-17

U-235 1.93E-12 1.93E-12

Pa-231 2.56E-15 2.56E-15

Ac-227 3.60E-14 3.60E-14

U-238 1.43E-12 1.43E-12

U-234 3.87E-18 3.87E-18

Th-230 6.03E-21 6.03E-21

Ra-226 2.46E-18 2.46E-18

Pb-210 1.31E-20 1.31E-20

RESRAD-BUILD Risk Tables

[Risk]

	Source 1	Source 2	Source 3	Source 4	Source 5	Total
Receptor 1	3.50E-09	5.41E-10	5.41E-10	5.41E-10	5.41E-10	5.67E-09
Total	3.50E-09	5.41E-10	5.41E-10	5.41E-10	5.41E-10	5.67E-09

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:45:01 Page: 57 **

Title : SLDS DCGL Resident

Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld

Evaluation Time: 1000.00000 years

Pathway Detail of Risks

[Risk]

Source: 1								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	1.10E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.41E-09	0.00E+00	3.50E-09
Total	1.10E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.41E-09	0.00E+00	3.50E-09
Source: 2								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	5.99E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.81E-10	0.00E+00	5.41E-10
Total	5.99E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.81E-10	0.00E+00	5.41E-10
Source: 3								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	5.99E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.81E-10	0.00E+00	5.41E-10
Total	5.99E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.81E-10	0.00E+00	5.41E-10
Source: 4								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	5.99E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.81E-10	0.00E+00	5.41E-10
Total	5.99E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.81E-10	0.00E+00	5.41E-10
Source: 5								
	External directly from Source	Inhalation	External from Deposition on floor	External from Suspension in air	Ingestion of Deposition	Radon	Ingestion of Source	Total
Receptor 1	5.99E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.81E-10	0.00E+00	5.41E-10
Total	5.99E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.81E-10	0.00E+00	5.41E-10

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:45:01 Page: 58 **
 Title : SLDS DCGL Resident
 Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld
 Evaluation Time: 1000.00000 years

Nuclide Detail of Risks

[Risk]

Source: 1

Nuclide	Receptor 1	Total
Ac-227	1.12E-24	1.12E-24
Pa-231	1.30E-11	1.30E-11
Ac-227	1.14E-10	1.14E-10
Pb-210	1.14E-25	1.14E-25
Ra-226	3.17E-10	3.17E-10
Pb-210	4.16E-12	4.16E-12
Ra-228	0.00E+00	0.00E+00
Th-228	0.00E+00	0.00E+00
Th-228	0.00E+00	0.00E+00
Th-230	3.66E-13	3.66E-13
Ra-226	1.74E-10	1.74E-10
Pb-210	2.20E-12	2.20E-12
Th-232	2.88E-13	2.88E-13
Ra-228	1.96E-10	1.96E-10
Th-228	2.61E-09	2.61E-09
U-234	3.68E-13	3.68E-13
Th-230	3.43E-15	3.43E-15
Ra-226	8.73E-13	8.73E-13
Pb-210	1.07E-14	1.07E-14
U-235	4.24E-11	4.24E-11
Pa-231	2.82E-13	2.82E-13
Ac-227	2.41E-12	2.41E-12
U-238	2.67E-11	2.67E-11
U-234	1.06E-15	1.06E-15
Th-230	4.92E-18	4.92E-18
Ra-226	8.65E-16	8.65E-16
Pb-210	1.02E-17	1.02E-17

Source: 2

Nuclide	Receptor 1	Total
Ac-227	5.78E-26	5.78E-26
Pa-231	3.77E-13	3.77E-13
Ac-227	5.90E-12	5.90E-12
Pb-210	5.48E-27	5.48E-27
Ra-226	2.80E-11	2.80E-11
Pb-210	2.00E-13	2.00E-13

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:45:01 Page: 59 **

Title : SLDS DCGL Resident

Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld

Evaluation Time: 1000.00000 years

Ra-228	0.00E+00	0.00E+00
Th-228	0.00E+00	0.00E+00
Th-228	0.00E+00	0.00E+00
Th-230	4.64E-15	4.64E-15
Ra-226	1.54E-11	1.54E-11
Pb-210	1.06E-13	1.06E-13
Th-232	4.10E-15	4.10E-15
Ra-228	1.08E-11	1.08E-11
Th-228	4.77E-10	4.77E-10
U-234	4.34E-15	4.34E-15
Th-230	4.34E-17	4.34E-17
Ra-226	7.71E-14	7.71E-14
Pb-210	5.12E-16	5.12E-16
U-235	1.93E-12	1.93E-12
Pa-231	8.17E-15	8.17E-15
Ac-227	1.24E-13	1.24E-13
U-238	1.43E-12	1.43E-12
U-234	1.24E-17	1.24E-17
Th-230	6.24E-20	6.24E-20
Ra-226	7.64E-17	7.64E-17
Pb-210	4.92E-19	4.92E-19

Source: 3

Nuclide	Receptor 1	Total
Ac-227	5.78E-26	5.78E-26
Pa-231	3.77E-13	3.77E-13
Ac-227	5.90E-12	5.90E-12
Pb-210	5.48E-27	5.48E-27
Ra-226	2.80E-11	2.80E-11
Pb-210	2.00E-13	2.00E-13
Ra-228	0.00E+00	0.00E+00
Th-228	0.00E+00	0.00E+00
Th-228	0.00E+00	0.00E+00
Th-230	4.64E-15	4.64E-15
Ra-226	1.54E-11	1.54E-11
Pb-210	1.06E-13	1.06E-13
Th-232	4.10E-15	4.10E-15
Ra-228	1.08E-11	1.08E-11
Th-228	4.77E-10	4.77E-10
U-234	4.34E-15	4.34E-15
Th-230	4.34E-17	4.34E-17
Ra-226	7.71E-14	7.71E-14
Pb-210	5.12E-16	5.12E-16
U-235	1.93E-12	1.93E-12
Pa-231	8.17E-15	8.17E-15
Ac-227	1.24E-13	1.24E-13
U-238	1.43E-12	1.43E-12
U-234	1.24E-17	1.24E-17

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:45:01 Page: 60 **

Title : SLDS DCGL Resident

Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld

Evaluation Time: 1000.00000 years

Th-230	6.24E-20	6.24E-20
Ra-226	7.64E-17	7.64E-17
Pb-210	4.92E-19	4.92E-19

Source: 4

Nuclide	Receptor	Total
	1	
Ac-227	5.78E-26	5.78E-26
Pa-231	3.77E-13	3.77E-13
Ac-227	5.90E-12	5.90E-12
Pb-210	5.48E-27	5.48E-27
Ra-226	2.80E-11	2.80E-11
Pb-210	2.00E-13	2.00E-13
Ra-228	0.00E+00	0.00E+00
Th-228	0.00E+00	0.00E+00
Th-228	0.00E+00	0.00E+00
Th-230	4.64E-15	4.64E-15
Ra-226	1.54E-11	1.54E-11
Pb-210	1.06E-13	1.06E-13
Th-232	4.10E-15	4.10E-15
Ra-228	1.08E-11	1.08E-11
Th-228	4.77E-10	4.77E-10
U-234	4.34E-15	4.34E-15
Th-230	4.34E-17	4.34E-17
Ra-226	7.71E-14	7.71E-14
Pb-210	5.12E-16	5.12E-16
U-235	1.93E-12	1.93E-12
Pa-231	8.17E-15	8.17E-15
Ac-227	1.24E-13	1.24E-13
U-238	1.43E-12	1.43E-12
U-234	1.24E-17	1.24E-17
Th-230	6.24E-20	6.24E-20
Ra-226	7.64E-17	7.64E-17
Pb-210	4.92E-19	4.92E-19

Source: 5

Nuclide	Receptor	Total
	1	
Ac-227	5.78E-26	5.78E-26
Pa-231	3.77E-13	3.77E-13
Ac-227	5.90E-12	5.90E-12
Pb-210	5.48E-27	5.48E-27
Ra-226	2.80E-11	2.80E-11

** RESRAD-BUILD Risk Program Output, Version 4.0 07/12/23 10:45:01 Page: 61 **
Title : SLDS DCGL Resident
Input File : C:\RESRAD_Family\BUILD\4.0\UserFiles\SLDS DCGL Res.bld
Evaluation Time: 1000.00000 years

Pb-210	2.00E-13	2.00E-13
Ra-228	0.00E+00	0.00E+00
Th-228	0.00E+00	0.00E+00
Th-228	0.00E+00	0.00E+00
Th-230	4.64E-15	4.64E-15
Ra-226	1.54E-11	1.54E-11
Pb-210	1.06E-13	1.06E-13
Th-232	4.10E-15	4.10E-15
Ra-228	1.08E-11	1.08E-11
Th-228	4.77E-10	4.77E-10
U-234	4.34E-15	4.34E-15
Th-230	4.34E-17	4.34E-17
Ra-226	7.71E-14	7.71E-14
Pb-210	5.12E-16	5.12E-16
U-235	1.93E-12	1.93E-12
Pa-231	8.17E-15	8.17E-15
Ac-227	1.24E-13	1.24E-13
U-238	1.43E-12	1.43E-12
U-234	1.24E-17	1.24E-17
Th-230	6.24E-20	6.24E-20
Ra-226	7.64E-17	7.64E-17
Pb-210	4.92E-19	4.92E-19

ATTACHMENT E-2

**SAMPLE IDENTIFIERS FOR THE DATASET USED TO CALCULATE
THE ACTIVITY FRACTIONS FOR THE ST. LOUIS DOWNTOWN SITE**

THIS PAGE INTENTIONALLY LEFT BLANK

Table E-2-1. Samples for the Dataset Used to Calculate the Activity Fractions for SLDS Properties

HTR106618	HTR106619	HTR106620	HTR106621	HTR201596	HTR201597	HTR201598	HTR201599	HTR222858
HTR222865	HTR238181	HTR77689	HTR77690	HTR77693	HTR77695	HTR77701	HTR77703	HTR77705
HTR77733	HTR77734	HTR77750	HTR77772	HTR77777	HTR79104	HTR79117	HTR83694	HTR83711
HTR83727	HTR83741	HTR83742	HTR83743	HTR83744	HTR83745	HTR83746	HTR83747	HTR83754
HTR84768	HTR84770	HTR84772	HTR84775	HTR84835	HTZ00065	HTZ00117	HTZ00118	HTZ00119
HTZ00120	HTZ00121	HTZ00122	HTZ00123	HTZ00124	HTZ00125	HTZ00126	HTZ00127	HTZ00128
HTZ00135	HTZ00136	HTZ00137	HTZ00138	HTZ00147	HTZ00148	HTZ00152	HTZ00154	HTZ00157
HTZ00159	HTZ00160	HTZ00164	HTZ00166	HTZ00167	HTZ00168	HTZ00169	HTZ00196	HTZ00197
HTZ00201	HTZ00204	HTZ00205	HTZ00246	HTZ00248	HTZ00250	HTZ00258	HTZ00262	HTZ00322
HTZ00329	HTZ00344	HTZ00355	HTZ00369	HTZ00405	HTZ00406	HTZ00407	HTZ00410	HTZ00413
HTZ00414	HTZ00439	HTZ00441	HTZ00442	HTZ00443	HTZ00445	HTZ00447	HTZ00448	HTZ00451
HTZ00452	HTZ00453	HTZ00463	HTZ00465	HTZ00466	HTZ00467	HTZ00469	HTZ00474	HTZ00475
HTZ00477	HTZ00478	HTZ00479	HTZ00488	HTZ00490	HTZ00493	HTZ00494	HTZ00500	HTZ00501
HTZ00515	HTZ00518	HTZ00524	HTZ00525	HTZ00529	HTZ00532	HTZ00537	HTZ00542	HTZ00614
HTZ00626	HTZ00628	HTZ00644	HTZ00645	HTZ00647	HTZ00648	HTZ00651	HTZ00653	HTZ00658
HTZ00671	HTZ00682	HTZ00687	HTZ00694	HTZ00706	HTZ103327	HTZ103330	HTZ103333	HTZ103338
HTZ103438	HTZ105666	HTZ105669	HTZ105703	HTZ105705	HTZ105708	HTZ105709	HTZ105758	HTZ105761
HTZ105763	HTZ105764	HTZ105765	HTZ105766	HTZ105767	HTZ105768	HTZ105813	HTZ105838	HTZ105839
HTZ108560	HTZ108618	HTZ108619	HTZ108621	HTZ108622	HTZ108623	HTZ108624	HTZ108625	HTZ108626
HTZ108627	HTZ108628	HTZ108630	HTZ108631	HTZ108633	HTZ1111291	HTZ1111292	HTZ1111297	HTZ111298
HTZ111305	HTZ111307	HTZ111308	HTZ111309	HTZ111310	HTZ111320	HTZ111322	HTZ113581	HTZ113584
HTZ113604	HTZ113606	HTZ113637	HTZ113646	HTZ113647	HTZ113648	HTZ113649	HTZ113653	HTZ113654
HTZ113658	HTZ113660	HTZ113666	HTZ113670	HTZ113671	HTZ113685	HTZ113688	HTZ113699	HTZ113700
HTZ113701	HTZ113702	HTZ113705	HTZ113706	HTZ119453	HTZ119454	HTZ119455	HTZ119459	HTZ119462
HTZ119468	HTZ119478	HTZ119483	HTZ119561	HTZ119564	HTZ119565	HTZ124127	HTZ124132	HTZ124248
HTZ124249	HTZ124313	HTZ124314	HTZ124318	HTZ124344	HTZ124346	HTZ128206	HTZ128208	HTZ128212
HTZ128235	HTZ128268	HTZ128270	HTZ128272	HTZ128273	HTZ128276	HTZ128302	HTZ128303	HTZ128304
HTZ128305	HTZ128306	HTZ128308	HTZ128309	HTZ128333	HTZ128334	HTZ128339	HTZ128340	HTZ128341
HTZ128342	HTZ128344	HTZ130629	HTZ130631	HTZ130632	HTZ130633	HTZ130634	HTZ130635	HTZ130636
HTZ130665	HTZ130666	HTZ130708	HTZ130709	HTZ130710	HTZ130711	HTZ130714	HTZ130715	HTZ130716
HTZ130717	HTZ130718	HTZ130719	HTZ130720	HTZ130721	HTZ130723	HTZ130743	HTZ130783	HTZ130784
HTZ130789	HTZ130800	HTZ130805	HTZ130831	HTZ131959	HTZ131960	HTZ131961	HTZ131962	HTZ131963
HTZ131968	HTZ131970	HTZ132028	HTZ132032	HTZ132033	HTZ132035	HTZ132036	HTZ132037	HTZ132038
HTZ132039	HTZ132041	HTZ132043	HTZ132980	HTZ132981	HTZ134353	HTZ134387	HTZ134389	HTZ134390
HTZ134391	HTZ134393	HTZ134394	HTZ134395	HTZ134396	HTZ134481	HTZ134482	HTZ134483	HTZ137776
HTZ137777	HTZ137778	HTZ137780	HTZ137781	HTZ137782	HTZ137797	HTZ137798	HTZ137820	HTZ137821
HTZ137822	HTZ137823	HTZ137826	HTZ137827	HTZ137882	HTZ137883	HTZ137884	HTZ137885	HTZ137887
HTZ137888	HTZ137889	HTZ137890	HTZ137891	HTZ137892	HTZ137893	HTZ137894	HTZ139549	HTZ139550
HTZ139551	HTZ139561	HTZ139562	HTZ139563	HTZ139624	HTZ139625	HTZ139630	HTZ139637	HTZ139671
HTZ139674	HTZ139675	HTZ139677	HTZ139678	HTZ139680	HTZ139681	HTZ139683	HTZ139684	HTZ139685
HTZ139692	HTZ139694	HTZ139712	HTZ139713	HTZ139714	HTZ139716	HTZ139717	HTZ139724	HTZ139726
HTZ139728	HTZ139730	HTZ142300	HTZ142349	HTZ142353	HTZ142354	HTZ142355	HTZ142356	HTZ142357
HTZ142358	HTZ142360	HTZ142362	HTZ142364	HTZ142366	HTZ142367	HTZ142368	HTZ142369	HTZ142370
HTZ142373	HTZ142374	HTZ142375	HTZ142376	HTZ142377	HTZ142380	HTZ142381	HTZ143027	HTZ143028
HTZ143030	HTZ143031	HTZ143035	HTZ143036	HTZ144308	HTZ144309	HTZ144347	HTZ144348	HTZ144350
HTZ144351	HTZ144377	HTZ144378	HTZ144379	HTZ144380	HTZ144381	HTZ144383	HTZ144384	HTZ144385
HTZ144386	HTZ144387	HTZ144416	HTZ150265	HTZ150382	HTZ150387	HTZ150405	HTZ150408	HTZ150411
HTZ150413	HTZ150416	HTZ150418	HTZ150419	HTZ150420	HTZ150445	HTZ150446	HTZ150450	HTZ150453
HTZ150454	HTZ150472	HTZ150473	HTZ150475	HTZ150476	HTZ150478	HTZ150480	HTZ150482	HTZ150483
HTZ150484	HTZ150487	HTZ155865	HTZ155866	HTZ155867	HTZ155868	HTZ155875	HTZ155879	HTZ155935
HTZ155936	HTZ155938	HTZ155952	HTZ155954	HTZ155955	HTZ155957	HTZ155959	HTZ155962	HTZ155963
HTZ155964	HTZ155967	HTZ155970	HTZ155971	HTZ155972	HTZ155982	HTZ155983	HTZ155993	HTZ155994
HTZ155995	HTZ156002	HTZ156005	HTZ156006	HTZ156011	HTZ156012	HTZ156013	HTZ156015	HTZ156017
HTZ156018	HTZ156019	HTZ156020	HTZ156021	HTZ156025	HTZ156026	HTZ156028	HTZ156032	HTZ156034
HTZ156035	HTZ156037	HTZ156038	HTZ156039	HTZ156040	HTZ156041	HTZ156042	HTZ156043	HTZ156050
HTZ156052	HTZ156058	HTZ156061	HTZ156062	HTZ156063	HTZ156064	HTZ156067	HTZ156068	HTZ156069
HTZ156070	HTZ156071	HTZ156072	HTZ156075	HTZ156076	HTZ156078	HTZ156079	HTZ156090	HTZ156095
HTZ156097	HTZ156101	HTZ156102	HTZ156103	HTZ156104	HTZ156105	HTZ156109	HTZ164996	HTZ164997
HTZ164999	HTZ165000	HTZ165003	HTZ165004	HTZ165006	HTZ165010	HTZ165024	HTZ165025	HTZ165026
HTZ165027	HTZ165028	HTZ165044	HTZ165045	HTZ165046	HTZ165048	HTZ165049	HTZ165050	HTZ165051
HTZ165052	HTZ165063	HTZ165069	HTZ165070	HTZ165082	HTZ165085	HTZ165086	HTZ165087	HTZ165088
HTZ165089	HTZ165090	HTZ165092	HTZ173300	HTZ173312	HTZ173316	HTZ173318	HTZ173322	HTZ173323
HTZ173324	HTZ173326	HTZ173327	HTZ173328	HTZ173329	HTZ173330	HTZ173333	HTZ173334	HTZ173336
HTZ173337	HTZ173339	HTZ173340	HTZ173341	HTZ173342	HTZ173343	HTZ173345	HTZ173346	HTZ173348
HTZ173349	HTZ173350	HTZ173351	HTZ173364	HTZ173365	HTZ173366	HTZ173367	HTZ173368	HTZ173369
HTZ173370	HTZ173391	HTZ173395	HTZ173396	HTZ173398	HTZ173399	HTZ173400	HTZ173401	HTZ173403

Table E-2-1. Samples for the Dataset Used to Calculate the Activity Fractions for SLDS Properties (Continued)

HTZ173405	HTZ173407	HTZ173408	HTZ176894	HTZ176895	HTZ176897	HTZ176899	HTZ176901	HTZ176902
HTZ176903	HTZ176904	HTZ176905	HTZ176906	HTZ176907	HTZ176928	HTZ176929	HTZ183138	HTZ183158
HTZ183162	HTZ183163	HTZ183164	HTZ183172	HTZ183175	HTZ183177	HTZ183183	HTZ183206	HTZ183208
HTZ183209	HTZ183211	HTZ183212	HTZ183213	HTZ183243	HTZ183246	HTZ183253	HTZ183254	HTZ183255
HTZ183257	HTZ183258	HTZ195330	HTZ195333	HTZ195334	HTZ195335	HTZ195340	HTZ195348	HTZ195375
HTZ195376	HTZ195377	HTZ195400	HTZ195401	HTZ195406	HTZ195421	HTZ195422	HTZ195425	HTZ195426
HTZ195431	HTZ195433	HTZ195434	HTZ195440	HTZ195442	HTZ195443	HTZ195470	HTZ195471	HTZ195568
HTZ195570	HTZ203131	HTZ203132	HTZ203133	HTZ203135	HTZ203136	HTZ203141	HTZ203144	HTZ203145
HTZ203146	HTZ203147	HTZ203149	HTZ203151	HTZ203152	HTZ203163	HTZ203168	HTZ203169	HTZ203170
HTZ203171	HTZ203175	HTZ203178	HTZ203179	HTZ203180	HTZ203194	HTZ203195	HTZ203196	HTZ203199
HTZ203200	HTZ203201	HTZ203202	HTZ203206	HTZ203214	HTZ203217	HTZ203218	HTZ203220	HTZ203222
HTZ203223	HTZ203224	HTZ203225	HTZ203227	HTZ203230	HTZ203233	HTZ203239	HTZ203244	HTZ203245
HTZ203249	HTZ203250	HTZ203251	HTZ203252	HTZ203253	HTZ203254	HTZ203255	HTZ203256	HTZ203261
HTZ203262	HTZ203265	HTZ203267	HTZ203268	HTZ203269	HTZ203276	HTZ203277	HTZ203294	HTZ203300
HTZ203330	HTZ203331	HTZ213396	HTZ213399	HTZ213400	HTZ213401	HTZ213403	HTZ213405	HTZ213406
HTZ213407	HTZ213408	HTZ213409	HTZ213410	HTZ213412	HTZ213413	HTZ213414	HTZ213415	HTZ213416
HTZ213418	HTZ213419	HTZ213420	HTZ213421	HTZ213427	HTZ213431	HTZ213434	HTZ213437	HTZ213447
HTZ213448	HTZ213449	HTZ213450	HTZ213451	HTZ213452	HTZ213455	HTZ213457	HTZ213460	HTZ213463
HTZ213466	HTZ213467	HTZ213486	HTZ213490	HTZ213492	HTZ213494	HTZ213495	HTZ213499	HTZ213501
HTZ213503	HTZ213510	HTZ213530	HTZ213538	HTZ213542	HTZ213543	HTZ213545	HTZ213565	HTZ213566
HTZ213570	HTZ213580	HTZ213608	HTZ213611	HTZ213614	HTZ213617	HTZ213621	HTZ213623	HTZ213625
HTZ213631	HTZ229146	HTZ229150	HTZ229190	HTZ229191	HTZ229193	HTZ229195	HTZ229196	HTZ229198
HTZ229200	HTZ229201	HTZ229205	HTZ229206	HTZ229207	HTZ229208	HTZ229210	HTZ229212	HTZ229218
HTZ229219	HTZ229220	HTZ229224	HTZ229225	HTZ229227	HTZ229233	HTZ229235	HTZ229237	HTZ229239
HTZ229241	HTZ229247	HTZ229249	HTZ229251	HTZ229253	HTZ229254	HTZ229255	HTZ229257	HTZ229259
HTZ229261	HTZ229262	HTZ229263	HTZ229267	HTZ229268	HTZ229269	HTZ229270	HTZ229271	HTZ229272
HTZ229274	HTZ229275	HTZ229276	HTZ229278	HTZ229280	HTZ229282	HTZ229284	HTZ229286	HTZ229288
HTZ229292	HTZ229301	HTZ229302	HTZ229304	HTZ229305	HTZ229329	HTZ229331	HTZ229340	HTZ229341
HTZ229344	HTZ229345	HTZ229346	HTZ229359	HTZ229367	HTZ241685	HTZ241689	HTZ241697	HTZ241700
HTZ241702	HTZ241704	HTZ241705	HTZ241736	HTZ241803	HTZ241804	HTZ241805	HTZ241818	HTZ241819
HTZ241871	HTZ241872	HTZ241873	HTZ241877	HTZ241882	HTZ241883	HTZ241887	HTZ241888	HTZ241892
HTZ241905	HTZ249884	HTZ249911	HTZ249938	HTZ249939	HTZ249952	HTZ249956	HTZ249957	HTZ249960
HTZ249965	HTZ249967	HTZ249973	HTZ249992	HTZ250011	HTZ25704	HTZ25723	HTZ25724	HTZ25727
HTZ25793	HTZ27395	HTZ27397	HTZ27420	HTZ27421	HTZ27422	HTZ27426	HTZ27427	HTZ27429
HTZ27431	HTZ27437	HTZ27442	HTZ27444	HTZ27459	HTZ27460	HTZ27461	HTZ27462	HTZ66182
HTZ66183	HTZ66184	HTZ66206	HTZ66207	HTZ66210	HTZ66211	HTZ66213	HTZ66214	HTZ66215
HTZ66216	HTZ66217	HTZ66219	HTZ66220	HTZ66221	HTZ66222	HTZ66223	HTZ66234	HTZ66235
HTZ66241	HTZ66242	HTZ66254	HTZ66255	HTZ66257	HTZ66259	HTZ66260	HTZ66262	HTZ66263
HTZ66267	HTZ66271	HTZ66280	HTZ66289	HTZ66300	HTZ66302	HTZ66305	HTZ66310	HTZ66322
HTZ66323	HTZ66329	HTZ66330	HTZ68167	HTZ68168	HTZ68207	HTZ68209	HTZ68211	HTZ68212
HTZ68218	HTZ68219	HTZ68220	HTZ69357	HTZ69380	HTZ69381	HTZ69382	HTZ69383	HTZ69384
HTZ69385	HTZ69417	HTZ69418	HTZ69432	HTZ69451	HTZ69452	HTZ69453	HTZ69468	HTZ69469
HTZ69470	HTZ69472	HTZ69475	HTZ69477	HTZ69479	HTZ69483	HTZ69484	HTZ69485	HTZ69489
HTZ70831	HTZ70853	HTZ70856	HTZ70858	HTZ70859	HTZ70860	HTZ70872	HTZ70873	HTZ70885
HTZ70888	HTZ70894	HTZ70895	HTZ70897	HTZ70902	HTZ70904	HTZ70905	HTZ70906	HTZ70926
HTZ70933	HTZ70936	HTZ70943	HTZ70944	HTZ70952	HTZ70958	HTZ71714	HTZ71719	HTZ71720
HTZ71728	HTZ71731	HTZ71735	HTZ71739	HTZ71755	HTZ71758	HTZ75234	HTZ75235	HTZ75236
HTZ75239	HTZ75240	HTZ75241	HTZ75242	HTZ75243	HTZ75244	HTZ75255	HTZ75257	HTZ75267
HTZ75268	HTZ75269	HTZ75270	HTZ75271	HTZ75272	HTZ75273	HTZ75274	HTZ75275	HTZ75276
HTZ75278	HTZ75279	HTZ75280	HTZ75294	HTZ75295	HTZ75297	HTZ75298	HTZ75300	HTZ75310
HTZ75311	HTZ75313	HTZ75323	HTZ75325	HTZ75326	HTZ75327	HTZ75332	HTZ75333	HTZ75336
HTZ75344	HTZ75347	HTZ75348	HTZ75366	HTZ75371	HTZ75372	HTZ75376	HTZ75378	HTZ75379
HTZ75383	HTZ75387	HTZ75390	HTZ75395	HTZ75396	HTZ75397	HTZ75399	HTZ75400	HTZ75401
HTZ75405	HTZ75415	HTZ75416	HTZ75418	HTZ75419	HTZ75420	HTZ76657	HTZ76659	HTZ76660
HTZ76664	HTZ76666	HTZ76673	HTZ76709	HTZ76712	HTZ76713	HTZ76719	HTZ76721	HTZ76722
HTZ76723	HTZ76727	HTZ76746	HTZ76747	HTZ76748	HTZ76755	HTZ76756	HTZ76757	HTZ76780
HTZ76782	HTZ76783	HTZ76785	HTZ76805	HTZ76806	HTZ76807	HTZ76818	HTZ76819	HTZ76820
HTZ76821	HTZ76822	HTZ76875	HTZ76876	HTZ76877	HTZ76878	HTZ76882	HTZ84021	HTZ84024
HTZ84025	HTZ84026	HTZ84027	HTZ84030	HTZ84033	HTZ84039	HTZ84042	HTZ84045	HTZ84046
HTZ84047	HTZ84048	HTZ84051	HTZ84056	HTZ84057	HTZ84058	HTZ84059	HTZ84068	HTZ84069
HTZ84073	HTZ84084	HTZ84087	HTZ84088	HTZ84089	HTZ84094	HTZ85283	HTZ85284	HTZ85287
HTZ85289	HTZ85294	HTZ85295	HTZ85296	HTZ85301	HTZ85302	HTZ85304	HTZ85306	HTZ85307
HTZ85308	HTZ85318	HTZ85320	HTZ85321	HTZ85323	HTZ85324	HTZ85325	HTZ85326	HTZ85327
HTZ85354	HTZ85355	HTZ85356	HTZ85357	HTZ85358	HTZ85359	HTZ85360	HTZ85361	HTZ85362
HTZ86428	HTZ86432	HTZ86433	HTZ86435	HTZ86436	HTZ86437	HTZ86438	HTZ86441	HTZ86442
HTZ86443	HTZ86452	HTZ86454	HTZ86455	HTZ86456	HTZ86457	HTZ86458	HTZ86501	HTZ86502

Table E-2-1. Samples for the Dataset Used to Calculate the Activity Fractions for SLDS Properties (Continued)

HTZ86503	HTZ86504	HTZ86505	HTZ86506	HTZ86507	HTZ86508	HTZ86509	HTZ86515	HTZ86516
HTZ86517	HTZ87350	HTZ87354	HTZ87357	HTZ87372	HTZ87374	HTZ87375	HTZ87376	HTZ87377
HTZ87378	HTZ87392	HTZ87400	HTZ87401	HTZ87402	HTZ87404	HTZ87405	HTZ87407	HTZ87408
HTZ87409	HTZ87410	HTZ87411	HTZ87413	HTZ87416	HTZ87419	HTZ87420	HTZ87421	HTZ87422
HTZ87423	HTZ87444	HTZ87445	HTZ87446	HTZ87447	HTZ87448	HTZ87450	HTZ87451	HTZ87452
HTZ87453	HTZ87454	HTZ87455	HTZ87456	HTZ87458	HTZ87462	HTZ87463	HTZ87464	HTZ87465
HTZ87466	HTZ87477	HTZ87479	HTZ87480	HTZ87481	HTZ87482	HTZ88889	HTZ88909	HTZ88910
HTZ88911	HTZ88912	HTZ88913	HTZ88914	HTZ88915	HTZ88918	HTZ88923	HTZ88924	HTZ88925
HTZ88926	HTZ88927	HTZ88929	HTZ88930	HTZ88931	HTZ88932	HTZ88934	HTZ88935	HTZ88940
HTZ88941	HTZ88942	HTZ88948	HTZ88949	HTZ88950	HTZ88951	HTZ88952	HTZ88954	HTZ88956
HTZ88957	HTZ88958	HTZ88959	HTZ88969	HTZ88970	HTZ88971	HTZ88982	HTZ88983	HTZ88984
HTZ88985	HTZ88986	HTZ88987	HTZ88989	HTZ88991	HTZ89007	HTZ89031	HTZ89032	HTZ89033
HTZ89061	HTZ89062	HTZ89067	HTZ89068	HTZ89069	HTZ89070	HTZ89071	HTZ89072	HTZ89073
HTZ89074	HTZ89075	HTZ89079	HTZ89080	HTZ89081	HTZ89084	HTZ89087	HTZ93400	HTZ93405
HTZ93407	HTZ93409	HTZ93410	HTZ93411	HTZ93412	HTZ93413	HTZ93414	HTZ93418	HTZ93420
HTZ93421	HTZ93422	HTZ93423	HTZ93425	HTZ93428	HTZ93429	HTZ93430	HTZ93431	HTZ93453
HTZ93454	HTZ93456	HTZ93460	HTZ93463	HTZ93464	HTZ93465	HTZ93468	HTZ93470	HTZ93471
HTZ93472	HTZ93473	HTZ93474	HTZ93475	HTZ93480	HTZ93484	HTZ93561	HTZ93563	HTZ93568
HTZ93592	HTZ93593	HTZ93594	HTZ93596	HTZ94742	HTZ94775	HTZ94777	HTZ94779	HTZ94781
HTZ94792	HTZ94793	HTZ94801	HTZ94802	HTZ94805	HTZ94816	HTZ94819	HTZ94861	HTZ94863
HTZ94864	HTZ94866	HTZ94881	HTZ94883	HTZ94884	HTZ94890	HTZ95749	HTZ95756	HTZ95758
HTZ95761	HTZ95762	HTZ95786	HTZ95789	HTZ95790	HTZ95793	HTZ95795	HTZ95799	HTZ95800
HTZ95801	HTZ95803	HTZ95805	HTZ95823	HTZ95826	HTZ95867	HTZ95872	HTZ95875	HTZ95878
HTZ95892	HTZ95895	HTZ95901	HTZ95915	HTZ95920	HTZ95922	HTZ95932	HTZ99667	HTZ99669
HTZ99675	HTZ99679	HTZ99681	HTZ99682	HTZ99758	HTZ99769	HTZ99781	HTZ99785	HTZ99821
HTZ99822	HTZ99823	HTZ99826	HTZ99829	HTZ99840	SLD00926	SLD00934	SLD00963	SLD00997
SLD01023	SLD01078	SLD01098	SLD01107	SLD01108	SLD01234	SLD01239	SLD02384	SLD02600
SLD02602	SLD02604	SLD02606	SLD02607	SLD02608	SLD02610	SLD02614	SLD02623	SLD02626
SLD02630	SLD02632	SLD02633	SLD02636	SLD02637	SLD02643	SLD02646	SLD02647	SLD02649
SLD02650	SLD02652	SLD02665	SLD02670	SLD02681	SLD02708	SLD02725	SLD02729	SLD02855
SLD02867	SLD03201	SLD03202	SLD03219	SLD03227	SLD03231	SLD03242	SLD03243	SLD03244
SLD03245	SLD03246	SLD03247	SLD03255	SLD03256	SLD03257	SLD03258	SLD03259	SLD03260
SLD03263	SLD03276	SLD03288	SLD03292	SLD03293	SLD03294	SLD03295	SLD03296	SLD03297
SLD03298	SLD03299	SLD03300	SLD03301	SLD03302	SLD03317	SLD03320	SLD03340	SLD03341
SLD03342	SLD03343	SLD03344	SLD03345	SLD03346	SLD03347	SLD03348	SLD03349	SLD03350
SLD03351	SLD03352	SLD03353	SLD03354	SLD03355	SLD03356	SLD03357	SLD03358	SLD03365
SLD03366	SLD03367	SLD03368	SLD03369	SLD03370	SLD03373	SLD03375	SLD03376	SLD03377
SLD03378	SLD03384	SLD03385	SLD03389	SLD03399	SLD03403	SLD03424	SLD03427	SLD03428
SLD03432	SLD03436	SLD03447	SLD03450	SLD03452	SLD03541	SLD03615	SLD03616	SLD03617
SLD03618	SLD03619	SLD03620	SLD03622	SLD03623	SLD03624	SLD03625	SLD03626	SLD03627
SLD03628	SLD03629	SLD03630	SLD03631	SLD03632	SLD03633	SLD03634	SLD03635	SLD03636
SLD03637	SLD03638	SLD03640	SLD03649	SLD03657	SLD03715	SLD03716	SLD03866	SLD03899
SLD03900	SLD03901	SLD03902	SLD03909	SLD03911	SLD03913	SLD03915	SLD03917	SLD03919
SLD03922	SLD03923	SLD03925	SLD03929	SLD03930	SLD03931	SLD03933	SLD03934	SLD03935
SLD03941	SLD03943	SLD03944	SLD03945	SLD03953	SLD03965	SLD03967	SLD03969	SLD03970
SLD03971	SLD03973	SLD03974	SLD03981	SLD04291	SLD04292	SLD04293	SLD04294	SLD04295
SLD04296	SLD04297	SLD04298	SLD04299	SLD04303	SLD04304	SLD04306	SLD04308	SLD04311
SLD04313	SLD04314	SLD04315	SLD04318	SLD04319	SLD04320	SLD04321	SLD04322	SLD04324
SLD04325	SLD04327	SLD04329	SLD04330	SLD04331	SLD04332	SLD04333	SLD04334	SLD04336
SLD04337	SLD04339	SLD04340	SLD04341	SLD04343	SLD04344	SLD04345	SLD04346	SLD04347
SLD04348	SLD04349	SLD04350	SLD04351	SLD04352	SLD04353	SLD04355	SLD04356	SLD04358
SLD04372	SLD04375	SLD04376	SLD04378	SLD04380	SLD04382	SLD04384	SLD04385	SLD04387
SLD04388	SLD04389	SLD04391	SLD04392	SLD04393	SLD04394	SLD04395	SLD04396	SLD04397
SLD04400	SLD04401	SLD04402	SLD04406	SLD04407	SLD04408	SLD04409	SLD04410	SLD04411
SLD04412	SLD04413	SLD04414	SLD04415	SLD04418	SLD04419	SLD04420	SLD04422	SLD04424
SLD04427	SLD04428	SLD04429	SLD04430	SLD04431	SLD04432	SLD04433	SLD04434	SLD04437
SLD04438	SLD04439	SLD04441	SLD04443	SLD04444	SLD04445	SLD04446	SLD04448	SLD04449
SLD04450	SLD04451	SLD04453	SLD04454	SLD04455	SLD04459	SLD04460	SLD04462	SLD04463
SLD04464	SLD04469	SLD04470	SLD04472	SLD04473	SLD04475	SLD04476	SLD04500	SLD04501
SLD04533	SLD04536	SLD04537	SLD04539	SLD04542	SLD04543	SLD04546	SLD04548	SLD04549
SLD04550	SLD04640	SLD04643	SLD04644	SLD04645	SLD04646	SLD04647	SLD04649	SLD04662
SLD04663	SLD04664	SLD04665	SLD04670	SLD04671	SLD04672	SLD04673	SLD04674	SLD04675
SLD04676	SLD04677	SLD04678	SLD04679	SLD04680	SLD04681	SLD04682	SLD04699	SLD04701
SLD04702	SLD04704	SLD04705	SLD04706	SLD04707	SLD04708	SLD04709	SLD04710	SLD04711
SLD04712	SLD04713	SLD04714	SLD04715	SLD04716	SLD04717	SLD04718	SLD04719	SLD04720
SLD04721	SLD04722	SLD04723	SLD04724	SLD04725	SLD04726	SLD04727	SLD04728	SLD04729

Table E-2-1. Samples for the Dataset Used to Calculate the Activity Fractions for SLDS Properties (Continued)

SLD04730	SLD04732	SLD04733	SLD04734	SLD04735	SLD04736	SLD04737	SLD04738	SLD04740
SLD04742	SLD04743	SLD04745	SLD04746	SLD04747	SLD04748	SLD04749	SLD04750	SLD04751
SLD04752	SLD04754	SLD04755	SLD04756	SLD04757	SLD04758	SLD04759	SLD04760	SLD04761
SLD04762	SLD04763	SLD04764	SLD04765	SLD04767	SLD04768	SLD04769	SLD04770	SLD04771
SLD04773	SLD04774	SLD04775	SLD04776	SLD04777	SLD04778	SLD04779	SLD04780	SLD04781
SLD04783	SLD04785	SLD04786	SLD04787	SLD04788	SLD04790	SLD04791	SLD04792	SLD04793
SLD04794	SLD04795	SLD04796	SLD04797	SLD04798	SLD04799	SLD04801	SLD04802	SLD04803
SLD04804	SLD04806	SLD04808	SLD04809	SLD04810	SLD04811	SLD04812	SLD04813	SLD04814
SLD04815	SLD04816	SLD04818	SLD04819	SLD04820	SLD04821	SLD04822	SLD04824	SLD04826
SLD04827	SLD04830	SLD04831	SLD04839	SLD04840	SLD04841	SLD04863	SLD04866	SLD04869
SLD04871	SLD04871-1	SLD04894	SLD04899	SLD04901	SLD04902	SLD04903	SLD04909	SLD04910
SLD04910-1	SLD04931	SLD04931-1	SLD04935	SLD04947	SLD04948	SLD04956	SLD05069	SLD05076
SLD05077	SLD05082	SLD05158	SLD05173	SLD05181	SLD05187	SLD05188	SLD05192	SLD05194
SLD05196	SLD05207	SLD05212	SLD05219	SLD05220	SLD05316	SLD05322	SLD05398	SLD05400
SLD05401	SLD05402	SLD05403	SLD05404	SLD05405	SLD05406	SLD05407	SLD05408	SLD05409
SLD05410	SLD05411	SLD05412	SLD05413	SLD05415	SLD05416	SLD05418	SLD05421	SLD05422
SLD05423	SLD05425	SLD05426	SLD05427	SLD05429	SLD05436	SLD05437	SLD05438	SLD05440
SLD05441	SLD05442	SLD05444	SLD05449	SLD05450	SLD05452	SLD05454	SLD05456	SLD05457
SLD05459	SLD05461	SLD05462	SLD05463	SLD05468	SLD05469	SLD05472	SLD05473	SLD05474
SLD05475	SLD05476	SLD05477	SLD05478	SLD05479	SLD05480	SLD05482	SLD05483	SLD05484
SLD05486	SLD05494	SLD05495	SLD05496	SLD05497	SLD05499	SLD05500	SLD05503	SLD05507
SLD05508	SLD05509	SLD05511	SLD05512	SLD05515	SLD05518	SLD05525	SLD05526	SLD05530
SLD05531	SLD05570	SLD05572	SLD05583	SLD05586	SLD05587	SLD05588	SLD05589	SLD05590
SLD05592	SLD05598	SLD05599	SLD05600	SLD05602	SLD05606	SLD05609	SLD05610	SLD05616
SLD05708	SLD05720	SLD05737	SLD05834	SLD05835	SLD05898	SLD05899	SLD05901	SLD05910
SLD05926	SLD05927	SLD05935	SLD05937	SLD05952	SLD05987	SLD06018	SLD06048	SLD06052
SLD06092	SLD06093	SLD06094	SLD06095	SLD06096	SLD06099	SLD06105	SLD06111	SLD06124
SLD06138	SLD06139	SLD06144	SLD06145	SLD06146	SLD06147	SLD06148	SLD06149	SLD06152
SLD06156	SLD06157	SLD06213	SLD06215	SLD06220	SLD06231	SLD06240	SLD06262	SLD06263
SLD06267	SLD06268	SLD06269	SLD06270	SLD06271	SLD06273	SLD06274	SLD06276	SLD06277
SLD06278	SLD06280	SLD06285	SLD06286	SLD06288	SLD06331	SLD06337	SLD06338	SLD06353
SLD06358	SLD06359	SLD06363	SLD06365	SLD06366	SLD06375	SLD06393	SLD06398	SLD06402
SLD06403	SLD06416	SLD06418	SLD06419	SLD06421	SLD06422	SLD06425	SLD06426	SLD06428
SLD06429	SLD06430	SLD06431	SLD06432	SLD06438	SLD06444	SLD06445	SLD06446	SLD06476
SLD06501	SLD06551	SLD06552	SLD06554	SLD06558	SLD06591	SLD06806	SLD06814	SLD06815
SLD06816	SLD06817	SLD06820	SLD06821	SLD06830	SLD06834	SLD06838	SLD06839	SLD06840
SLD06841	SLD06842	SLD06844	SLD06868	SLD06873	SLD07206	SLD07241	SLD07247	SLD07269
SLD07285	SLD07315	SLD07317	SLD07319	SLD07329	SLD07341	SLD07345	SLD07357	SLD07359
SLD07367	SLD07369	SLD07373	SLD07439	SLD07444	SLD105055	SLD106354	SLD106355	SLD106356
SLD106387	SLD106388	SLD106464	SLD106464-1	SLD106560	SLD106782	SLD110018	SLD110019	SLD110499
SLD113490	SLD114931	SLD115205	SLD115205-1	SLD115206	SLD118874	SLD118885	SLD118901	SLD118901-2
SLD118906	SLD118907	SLD118921-2	SLD118933	SLD118941-2	SLD118953	SLD119018	SLD119768	SLD119819
SLD120280	SLD120281	SLD120312	SLD120319	SLD120319-1	SLD120319-2	SLD120380	SLD120387	SLD120580
SLD120945	SLD120946	SLD120947	SLD120948	SLD121061	SLD121103	SLD121636	SLD121666	SLD121760
SLD121760-1	SLD121760-2	SLD122472	SLD123502	SLD123584	SLD123698	SLD124540	SLD124581	SLD124581-1
SLD124581-2	SLD124704	SLD124740	SLD125006	SLD125007	SLD125034	SLD125035	SLD125050	SLD125051
SLD125067	SLD125086	SLD125090	SLD125094	SLD125102	SLD125105	SLD125106	SLD125117	SLD125121-1
SLD125138	SLD125139	SLD125204	SLD125219	SLD125237-2	SLD125349	SLD125351	SLD125352	SLD125413
SLD125428	SLD125525	SLD125526	SLD125527	SLD125528	SLD125529	SLD125530	SLD125532	SLD125581
SLD125581-1	SLD125582	SLD125589	SLD125593	SLD125597	SLD125650	SLD125670	SLD125952	SLD125971
SLD125972	SLD125991	SLD125993	SLD125996	SLD126000	SLD126049	SLD126083	SLD126084	SLD126170
SLD126171	SLD126612	SLD126612-1	SLD126612-2	SLD126625	SLD126779	SLD126824	SLD126835	SLD126836
SLD126839	SLD126868	SLD126991	SLD126992	SLD126996	SLD126997-1	SLD127001	SLD127052	SLD127544
SLD127572	SLD127924	SLD129750	SLD129750-1	SLD129750-2	SLD130224	SLD130237	SLD130238	SLD130239
SLD130240	SLD131114	SLD131115	SLD131206	SLD131207	SLD131209	SLD131210	SLD131212	SLD131213
SLD131214	SLD131728	SLD132411	SLD133892	SLD139104	SLD139105	SLD141248	SLD141249	SLD141250
SLD141251	SLD142023	SLD142024	SLD142104	SLD142105	SLD145623	SLD146236	SLD151995	SLD151996
SLD155776	SLD156125	SLD157070-2	SLD157101	SLD165944	SLD165946	SLD165948	SLD166327	SLD166329
SLD166329-1	SLD166329-2	SLD166330	SLD166339-1	SLD166340	SLD166343	SLD166344	SLD166345	SLD167247
SLD167990	SLD169912-2	SLD169921	SLD173929	SLD174415	SLD174415-1	SLD175065	SLD191446	SLD191457
SLD191462	SLD191463	SLD191690	SLD191691	SLD191694	SLD191698	SLD191699	SLD191702	SLD191703
SLD191704	SLD192075	SLD192078	SLD192078-1	SLD192078-2	SLD192079	SLD192094	SLD192549	SLD192550
SLD192553	SLD192554	SLD192557	SLD192558	SLD192559	SLD192561	SLD192562	SLD192565	SLD192566
SLD192569	SLD192570	SLD192575	SLD192576	SLD192579	SLD192583	SLD192585	SLD192587	SLD192592
SLD192593	SLD192841	SLD192845	SLD195582	SLD196133-2	SLD196748	SLD196765	SLD196769	SLD196837
SLD197057	SLD197058	SLD197061	SLD197062	SLD197065	SLD197066	SLD197070	SLD197081	SLD197082

Table E-2-1. Samples for the Dataset Used to Calculate the Activity Fractions for SLDS Properties (Continued)

SLD197085	SLD197086	SLD197577	SLD198475	SLD198476	SLD198480	SLD198485	SLD198499-2	SLD198511
SLD198515	SLD198523-2	SLD198531	SLD198531-1	SLD198531-2	SLD198543	SLD198544	SLD198555	SLD198556
SLD198587	SLD198591-2	SLD198627-2	SLD198631	SLD198647	SLD198647-1	SLD198647-2	SLD198648	SLD198663
SLD198675-1	SLD198675-2	SLD198759	SLD199103	SLD199103-1	SLD199103-2	SLD199829	SLD199830	SLD199833
SLD199928	SLD199929	SLD199933	SLD200696	SLD200701	SLD200704	SLD200705	SLD200708	SLD200709
SLD200713	SLD200958	SLD200959	SLD208804	SLD208804-1	SLD208814	SLD208815	SLD208816	SLD209452
SLD209452-1	SLD210883	SLD211670	SLD211688	SLD211721	SLD211746	SLD211757	SLD215537	SLD215538
SLD215539	SLD215539-2	SLD223131	SLD223831	SLD225593	SLD229105	SLD229105-1	SLD233061	SLD233066
SLD233067	SLD233072	SLD233076	SLD233077	SLD233080	SLD233107	SLD233117	SLD233147	SLD233149
SLD233157	SLD233158	SLD233196	SLD233197	SLD233221	SLD233222	SLD233227	SLD233261	SLD233271-2
SLD233272	SLD233276	SLD233286-2	SLD233296-2	SLD233306	SLD233326-2	SLD233332	SLD233336-2	SLD233341
SLD233341-1	SLD233341-2	SLD233351-2	SLD233357	SLD233371-2	SLD233386	SLD233401	SLD233402	SLD233462
SLD233476	SLD233477	SLD233481	SLD233482	SLD233506	SLD233507	SLD233571	SLD233577	SLD233596-1
SLD233596-2	SLD233607	SLD233621	SLD233621-1	SLD233622	SLD233632	SLD233636	SLD233641	SLD233662
SLD233666	SLD233666-1	SLD234189	SLD238187	SLD238187-1	SLD238188	SLD238190	SLD238194	SLD238205
SLD238220	SLD238236	SLD238465	SLD238664	SLD238666	SLD238744	SLD238746	SLD239115	SLD245753
SLD245757	SLD245768	SLD245771	SLD250315	SLD250316	SLD250357	SLD250357-1	SLD250357-2	SLD254197
SLD25660	SLD261484	SLD26668	SLD26670	SLD26674	SLD26808	SLD27166	SLD27167	SLD27316
SLD27673	SLD27674	SLD27688	SLD27689	SLD27718	SLD27727	SLD27736	SLD27771	SLD27775
SLD27787	SLD27795	SLD27800	SLD27801	SLD27802	SLD27803	SLD27808	SLD27809	SLD27838
SLD27857	SLD27859	SLD27861	SLD27884	SLD27889	SLD27918	SLD27934	SLD27937	SLD27941
SLD27941-1	SLD27941-2	SLD27948	SLD27963	SLD28062	SLD28638	SLD28639	SLD28640	SLD3471
SLD65114	SLD65116	SLD65120	SLD65121	SLD65159	SLD65160	SLD65166	SLD65167	SLD65605
SLD65643	SLD68593	SLD68594	SLD68595	SLD68694	SLD68695	SLD68696	SLD68766	SLD69655
SLD69659	SLD69662	SLD69665	SLD69668	SLD69671	SLD69684	SLD69686	SLD69741	SLD69758
SLD69916	SLD69917	SLD70005	SLD70012	SLD70016	SLD70019	SLD70030	SLD70042	SLD70044
SLD70053	SLD70080	SLD70103	SLD70115-2	SLD70323-1	SLD70381	SLD70382	SLD70383	SLD70393
SLD70394	SLD70406	SLD70409	SLD70410	SLD70458	SLD70478	SLD70482	SLD70487	SLD70488
SLD70489	SLD70688	SLD70690	SLD70714	SLD70724	SLD70776	SLD70982	SLD71331	SLD71332
SLD71342	SLD71352	SLD71354	SLD71355	SLD71514	SLD71515	SLD71546	SLD72685	SLD72688
SLD72689	SLD72827	SLD72878	SLD72943	SLD72948	SLD72952	SLD73010	SLD73618	SLD73622
SLD73623	SLD73624	SLD73626	SLD73708	SLD73709	SLD73710	SLD73711	SLD73712	SLD73713
SLD73714	SLD73715	SLD73716	SLD73717	SLD73719	SLD73720	SLD73723	SLD73724	SLD73726
SLD73727	SLD73728	SLD73731	SLD73732	SLD73733	SLD73736	SLD73737	SLD73742	SLD73743
SLD73744	SLD73746	SLD74224	SLD74232	SLD74256	SLD74257	SLD74263	SLD74288	SLD75165
SLD75166	SLD75175	SLD75176	SLD75177	SLD75179	SLD75185	SLD75187	SLD75189	SLD75191
SLD75192	SLD75458	SLD75459	SLD75460	SLD75461	SLD75462	SLD75464	SLD75564	SLD75570
SLD75573	SLD75574	SLD75578	SLD75585	SLD75587	SLD75644	SLD75721	SLD75755	SLD75756
SLD75758	SLD75766	SLD75767	SLD75768	SLD75769	SLD75770	SLD75771	SLD75772	SLD75773
SLD75774	SLD75775	SLD75776	SLD75777	SLD75778	SLD75779	SLD75802	SLD75814	SLD75839
SLD75841	SLD75892	SLD75893	SLD75918	SLD75994	SLD76077	SLD76078	SLD76079	SLD76082
SLD76083	SLD76084	SLD76085	SLD76086	SLD76092	SLD76094	SLD76131	SLD76163	SLD76168
SLD76169	SLD76172	SLD76185	SLD76188	SLD76206	SLD76209	SLD76232	SLD76420	SLD76421-1
SLD76430	SLD76437	SLD76476	SLD76479	SLD76480	SLD76481	SLD76486	SLD76504	SLD76505
SLD76614	SLD76619	SLD76912	SLD76946	SLD76949	SLD76952	SLD76955	SLD76956	SLD76958
SLD76961	SLD76964	SLD76965	SLD76967	SLD77191	SLD77195	SLD77199	SLD77525	SLD77599
SLD77599-2	SLD77603	SLD77638	SLD77639	SLD77780	SLD77969	SLD77977	SLD77980	SLD78054
SLD78064	SLD78077	SLD78119	SLD78121	SLD78293	SLD78670	SLD78701	SLD78702	SLD78706
SLD78718	SLD78728-1	SLD78733	SLD78736	SLD78737	SLD78739	SLD78759	SLD78762	SLD78763
SLD78765	SLD78766	SLD78774	SLD78776	SLD78777	SLD78791	SLD78794	SLD78797	SLD78798
SLD78883	SLD78958	SLD78985	SLD78986	SLD78987	SLD78989	SLD78990	SLD79203	SLD79204
SLD79205	SLD79206	SLD79650	SLD79655	SLD79656	SLD80370	SLD80374	SLD80392	SLD80399
SLD80491	SLD81290	SLD81294	SLD81307	SLD81315	SLD81316	SLD81677	SLD81736	SLD81738
SLD81740	SLD81741	SLD81742	SLD81743	SLD81748	SLD81749	SLD81752	SLD81753	SLD81761
SLD81762	SLD81763	SLD81766	SLD81773	SLD81788	SLD81794	SLD81801	SLD81802	SLD81807
SLD81812	SLD81818	SLD81819	SLD81820	SLD81821	SLD81822	SLD81823	SLD81826	SLD81827
SLD81828	SLD81830	SLD81831	SLD81835	SLD81840	SLD81845	SLD81846	SLD81847	SLD81851
SLD81856	SLD81858	SLD81859	SLD81860	SLD81861	SLD81862	SLD81863	SLD81870	SLD81871
SLD81872	SLD81876	SLD81880	SLD81881	SLD81885	SLD81885-1	SLD81886	SLD81887	SLD81888
SLD81889	SLD81890	SLD81907	SLD81908	SLD81909	SLD81910	SLD81911	SLD81912	SLD81913
SLD81914	SLD81915	SLD81916	SLD81917	SLD81918	SLD81918-1	SLD81921	SLD81922	SLD81923
SLD81939	SLD81941	SLD82023	SLD82024	SLD82031	SLD82033	SLD82034	SLD82035	SLD82036
SLD82037	SLD82038	SLD82039	SLD82040	SLD82041	SLD82208	SLD82225	SLD82577	SLD82580
SLD82581	SLD82803	SLD82804	SLD82805	SLD82806	SLD82807	SLD82810	SLD82810-1	SLD82813
SLD82815	SLD82817	SLD82820	SLD82820-1	SLD82821	SLD82822	SLD82823	SLD82826	SLD82829
SLD82832	SLD83216	SLD83226	SLD83227	SLD83252	SLD83253	SLD83256	SLD83268	SLD83269

Table E-2-1. Samples for the Dataset Used to Calculate the Activity Fractions for SLDS Properties (Continued)

SLD83286	SLD83295	SLD83296	SLD83298	SLD83304	SLD83306	SLD83309	SLD83312	SLD83322
SLD83325	SLD83326	SLD83333	SLD83344	SLD83349	SLD83354	SLD83358	SLD83360	SLD83367
SLD83373	SLD83408	SLD83415	SLD83416	SLD83417	SLD83421	SLD83424	SLD83425	SLD83428
SLD83497	SLD83498	SLD83503	SLD83505	SLD83506	SLD83510	SLD83512	SLD83514	SLD83523
SLD83525	SLD83530	SLD83536	SLD83538	SLD83555	SLD83556	SLD83558	SLD83559	SLD83567
SLD83569	SLD83570	SLD83571	SLD83579	SLD83583	SLD83592	SLD83621	SLD83622	SLD83623
SLD83626	SLD83627	SLD83633	SLD83636	SLD83637	SLD83639	SLD83640	SLD83641	SLD83645
SLD83646	SLD83647	SLD83648	SLD83649	SLD83650	SLD83653	SLD83655	SLD83660	SLD83661
SLD83860	SLD83861	SLD83862	SLD83863	SLD83864	SLD83865	SLD83866	SLD83867	SLD83882
SLD83888	SLD83896	SLD83904	SLD84108	SLD84413	SLD84656	SLD84656-1	SLD84657	SLD84658
SLD84659	SLD84660	SLD84662	SLD84666	SLD84667	SLD84668	SLD84671	SLD84674	SLD84675
SLD84676	SLD84679	SLD84680	SLD84681	SLD84682	SLD84683	SLD84684	SLD84685	SLD84689
SLD85033	SLD85034	SLD85052	SLD85052-1	SLD85058	SLD85059	SLD85138	SLD85205	SLD85207
SLD85208	SLD85209	SLD85210	SLD85214	SLD85525	SLD86234	SLD86248	SLD86248-1	SLD86248-2
SLD86250	SLD86261	SLD86261-1	SLD86261-2	SLD86278	SLD86617	SLD86641	SLD87265	SLD87270
SLD87678	SLD87681	SLD87905	SLD87975	SLD88402	SLD88404	SLD89149	SLD89157	SLD89158
SLD89160	SLD89161	SLD90956	SLD90966	SLD92447	SLD92448	SLD92450	SLD92452	SLD92899
SLD92901	SLD92903	SLD92905	SLD92906	SLD92907	SLD92909	SLD92909-1	SLD92909-2	SLD92911
SLD93365	SLD93368	SLD93369	SLD93370-2	SLD95247	SLD95368	SLD95370	SLD95423	SLD96208
SLD96629	SLD96795	SLD96813	SLD97197	SLD97197-1	SLD97197-2	SLD98307	SLD98323	SLD98341
SLD99626	SLD99633	SLD99645	SLDB0901	SLDB1002	SLDB1003	SLDB1101	SLDB1102	SLDB1103
SLDB1201	SLDB1202	SLDB1203	SLDB1401	SLDB1402	SLDB1403	SLDB1501	SLDB1502	SLDB1503
SLDB1601	SLDB1602	SLDB1603	SLDB1701	SLDB1702	SLDB1703	SLDB1801	SLDB1802	SLDB1803
SLDB1902	SLDB2002	SLDB2003	SLDB2101	SLDB2102	SLDB2103	SLDB2201	SLDB2202	SLDB2203
SLDB2301	SLDB2303	SLDB2401	SLDB2402	SLDB2403	SLDB2404	SLDB2405	SLDB2503	SLDB2504
SLDB2603	SLDB2802	SLDB2803	SLDB2805	SLDB2902	SLDB2903	SLDB2904	SLDB2905	SLDB3001
SLDB3002	SLDB3003	SLDB3004	SLDB3005	SLDB3105	SLDB3202	SLDB3203	SLDB3601	SLDB3602
SLDB3603	SLDB4305	SLDB4705	SLDB4905	SLDB4907	SLDB4908	SLDS0502	SLDS1101	SLDS1102
SLDS1201	SLDS1202	SLDS1401	SLDS1402	SLDS1801	SLDS1802	SLDS1803		

APPENDIX F

SODIUM IODIDE 2-INCH-BY-2-INCH SCINTILLATION DETECTOR SCAN MINIMUM DETECTABLE CONCENTRATIONS FOR RADIOLOGICAL CONTAMINANTS OF CONCERN AT THE ST. LOUIS FUSRAP SITES

THIS PAGE INTENTIONALLY LEFT BLANK

SODIUM IODIDE 2-INCH-BY-2-INCH SCINTILLATION DETECTOR SCAN MINIMUM DETECTABLE CONCENTRATIONS FOR RADIOLOGICAL CONTAMINANTS OF CONCERN AT THE ST. LOUIS FUSRAP SITES

The objective of this assessment is to determine whether the collective scan MDCs for the radiological COCs are sufficient to reliably detect when the average SOR_N over 100 m² exceeds 1.0, which is the primary ARAR-based RG. The primary steps utilized for determining whether this objective is met are as follows.

1. Calculate the $MDCR_{surveyor}$ using methodology in NUREG-1507 (NRC 2020).
2. Calculate the scan MDC for each radiological COC using a representative soil and detector configuration using methodology in NUREG-1507.
3. Use the net sum of fractions (SOF_N) of scan MDCs results, SOR_N results, and whether the sample was prompted by a GWS to determine whether the proportion of false negative outcomes is consistent with the DQOs.

Step 1. The following parameters are selected based on experience at the SLS: an average background count rate of 10,000 cpm for the 2-inch-by-2-inch NaI detector, a 1-m² area of interest, and a scan rate of 0.5 m per seconds. The 1-m² area of interest is based on experience with the size of areas of interest at the SLS and area-weighted averaging per the RGs. The observational interval is calculated based on the diameter of a circle having a 1-m² area.

$$Observation\ Interval = \frac{diameter}{scan\ rate} = \frac{\sqrt{4(area)/\pi}}{scan\ rate} = \frac{\sqrt{4(1)/\pi}}{0.5} = 2.257\ seconds = 0.0376\ minutes$$

The observation rate is calculated from the observation interval.

$$Observation\ Rate = \frac{1}{Observation\ Interval} = \frac{1}{0.0376\ minutes} = 26.6 /minute$$

The observable background counts (b_i) are calculated from the average background count rate and observation interval.

$$b_i = (Average\ Background\ Count\ Rate)(Observation\ Interval) = (10000\ cpm)(0.0376\ minutes) = 376\ counts$$

The index of sensitivity (d') is based on the false negative proportion and the false positive proportion. Consistent with Section 3.6 of this FSSP, the false negative proportion is set at 0.05, which equates to 0.95 true positive proportion. Based on experience, a false positive proportion of 0.6 is acceptable to the project. Using these values, an index of sensitivity of 1.38 is obtained from MARSSIM Table 6.5 (DoD 2000). For false positive proportions not in MARSSIM Table 6.5, the index of sensitivity can be calculated using the inverse cumulative distribution function of normal distribution for the false positive and false negative proportions and taking the difference as follows using spreadsheet function nomenclature.

$$d' = NORM.S.INV(1 - false\ positive\ proportion) - NORM.S.INV(false\ negative\ proportion)$$

The net MDCR that an ideal surveyor can distinguish from the background detector response is calculated using d' , b_i , and observation rate.

$$MDCR = (d')\sqrt{b_i}(Observation\ Rate) = (1.38)\sqrt{376}(26.6) = 712\ cpm$$

The $MDCR_{surveyor}$ accounts for actual surveyors being less than ideal using MDCR and a surveyor efficiency. Per NUREG-1507, “[t]he results of an experiment on defined-interval confidence rating

indicate that p , as a general rule, is no greater than 0.75, but an efficiency value of 0.5 may be the more appropriate default for estimating field performance during the planning phase of a decommissioning project” (NRC 2020). Therefore, a surveyor efficiency of 0.5 is selected.

$$MDCR_{surveyor} = \frac{MDCR}{\sqrt{\text{surveyor efficiency}}} = \frac{712 \text{ cpm}}{\sqrt{0.5}} = 1,007 \text{ cpm}$$

Step 2. Microshield™ is used to estimate the exposure rate concentration ratio (ERC) (in units of [μR per hour]/pCi/g) for each radionuclide using the parameters in Table F-1.

Table F-1. Input Parameters for Microshield™

Parameter	NUREG-1507	Basis
Depth of Area of Interest	15 cm	NUREG-1507
Radius of Area of Interest	56.4 cm	Area and diameter described in Step 1
Dose Point	10 cm above source	NUREG-1507
Soil Density	1.6 g/cm	NUREG-1507
Material Type in Model	Concrete	NUREG-1507
Source Contamination	Uniform/Homogenized	Experience at the SLS
Grouped Energies	Yes	Allows for use of Table 6-3 in NUREG-1507
Exclude Photons <15 keV	Yes	Photons <15 keV provide no contribution
Library	Grove	Default
Decay	None	Addressed in parent and decay chain isotopes concentrations for each radiological COC
Model	Annual Cylinder – End Shields	Geometry of a 1-m ² circle of soil that is 15 cm thick with a detector 10 cm above the soil
Parent and Decay Chain Isotopes Concentrations for Each Radiological COC Associated with Uranium Ore	Parent: Ac-227 at 1 pCi/g Included Decay Chain Isotopes: Th-227 (0.9862), francium (Fr)-223 (0.014), Ra-223, Rn-219, Po-215, Pb-211, Bi-211, and Tl-207	NUREG-1507: Unit concentration of 1 pCi/g. Decay chain isotopes have the same concentration as the parent except for decay chain splits. Splits in the decay chain are identified by their respective fractions, which are also the concentrations.
	Parent: Pa-231 at 1 pCi/g Included Decay Chain Isotopes: None	NUREG-1507: Unit concentration of 1 pCi/g. Pa-231 decays to Ac-227, which is separately addressed.
	Parent: Ra-226 at 1 pCi/g Included Decay Chain Isotopes: Rn-222, Po-218, Pb-214, Bi-214, and Po-214	NUREG-1507: Unit concentration of 1 pCi/g. Decay chain isotopes have same concentration as parent.
	Parent: Th-230 at 1 pCi/g Included Decay Chain Isotopes: None	NUREG-1507: Unit concentration of 1 pCi/g. Th-230 decays to Ra-226, which is separately addressed.
	Parent: Th-232 at 1 pCi/g Included Decay Chain Isotopes: Ra-228, Ac-228, Th-228, Ra-224, Rn-220, Po-216, Pb-210, Bi-212, Po-212 (0.64), and Tl-208 (0.36)	NUREG-1507: Unit concentration of 1 pCi/g. Decay chain isotopes have the same concentration as the parent except for decay chain splits. Splits in the decay chain are identified by their respective fractions, which are also the concentrations.
	Parent: Natural uranium at 1 pCi/g (0.489 for U-234, 0.489 for U-238, and 0.022 for U-235) Included Decay Chain Isotopes: Th-234, Pa-234m, U-234, U-235, and Th-231	NUREG-1507: Unit concentration of 1 pCi/g. Fractional contributions of parents are carried forward to their progenies.

Table F-1-1 in Attachment F-1 contains the Microshield™ results for ERC for the grouped photon energies, the count rate to exposure rate ratio (CPMR) (in units of cpm/[μR per hour]) for the

grouped photon energies, the weighted CPMR for the grouped photon energies, and the total exposure rate and total weighted CPMR for the 1-m² area of interest. Table F-1-2 in Attachment F-1 contains the same information for a 10-m² area of interest; all other parameters are the same.

The scan MDC for each radiological COC is calculated using the $MDCR_{surveyor}$, total ERC, and total weighted CPMR.

$$Scan\ MDC = \frac{MDCR_{surveyor}}{(total\ ERC)(total\ weighted\ CPMR)}$$

The scan MDC for Ac-227 is shown as an example of this calculation.

$$Scan\ MDC = \frac{1007}{(0.239)(3058)} = 1.38\ pCi/g$$

Table F-2 contains the scan MDC results for the key parameters listed.

Table F-2. Gamma Walkover Survey Instrument Detection Sensitivity

Area (m ²)	Background (cps)	Scan Rate (m/second)	Index of Sensitivity	Surveyor Efficiency	Scan MDC (pCi/g)					
					Ac-227	Pa-231	Ra-226	Th-230	Th-232	Natural Uranium
1	166.7	0.5	1.38	0.5	1.38	17.8	1.11	1,064	1.07	37.9
10	166.7	0.5	1.38	0.5	0.64	8.1	0.49	430	0.47	17.6

Step 3. For a given soil sample, the radionuclide scan MDCs can be used to calculate an SOF_N using the following equations.

$$SOF_N^{1\ m^2} = \frac{Ac - 227_N}{1.38\ pCi/g} + \frac{Pa - 231_N}{17.79\ pCi/g} + \frac{Ra - 226_N}{1.11\ pCi/g} + \frac{Th - 230_N}{1064\ pCi/g} + \frac{Th - 232_N}{1.07\ pCi/g} + \frac{(2.04)(U - 238_N)}{37.9\ pCi/g}$$

$$SOF_N^{10\ m^2} = \frac{Ac - 227_N}{0.64\ pCi/g} + \frac{Pa - 231_N}{8.1\ pCi/g} + \frac{Ra - 226_N}{0.49\ pCi/g} + \frac{Th - 230_N}{430\ pCi/g} + \frac{Th - 232_N}{0.47\ pCi/g} + \frac{(2.04)(U - 238_N)}{17.6\ pCi/g}$$

Because the scan MDC for natural uranium includes U-234, U-235, and U-238, the U-238 sample concentration is adjusted to account for the other radionuclides. The AFs for natural uranium are 0.489 for U-234 and U-238 and 0.022 for U-235 (NRC 2014). To account for the entirety of the natural uranium activity in the SOF_N equation, the concentration of U-238 is multiplied by 1/0.489, or 2.04.

The SOR_N equations are based on the net sample result and criteria established in the respective RODs. Background values are contained in Table F-3.

$$SLDS: SOR_N^{depth \leq 0.5\ ft} = \frac{Greater\ of\ Ra_N^{226}\ or\ Th_N^{230}}{5\ pCi/g} + \frac{Greater\ of\ Ra_N^{228}\ or\ Th_N^{232}}{5\ pCi/g} + \frac{U_N^{238}}{50\ pCi/g}$$

$$SLDS: SOR_N^{depth > 0.5\ ft} = \frac{Greater\ of\ Ra_N^{226}\ or\ Th_N^{230}}{15\ pCi/g} + \frac{Greater\ of\ Ra_N^{228}\ or\ Th_N^{232}}{15\ pCi/g} + \frac{U_N^{238}}{50\ pCi/g}$$

$$NC\ and\ CWC: SOR_N^{depth \leq 0.5\ ft} = \frac{Ra_N^{226}}{5\ pCi/g} + \frac{Th_N^{230}}{14\ pCi/g} + \frac{U_N^{238}}{50\ pCi/g}$$

$$NC \text{ and } CWC: SOR_N^{depth>0.5ft} = \frac{Ra_N^{226}}{15 \text{ pCi/g}} + \frac{Th_N^{230}}{15 \text{ pCi/g}} + \frac{U_N^{238}}{50 \text{ pCi/g}}$$

Table F-3. Background Values for Soil

Location	Ac-227	Pa-231	Ra-226	Th-230	Th-232	U-238
SLDS Surface and Subsurface	0.10	0.90	2.78	0.95	1.94	1.09
North St. Louis County VPs and CWC Surface	0.20	0.24	0.95	1.48	1.07	1.08
North St. Louis County VPs and CWC Subsurface	0.21	0.15	1.15	1.83	1.15	1.27

A representative dataset of soil samples is needed so the SOF_N and SOR_N results can be calculated and compared to determine whether the proportion of false negative results of the GWS is consistent with the DQOs. Because the mixture of radionuclides is slightly different, three representative datasets are identified: the SLDS dataset (for all SLDS), the North St. Louis County VPs dataset (for North St. Louis County properties south of Pershall Road), and the CWC dataset (North St. Louis County properties north of Pershall Road). To obtain sufficient samples with SOF_N and SOR_N values exceeding 1.0, data from contaminated soil excavated for offsite disposal are used. The samples used in each of the three datasets are identified in Tables F-1-3 through F-1-5 in Attachment F-1.

The comparison of the results for a given sample has five possible outcomes. (The true/false positive/negative designation is based on consistency between the SOF_N and the SOR_N or GWS-based sampling. GWS-based samples are given a sample prefix of HTZ or HTR.)

- Both SOF_N and SOR_N exceed 1.0 (true positive).
- SOF_N does not exceed 1.0, but the surveyor noticed a change in the count rate anyway, and a GWS-based sample was collected (true positive).
- SOF_N does not exceed 1.0, while SOR_N exceeds 1.0 for a non-GWS-based sample (false negative).
- SOF_N exceeds 1.0, while SOR_N does not exceed 1.0 (false positive).
- Both SOF_N and SOR_N do not exceed 1.0 (true negative).

Based on 20-plus years of field experience, the program is willing to accept the consequence of investigation, including sampling, of false positive outcomes in the interest of minimizing false negative outcomes. In addition, true negative outcomes are not relevant to minimizing false negatives. Therefore, the outcomes described in the last two bulleted entries are not carried forward in this evaluation.

For the SLDS dataset, the number of samples with an SOR_N exceeding 1.0 is 292. The number of false negative outcomes using the 1-m² SOF_N is 17, yielding a proportion of false negative outcomes of 0.058 (17/292), which is reasonably consistent with the DQOs. Collectively, the scan MDCs for the radionuclide COCs are sufficient to reliably detect when the average SOR_N over 100 m² exceeds 1.0.

For the North St. Louis County VPs dataset, the number of samples with an SOR_N exceeding 1.0 is 724. The number of false negative outcomes using the 1-m² SOF_N is 189, yielding a proportion of false negative outcomes of 0.261 (189/724), which is not consistent with the DQOs. However, that calculation does not consider the averaging-over-100-m² aspect of the RG. To include that aspect, two different calculations are required: (a) one that ensures enough of the SOR_N values in

the false negative group are small and (b) one that ensures the land area associated with the false negative group is small enough.

- a. For this calculation, the SOR_N value is incrementally increased until the false negative proportion reaches a value consistent with the DQOs. For the North St. Louis County VPs dataset, an SOR_N value of 2 produces 39 false negative outcomes and a false negative proportion of 0.054 (39/724). The 1-m^2 SOF_N is used as part of this calculation. An SOR_N value of 2 is small enough that an average SOR_N for a 100-m^2 area would be less than 1.0.
- b. For this calculation, a 10-m^2 area is selected. An SOR_N exceeding 1.0 is used as part of this calculation. The number of false negative outcomes is 46, and the false negative proportion is 0.064 (46/724), which is reasonably consistent with the DQOs. An area of 10 m^2 is small enough that an average SOR_N for a 100-m^2 area would be less than 1.0.

The results of these two additional calculations demonstrate that the SOR_N values and the areas of interest are small enough that the DQOs are met when considering an average SOR_N over a 100-m^2 area. Collectively, the scan MDCs for the radionuclide COCs are sufficient to reliably detect when the average SOR_N over 100 m^2 exceeds 1.0.

For the CWC dataset, the number of samples with an SOR_N exceeding 1.0 is 186. The number of false negative outcomes using the 1-m^2 SOF_N is 65, yielding a proportion of false negative outcomes of 0.349 (65/186), which is not consistent with the DQOs. However, that calculation does not consider the averaging-over- 100-m^2 aspect of the RG. To include that aspect, two different calculations are required: (a) one that ensures enough of the SOR_N values in the false negative group are small and (b) one that ensures the land area associated with the false negative group is small enough.

- a. For this calculation, the SOR_N value is incrementally increased until the false negative proportion reaches a value consistent with the DQOs. For the CWC dataset, an SOR_N value of 1.8 produces 7 false negative outcomes and a false negative proportion of 0.038 (7/186), which is reasonably consistent with the DQOs. The 1-m^2 SOF_N is used as part of this calculation. An SOR_N value of 1.8 is small enough that an average SOR_N for a 100-m^2 area would be less than 1.0.
- b. For this calculation, a 10-m^2 area is selected. An SOR_N exceeding 1.0 is used as part of this calculation. The number of false negative outcomes is 14, and the false negative proportion is 0.075 (14/186), which is reasonably consistent with the DQOs. If an SOR_N exceeding 1.1 is used as part of this calculation, then the number of false negative outcomes is 10, and the false negative proportion is 0.054 (10/186), which is even more consistent with the DQOs. A 10-m^2 area with an SOR_N of 1.1 is small enough that an average SOR_N for a 100-m^2 area would be less than 1.0.

The results of these two additional calculations demonstrate that the SOR_N values and the areas of interest are small enough that the DQOs are met when considering an average SOR_N over a 100-m^2 area. Collectively, the scan MDCs for the radionuclide COCs are sufficient to reliably detect when the average SOR_N over 100 m^2 exceeds 1.0.

This same methodology can be applied to assess unique conditions by changing parameters affected by the conditions, such as different scan rates, background count rates, a limited thickness of cover material, or areas of interest.

THIS PAGE INTENTIONALLY LEFT BLANK

ATTACHMENT F-1
TABLES

THIS PAGE INTENTIONALLY LEFT BLANK

Table F-1-1. Exposure Rate Concentration and Count Rate to Exposure Rate Ratio Calculations and Results for a 1-m² Area of Interest

Ac-227						Pa-231					
Energy (keV)	ERC ^a (mR/hour)	ERC (μR/hour)	Fractional ERC	CPMR ^b (cpm/μR/hour)	Weighted CPMR ^c (cpm/μR/hour)	Energy (keV)	ERC ^a (mR/hour)	ERC (μR/hour)	Fractional ERC	CPMR ^b (cpm/μR/hour)	Weighted CPMR ^c (cpm/μR/hour)
15	8.324E-10	8.32E-07	3.48E-06	1,160	0.00	15	--	--	--	1,160	--
20	6.51E-09	6.51E-06	2.73E-05	2,150	0.06	20	1.10E-08	1.10E-05	6.02E-04	2,150	1.30
30	4.58E-09	4.58E-06	1.92E-05	5,030	0.10	30	4.32E-07	4.32E-04	2.37E-02	5,030	119.22
40	1.49E-08	1.49E-05	6.24E-05	8,480	0.53	40	9.78E-09	9.78E-06	5.37E-04	8,480	4.56
50	8.16E-07	8.16E-04	3.42E-03	11,300	38.59	50	1.90E-08	1.90E-05	1.04E-03	11,300	11.79
60	3.19E-08	3.19E-05	1.33E-04	12,700	1.69	60	--	--	--	12,700	--
80	1.19E-05	1.19E-02	4.97E-02	12,000	596.27	80	1.46E-07	1.46E-04	8.02E-03	12,000	96.28
100	6.01E-06	6.01E-03	2.51E-02	9,970	250.71	100	5.49E-07	5.49E-04	3.02E-02	9,970	300.64
150	7.38E-06	7.38E-03	3.09E-02	6,190	191.21	150	1.10E-06	1.10E-03	6.01E-02	6,190	372.22
200	1.81E-05	1.81E-02	7.57E-02	4,320	326.96	200	--	--	--	4,320	--
300	1.02E-04	1.02E-01	4.25E-01	2,540	1080.29	300	1.55E-05	1.55E-02	8.50E-01	2,540	2159.26
400	6.96E-05	6.96E-02	2.91E-01	1,710	497.86	400	4.68E-07	4.68E-04	2.57E-02	1,710	43.95
500	1.69E-06	1.69E-03	7.09E-03	1,270	9.00	500	--	--	--	1,270	--
600	--	--	--	1,010	--	600	--	--	--	1,010	--
800	2.18E-05	2.18E-02	9.14E-02	710	64.88	800	--	--	--	710	--
1,000	--	--	--	550	--	1,000	--	--	--	550	--
1,500	--	--	--	350	--	1,500	--	--	--	350	--
2,000	--	--	--	270	--	2,000	--	--	--	270	--
3,000	--	--	--	190	--	3,000	--	--	--	190	--
Totals	--	2.39E-01	--	--	3,058	Totals	--	1.82E-02	--	--	3,109

Table F-1-1. Exposure Rate Concentration and Count Rate to Exposure Rate Ratio Calculations and Results for a 1-m² Area of Interest (Continued)

Ra-226						Th-230					
Energy (keV)	ERC ^a (mR/hour)	ERC (μR/hour)	Fractional ERC	CPMR ^b (cpm/μR/hour)	Weighted CPMR ^c (cpm/μR/hour)	Energy (keV)	ERC ^a (mR/hour)	ERC (μR/hour)	Fractional ERC	CPMR ^b (cpm/μR/hour)	Weighted CPMR ^c (cpm/μR/hour)
15	--	--	--	1,160	--	15	--	--	--	1,160	--
20	--	--	--	2,150	--	20	--	--	--	2,150	--
30	--	--	--	5,030	--	30	--	--	--	5,030	--
40	--	--	--	8,480	--	40	--	--	--	8,480	--
50	1.01E-07	1.01E-04	8.95E-05	11,300	1.01	50	--	--	--	11,300	--
60	--	--	--	12,700	--	60	4.91E-08	4.91E-05	4.85E-01	12,700	6,164.23
80	5.43E-06	5.43E-03	4.81E-03	12,000	57.75	80	--	--	--	12,000	--
100	5.01E-08	5.01E-05	4.44E-05	9,970	0.44	100	--	--	--	9,970	--
150	--	--	--	6,190	--	150	5.21E-08	5.21E-05	5.15E-01	6,190	3,185.54
200	1.25E-05	1.25E-02	1.11E-02	4,320	47.82	200	--	--	--	4,320	--
300	4.02E-05	4.02E-02	3.57E-02	2,540	90.57	300	--	--	--	2,540	--
400	1.04E-04	1.04E-01	9.17E-02	1,710	156.87	400	--	--	--	1,710	--
500	6.15E-06	6.15E-03	5.45E-03	1,270	6.92	500	--	--	--	1,270	--
600	1.99E-04	1.99E-01	1.76E-01	1,010	178.06	600	--	--	--	1,010	--
800	5.14E-05	5.14E-02	4.55E-02	710	32.33	800	--	--	--	710	--
1,000	2.10E-04	2.10E-01	1.86E-01	550	102.13	1,000	--	--	--	550	--
1,500	1.80E-04	1.80E-01	1.60E-01	350	55.93	1,500	--	--	--	350	--
2,000	3.20E-04	3.20E-01	2.84E-01	270	76.63	2,000	--	--	--	270	--
3,000	--	--	--	190	--	3,000	--	--	--	190	--
Totals	--	1.13E+00	--	--	806	Totals	--	1.01E-04	--	--	9,350

Table F-1-1. Exposure Rate Concentration and Count Rate to Exposure Rate Ratio Calculations and Results for a 1-m² Area of Interest (Continued)

Th-232						Natural Uranium					
Energy (keV)	ERC ^a (mR/hour)	ERC (μR/hour)	Fractional ERC	CPMR ^b (cpm/μR/hour)	Weighted CPMR ^c (cpm/μR/hour)	Energy (keV)	ERC ^a (mR/hour)	ERC (μR/hour)	Fractional ERC	CPMR ^b (cpm/μR/hour)	Weighted CPMR ^c (cpm/μR/hour)
15	--	--	--	1,160	--	15	--	--	--	1,160	--
20	--	--	--	2,150	--	20	9.51E-11	9.51E-08	1.35E-05	2,150	0.03
30	--	--	--	5,030	--	30	1.50E-08	1.50E-05	2.12E-03	5,030	10.65
40	6.71E-08	6.71E-05	4.30E-05	8,480	0.36	40	--	--	--	8,480	--
50	3.70E-07	3.70E-04	2.37E-04	11,300	2.68	50	5.27E-09	5.27E-06	7.46E-04	11,300	8.43
60	9.10E-08	9.10E-05	5.83E-05	12,700	0.74	60	2.53E-07	2.53E-04	3.58E-02	12,700	454.55
80	1.54E-06	1.54E-03	9.86E-04	12,000	11.83	80	7.71E-08	7.71E-05	1.09E-02	12,000	130.94
100	2.40E-06	2.40E-03	1.54E-03	9,970	15.31	100	1.18E-06	1.18E-03	1.67E-01	9,970	1,669.95
150	3.18E-06	3.18E-03	2.03E-03	6,190	12.59	150	2.59E-07	2.59E-04	3.66E-02	6,190	226.71
200	1.12E-05	1.12E-02	7.15E-03	4,320	30.90	200	1.57E-06	1.57E-03	2.23E-01	4,320	961.93
300	4.44E-05	4.44E-02	2.84E-02	2,540	72.26	300	--	--	--	2,540	--
400	6.40E-06	6.40E-03	4.10E-03	1,710	7.01	400	--	--	--	1,710	--
500	4.89E-05	4.89E-02	3.13E-02	1,270	39.76	500	--	--	--	1,270	--
600	1.37E-04	1.37E-01	8.75E-02	1,010	88.36	600	--	--	--	1,010	--
800	1.75E-04	1.75E-01	1.12E-01	710	79.35	800	5.49E-07	5.49E-04	7.77E-02	710	55.18
1,000	3.90E-04	3.90E-01	2.50E-01	550	137.30	1,000	3.15E-06	3.15E-03	4.46E-01	550	245.25
1,500	1.27E-04	1.27E-01	8.13E-02	350	28.47	1,500	--	--	--	350	--
2,000	3.63E-06	3.63E-03	2.33E-03	270	0.63	2,000	--	--	--	270	--
3,000	6.11E-04	6.11E-01	3.92E-01	190	74.40	3,000	--	--	--	190	--
Totals	--	1.56E+00	--	--	602	Totals	--	7.07E-03	--	--	3,764

^a Exposure rate with buildup output from Microshield™ (in mR per hour).^b Values for 2-inch-by-2-inch NaI gamma scintillation detectors from Table 6-3 of NUREG-1507 (NRC 2020) (in cpm/μR/hour).^c Weighted CPMR = (Fractional ERC) x (CPMR).

Note:

No result is indicated by --.

Table F-1-2. Exposure Rate Concentration and Count Rate to Exposure Rate Ratio Calculations and Results for a 10-m² Area of Interest

Ac-227						Pa-231					
Energy (keV)	ERC ^a (mR/hour)	ERC (μR/hour)	Fractional ERC	CPMR ^b (cpm/μR/hour)	Weighted CPMR ^c (cpm/μR/hour)	Energy (keV)	ERC ^a (mR/hour)	ERC (μR/hour)	Fractional ERC	CPMR ^b (cpm/μR/hour)	Weighted CPMR ^c (cpm/μR/hour)
15	7.842E-10	7.84E-07	2.66E-06	1,160	0.00	15	9.354E-07	9.35E-04	4.03E-02	1,160	46.70
20	7.181E-09	7.18E-06	2.44E-05	2,150	0.05	20	1.210E-08	1.21E-05	5.21E-04	2,150	1.12
30	5.228E-09	5.23E-06	1.77E-05	5,030	0.09	30	4.930E-07	4.93E-04	2.12E-02	5,030	106.73
40	1.700E-08	1.70E-05	5.77E-05	8,480	0.49	40	1.117E-08	1.12E-05	4.81E-04	8,480	4.08
50	9.357E-07	9.36E-04	3.18E-03	11,300	35.89	50	2.180E-08	2.18E-05	9.38E-04	11,300	10.60
60	3.673E-08	3.67E-05	1.25E-04	12,700	1.58	60	--	--	--	12,700	--
80	1.384E-05	1.38E-02	4.70E-02	12,000	563.71	80	1.704E-07	1.70E-04	7.33E-03	12,000	88.01
100	7.070E-06	7.07E-03	2.40E-02	9,970	239.25	100	6.470E-07	6.47E-04	2.78E-02	9,970	277.62
150	8.839E-06	8.84E-03	3.00E-02	6,190	185.71	150	1.311E-06	1.31E-03	5.64E-02	6,190	349.26
200	2.190E-05	2.19E-02	7.43E-02	4,320	321.12	200	--	--	--	4,320	--
300	1.251E-04	1.25E-01	4.25E-01	2,540	1,078.52	300	1.905E-05	1.91E-02	8.20E-01	2,540	2,082.51
400	8.665E-05	8.67E-02	2.94E-01	1,710	502.92	400	5.831E-07	5.83E-04	2.51E-02	1,710	42.91
500	2.129E-06	2.13E-03	7.23E-03	1,270	9.18	500	--	--	--	1,270	--
600	--	--	--	1,010	--	600	--	--	--	1,010	--
800	2.809E-05	2.81E-02	9.53E-02	710	67.69	800	--	--	--	710	--
1,000	--	--	--	550	--	1,000	--	--	--	550	--
1,500	--	--	--	350	--	1,500	--	--	--	350	--
2,000	--	--	--	270	--	2,000	--	--	--	270	--
3,000	--	--	--	190	--	3,000	--	--	--	190	--
Totals	--	2.95E-01	--	--	3,006	Totals	--	2.32E-02	--	--	3,010

Table F-1-2. Exposure Rate Concentration and Count Rate to Exposure Rate Ratio Calculations and Results for a 10-m² Area of Interest (Continued)

Ra-226						Th-230					
Energy (keV)	ERC ^a (mR/hour)	ERC (μR/hour)	Fractional ERC	CPMR ^b (cpm/μR/hour)	Weighted CPMR ^c (cpm/μR/hour)	Energy (keV)	ERC ^a (mR/hour)	ERC (μR/hour)	Fractional ERC	CPMR ^b (cpm/μR/hour)	Weighted CPMR ^c (cpm/μR/hour)
15	3.210E-07	3.21E-04	2.17E-04	1,160	0.25	15	1.825E-07	1.83E-04	6.05E-01	1,160	702.16
20	--	--	--	2,150	--	20	--	--	--	2,150	--
30	--	--	--	5,030	--	30	--	--	--	5,030	--
40	--	--	--	8,480	--	40	--	--	--	8,480	--
50	1.158E-07	1.16E-04	7.85E-05	11,300	0.89	50	--	--	--	11,300	--
60	--	--	--	12,700	--	60	5.662E-08	5.66E-05	1.88E-01	12,700	2,384.99
80	6.334E-06	6.33E-03	4.29E-03	12,000	51.50	80	--	--	--	12,000	--
100	5.904E-08	5.90E-05	4.00E-05	9,970	0.40	100	--	--	--	9,970	--
150	--	--	--	6,190	--	150	6.238E-08	6.24E-05	2.07E-01	6,190	1,280.70
200	1.513E-05	1.51E-02	1.03E-02	4,320	44.28	200	--	--	--	4,320	--
300	4.953E-05	4.95E-02	3.36E-02	2,540	85.24	300	--	--	--	2,540	--
400	1.290E-04	1.29E-01	8.74E-02	1,710	149.46	400	--	--	--	1,710	--
500	7.732E-06	7.73E-03	5.24E-03	1,270	6.65	500	--	--	--	1,270	--
600	2.524E-04	2.52E-01	1.71E-01	1,010	172.72	600	--	--	--	1,010	--
800	6.611E-05	6.61E-02	4.48E-02	710	31.80	800	--	--	--	710	--
1,000	2.729E-04	2.73E-01	1.85E-01	550	101.70	1,000	--	--	--	550	--
1,500	2.407E-04	2.41E-01	1.63E-01	350	57.08	1,500	--	--	--	350	--
2,000	4.356E-04	4.36E-01	2.95E-01	270	79.69	2,000	--	--	--	270	--
3,000	--	--	--	190	--	3,000	--	--	--	190	--
Totals	--	1.48E+00	--	--	782	Totals	--	3.02E-04	--	--	4,368

Table F-1-2. Exposure Rate Concentration and Count Rate to Exposure Rate Ratio Calculations and Results for a 10-m² Area of Interest (Continued)

Th-232						Natural Uranium					
Energy (keV)	ERC ^a (mR/hour)	ERC (μR/hour)	Fractional ERC	CPMR ^b (cpm/μR/hour)	Weighted CPMR ^c (cpm/μR/hour)	Energy (keV)	ERC ^a (mR/hour)	ERC (μR/hour)	Fractional ERC	CPMR ^b (cpm/μR/hour)	Weighted CPMR ^c (cpm/μR/hour)
15	1.961E-06	1.96E-03	9.42E-04	1,160	1.09	15	3.598E-07	3.60E-04	3.92E-02	1,160	45.43
20	--	--	--	2,150	--	20	--	--	--	2,150	--
30	--	--	--	5,030	--	30	1.709E-08	1.71E-05	1.86E-03	5,030	9.36
40	7.662E-08	7.66E-05	3.68E-05	8,480	0.31	40	--	--	--	8,480	--
50	4.244E-07	4.24E-04	2.04E-04	11,300	2.30	50	6.047E-09	6.05E-06	6.58E-04	11,300	7.44
60	1.049E-07	1.05E-04	5.04E-05	12,700	0.64	60	2.917E-07	2.92E-04	3.17E-02	12,700	403.21
80	1.795E-06	1.80E-03	8.62E-04	12,000	10.34	80	8.997E-08	9.00E-05	9.79E-03	12,000	117.51
100	2.825E-06	2.83E-03	1.36E-03	9,970	13.52	100	1.395E-06	1.40E-03	1.52E-01	9,970	1,513.78
150	3.804E-06	3.80E-03	1.83E-03	6,190	11.31	150	3.101E-07	3.10E-04	3.38E-02	6,190	208.92
200	1.353E-05	1.35E-02	6.50E-03	4,320	28.07	200	1.907E-06	1.91E-03	2.08E-01	4,320	896.66
300	5.468E-05	5.47E-02	2.63E-02	2,540	66.69	300	--	--	--	2,540	--
400	7.975E-06	7.98E-03	3.83E-03	1,710	6.55	400	--	--	--	1,710	--
500	6.150E-05	6.15E-02	2.95E-02	1,270	37.51	500	--	--	--	1,270	--
600	1.733E-04	1.73E-01	8.32E-02	1,010	84.05	600	--	--	--	1,010	--
800	2.245E-04	2.25E-01	1.08E-01	710	76.54	800	7.070E-07	7.07E-04	7.70E-02	710	54.63
1,000	5.076E-04	5.08E-01	2.44E-01	550	134.06	1,000	4.104E-06	4.10E-03	4.47E-01	550	245.68
1,500	1.696E-04	1.70E-01	8.14E-02	350	28.50	1,500	--	--	--	350	--
2,000	4.940E-06	4.94E-03	2.37E-03	270	0.64	2,000	--	--	--	270	--
3,000	8.539E-04	8.54E-01	4.10E-01	190	77.91	3,000	--	--	--	190	--
Totals	--	2.08E+00	--	--	580	Totals	--	9.19E-03	--	--	3,503

^a Exposure rate with buildup output from Microshield™.^b Values for 2-inch-by-2-inch NaI gamma scintillation detectors from Table 6-3 of NUREG-1507 (NRC 2020).^c Weight CPMR = (Fractional ERC) x (CPMR).

Note:

No result is indicated by --.

Table F-1-3. Samples Used for SLDS Dataset of Remediated Soil^a

HTR83743	HTZ75280	HTZ119478	SLD02676	SLD02794	SLD04940	SLD07202	SLD27588	SLD27753	SLD27961
HTR94006	HTZ75281	HTZ119480	SLD02678	SLD02795	SLD04941	SLD07203	SLD27589	SLD27762	SLD27963
HTR94007	HTZ75298	HTZ142359	SLD02681	SLD02797	SLD04942	SLD07204	SLD27591	SLD27763	SLD27964
HTR94008	HTZ75300	HTZ142360	SLD02683	SLD02800	SLD04946	SLD07306	SLD27592	SLD27764	SLD27965
HTR94009	HTZ75313	HTZ142361	SLD02688	SLD02801	SLD04949	SLD07315	SLD27593	SLD27765	SLD27978
HTR94013	HTZ75325	HTZ142362	SLD02689	SLD02802	SLD04972	SLD07317	SLD27594	SLD27768	SLD27979
HTR94014	HTZ75326	HTZ142363	SLD02690	SLD02803	SLD04975	SLD07319	SLD27596	SLD27769	SLD27980
HTR94015	HTZ75329	HTZ142368	SLD02691	SLD02804	SLD04976	SLD07321	SLD27597	SLD27770	SLD27981
HTR177471	HTZ75337	HTZ142375	SLD02694	SLD02805	SLD04977	SLD07323	SLD27598	SLD27771	SLD27982
HTR177472	HTZ75401	HTZ144407	SLD02695	SLD02806	SLD04979	SLD07325	SLD27607	SLD27774	SLD28006
HTR177473	HTZ75402	HTZ176895	SLD02696	SLD02810	SLD04983	SLD07327	SLD27612	SLD27775	SLD65162
HTR177474	HTZ85324	HTZ176901	SLD02697	SLD02813	SLD04985	SLD07329	SLD27613	SLD27785	SLD65176
HTR177475	HTZ85325	HTZ176902	SLD02698	SLD02830	SLD04986	SLD07331	SLD27614	SLD27787	SLD65646
HTR177476	HTZ85326	HTZ176903	SLD02699	SLD02835	SLD04987	SLD07337	SLD27619	SLD27790	SLD65763
HTR177477	HTZ86435	HTZ176904	SLD02700	SLD02838	SLD04988	SLD07339	SLD27620	SLD27791	SLD65764
HTR177478	HTZ86436	HTZ176905	SLD02703	SLD02854	SLD05076	SLD07341	SLD27643	SLD27792	SLD69511
HTR177479	HTZ87374	HTZ176906	SLD02704	SLD02855	SLD05077	SLD07343	SLD27644	SLD27793	SLD69692
HTZ00466	HTZ87375	HTZ176907	SLD02705	SLD02862	SLD05079	SLD07345	SLD27645	SLD27794	SLD70003
HTZ00523	HTZ87376	HTZ183161	SLD02706	SLD02863	SLD05080	SLD07357	SLD27646	SLD27799	SLD70004
HTZ00528	HTZ87377	HTZ183178	SLD02707	SLD02864	SLD05082	SLD07359	SLD27653	SLD27800	SLD70005
HTZ00628	HTZ87378	HTZ183179	SLD02708	SLD02865	SLD05083	SLD07361	SLD27654	SLD27801	SLD70007
HTZ00644	HTZ87391	SLD00953	SLD02709	SLD03320	SLD05084	SLD07363	SLD27662	SLD27802	SLD70008
HTZ00645	HTZ87392	SLD02532	SLD02710	SLD03340	SLD05086	SLD07365	SLD27668	SLD27803	SLD70010
HTZ00646	HTZ87403	SLD02604	SLD02711	SLD03350	SLD05087	SLD07367	SLD27673	SLD27809	SLD70011
HTZ00647	HTZ87421	SLD02606	SLD02713	SLD03353	SLD05090	SLD07369	SLD27674	SLD27817	SLD70012
HTZ00648	HTZ87422	SLD02611	SLD02714	SLD03866	SLD05091	SLD07373	SLD27675	SLD27818	SLD70013
HTZ00651	HTZ87444	SLD02612	SLD02716	SLD03897	SLD05093	SLD07379	SLD27676	SLD27820	SLD70015
HTZ00653	HTZ87445	SLD02613	SLD02717	SLD03899	SLD05094	SLD07381	SLD27677	SLD27821	SLD70016
HTZ00654	HTZ87447	SLD02614	SLD02718	SLD03925	SLD05429	SLD07383	SLD27678	SLD27822	SLD70019
HTZ00655	HTZ87451	SLD02616	SLD02719	SLD03934	SLD05839	SLD07397	SLD27679	SLD27823	SLD70020
HTZ00656	HTZ87452	SLD02617	SLD02720	SLD04377	SLD05840	SLD07399	SLD27680	SLD27824	SLD70021
HTZ00657	HTZ87453	SLD02618	SLD02723	SLD04378	SLD05900	SLD07403	SLD27682	SLD27825	SLD70452
HTZ00658	HTZ87458	SLD02619	SLD02724	SLD04379	SLD05906	SLD07405	SLD27683	SLD27826	SLD70470
HTZ00697	HTZ87463	SLD02620	SLD02725	SLD04541	SLD05907	SLD07413	SLD27684	SLD27827	SLD73618
HTZ25704	HTZ87464	SLD02621	SLD02726	SLD04658	SLD05925	SLD07415	SLD27686	SLD27857	SLD73625
HTZ25714	HTZ87476	SLD02622	SLD02727	SLD04876	SLD06815	SLD07417	SLD27687	SLD27858	SLD73626
HTZ25715	HTZ88969	SLD02623	SLD02728	SLD04880	SLD06816	SLD07419	SLD27688	SLD27859	SLD73748
HTZ25717	HTZ88970	SLD02626	SLD02729	SLD04882	SLD06817	SLD07423	SLD27689	SLD27861	SLD73749
HTZ25718	HTZ88971	SLD02627	SLD02731	SLD04883	SLD06818	SLD07431	SLD27707	SLD27862	SLD73953
HTZ27420	HTZ88982	SLD02628	SLD02733	SLD04884	SLD06819	SLD07433	SLD27708	SLD27865	SLD74289
HTZ27421	HTZ88983	SLD02629	SLD02736	SLD04885	SLD06821	SLD07435	SLD27709	SLD27866	SLD74290
HTZ27422	HTZ88984	SLD02630	SLD02753	SLD04886	SLD06824	SLD07437	SLD27710	SLD27875	SLD74292
HTZ27459	HTZ89069	SLD02631	SLD02758	SLD04887	SLD06826	SLD07439	SLD27712	SLD27876	SLD74297
HTZ66206	HTZ89070	SLD02632	SLD02760	SLD04889	SLD06828	SLD07441	SLD27713	SLD27883	SLD74298
HTZ66207	HTZ89084	SLD02633	SLD02765	SLD04891	SLD06830	SLD25042	SLD27714	SLD27884	SLD74300
HTZ66234	HTZ93417	SLD02636	SLD02766	SLD04893	SLD06837	SLD25043	SLD27715	SLD27886	SLD74302
HTZ66241	HTZ93418	SLD02637	SLD02767	SLD04894	SLD06838	SLD26808	SLD27718	SLD27889	SLD75166
HTZ66242	HTZ93420	SLD02639	SLD02771	SLD04895	SLD06839	SLD27306	SLD27719	SLD27890	SLD75167
HTZ66288	HTZ93421	SLD02640	SLD02773	SLD04896	SLD06841	SLD27312	SLD27721	SLD27891	SLD75168
HTZ69431	HTZ93425	SLD02641	SLD02774	SLD04900	SLD06842	SLD27576	SLD27722	SLD27892	SLD75169
HTZ70831	HTZ93463	SLD02642	SLD02777	SLD04903	SLD06844	SLD27577	SLD27723	SLD27917	SLD75170
HTZ70832	HTZ93470	SLD02643	SLD02781	SLD04926	SLD06855	SLD27578	SLD27725	SLD27921	SLD75173
HTZ75255	HTZ93471	SLD02646	SLD02783	SLD04928	SLD06857	SLD27579	SLD27726	SLD27922	SLD75232
HTZ75268	HTZ93472	SLD02649	SLD02784	SLD04929	SLD06864	SLD27580	SLD27727	SLD27924	SLD75459
HTZ75269	HTZ93473	SLD02650	SLD02785	SLD04930	SLD06868	SLD27581	SLD27728	SLD27938	SLD75643
HTZ75271	HTZ93484	SLD02651	SLD02786	SLD04931	SLD06871	SLD27582	SLD27730	SLD27941	SLD75644
HTZ75275	HTZ93563	SLD02653	SLD02787	SLD04933	SLD06872	SLD27583	SLD27736	SLD27945	SLD75794
HTZ75276	HTZ95823	SLD02654	SLD02790	SLD04935	SLD06873	SLD27584	SLD27742	SLD27948	SLD75795
HTZ75278	HTZ95824	SLD02656	SLD02791	SLD04937	SLD06874	SLD27585	SLD27751	SLD27949	SLD75796
HTZ75279	HTZ95825	SLD02659	SLD02793	SLD04939	SLD07201	SLD27587	SLD27752	SLD27950	SLD75797

Table F-1-3. Samples Used for SLDS Dataset of Remediated Soil^a (Continued)

SLD75802	SLD77190	SLD81317	SLD83411	SLD86844	SLD89162	SLD103832	SLD125973	SLD126071	SLD131282
SLD75806	SLD77191	SLD81318	SLD83412	SLD86911	SLD89163	SLD103833	SLD125974	SLD126072	SLD136256
SLD75807	SLD77192	SLD81319	SLD83413	SLD86955	SLD89395	SLD103834	SLD125975	SLD126073	SLD136257
SLD75810	SLD77193	SLD81320	SLD83414	SLD87112	SLD89396	SLD103835	SLD125976	SLD126074	SLD136258
SLD75816	SLD77194	SLD81321	SLD83415	SLD87113	SLD89397	SLD103836	SLD125981	SLD126079	SLD136259
SLD75817	SLD77195	SLD81322	SLD83416	SLD87115	SLD89403	SLD103837	SLD125982	SLD126080	SLD136260
SLD75819	SLD77198	SLD81323	SLD83417	SLD87116	SLD89404	SLD103838	SLD125983	SLD126081	SLD136265
SLD75820	SLD77199	SLD81324	SLD83418	SLD87117	SLD89405	SLD103839	SLD125984	SLD126082	SLD136266
SLD75823	SLD77200	SLD81325	SLD83419	SLD87120	SLD92092	SLD103840	SLD125985	SLD126083	SLD136267
SLD75825	SLD77203	SLD81326	SLD83420	SLD87121	SLD92093	SLD103841	SLD125986	SLD126084	SLD136268
SLD75828	SLD77204	SLD81327	SLD83421	SLD87122	SLD93392	SLD103842	SLD125987	SLD126089	SLD136269
SLD75839	SLD77205	SLD81328	SLD83422	SLD87123	SLD93394	SLD103843	SLD125991	SLD126090	SLD136270
SLD75840	SLD77206	SLD81329	SLD83423	SLD87125	SLD93395	SLD106363	SLD125992	SLD126091	SLD136271
SLD75841	SLD77207	SLD81330	SLD83424	SLD87126	SLD93396	SLD106364	SLD125993	SLD126092	SLD136274
SLD75842	SLD77208	SLD81331	SLD83425	SLD87127	SLD93398	SLD106365	SLD125994	SLD126093	SLD136275
SLD75847	SLD77524	SLD81332	SLD83426	SLD87128	SLD93629	SLD106366	SLD125995	SLD126094	SLD136276
SLD75853	SLD77525	SLD81333	SLD83427	SLD87129	SLD93955	SLD106367	SLD125996	SLD126099	SLD136277
SLD75854	SLD79668	SLD81334	SLD83428	SLD87130	SLD96208	SLD106368	SLD125997	SLD126100	SLD136278
SLD75891	SLD80291	SLD81335	SLD83429	SLD87131	SLD96587	SLD106369	SLD125998	SLD126101	SLD136279
SLD75893	SLD80540	SLD81428	SLD83430	SLD87132	SLD96590	SLD106370	SLD125999	SLD126102	SLD136280
SLD75919	SLD80541	SLD81429	SLD83431	SLD87133	SLD96591	SLD106371	SLD126000	SLD126103	SLD136281
SLD75993	SLD80542	SLD81430	SLD83432	SLD87134	SLD96592	SLD106372	SLD126001	SLD126104	SLD136283
SLD75994	SLD80543	SLD81431	SLD83433	SLD87135	SLD96593	SLD106392	SLD126002	SLD126109	SLD136284
SLD75998	SLD80544	SLD81936	SLD83434	SLD87199	SLD96594	SLD106393	SLD126003	SLD126110	SLD136285
SLD76092	SLD80545	SLD81937	SLD83435	SLD87521	SLD96595	SLD106394	SLD126004	SLD126111	SLD136286
SLD76399	SLD80546	SLD81938	SLD85273	SLD87616	SLD96596	SLD106395	SLD126005	SLD126112	SLD136287
SLD76403	SLD80547	SLD81939	SLD85520	SLD87617	SLD96597	SLD106396	SLD126006	SLD126113	SLD136288
SLD76404	SLD81266	SLD81940	SLD85521	SLD87669	SLD96599	SLD106397	SLD126011	SLD126114	SLD136291
SLD76405	SLD81270	SLD83242	SLD86342	SLD87670	SLD96600	SLD106398	SLD126012	SLD126119	SLD136292
SLD76406	SLD81274	SLD83243	SLD86343	SLD87675	SLD96601	SLD106399	SLD126013	SLD126120	SLD136293
SLD76407	SLD81275	SLD83244	SLD86558	SLD87676	SLD96602	SLD106400	SLD126014	SLD126121	SLD136294
SLD76408	SLD81276	SLD83245	SLD86559	SLD87677	SLD96612	SLD106401	SLD126021	SLD126122	SLD136295
SLD76409	SLD81277	SLD83246	SLD86560	SLD87678	SLD103801	SLD106403	SLD126022	SLD126123	SLD136296
SLD76411	SLD81286	SLD83247	SLD86566	SLD87679	SLD103802	SLD106404	SLD126031	SLD126129	SLD136297
SLD76412	SLD81287	SLD83383	SLD86617	SLD87680	SLD103803	SLD112809	SLD126032	SLD126130	SLD136300
SLD76413	SLD81290	SLD83384	SLD86619	SLD87681	SLD103804	SLD112810	SLD126033	SLD126131	SLD136301
SLD76414	SLD81293	SLD83385	SLD86620	SLD87682	SLD103805	SLD112811	SLD126034	SLD126132	SLD136302
SLD76415	SLD81294	SLD83386	SLD86621	SLD87688	SLD103806	SLD112812	SLD126039	SLD126133	SLD136303
SLD76416	SLD81295	SLD83387	SLD86622	SLD87905	SLD103807	SLD112813	SLD126040	SLD126134	SLD136304
SLD76417	SLD81296	SLD83388	SLD86737	SLD87906	SLD103808	SLD112841	SLD126041	SLD126135	SLD136309
SLD76418	SLD81297	SLD83389	SLD86738	SLD87963	SLD103809	SLD112842	SLD126042	SLD127552	SLD136310
SLD76419	SLD81298	SLD83390	SLD86740	SLD88115	SLD103810	SLD112843	SLD126043	SLD127553	SLD136311
SLD76420	SLD81299	SLD83391	SLD86741	SLD88131	SLD103811	SLD112844	SLD126044	SLD127552	SLD136312
SLD76421	SLD81300	SLD83392	SLD86742	SLD88132	SLD103815	SLD112858	SLD126045	SLD127563	SLD136313
SLD76422	SLD81301	SLD83393	SLD86743	SLD88133	SLD103816	SLD112866	SLD126046	SLD127564	SLD136314
SLD76423	SLD81302	SLD83394	SLD86744	SLD88406	SLD103817	SLD112867	SLD126049	SLD127565	SLD136318
SLD76424	SLD81303	SLD83395	SLD86747	SLD88407	SLD103818	SLD112869	SLD126050	SLD127566	SLD136319
SLD76425	SLD81304	SLD83396	SLD86750	SLD88409	SLD103819	SLD112870	SLD126051	SLD127572	SLD136320
SLD76426	SLD81305	SLD83397	SLD86755	SLD88410	SLD103820	SLD112871	SLD126052	SLD127573	SLD136327
SLD76430	SLD81306	SLD83400	SLD86801	SLD88411	SLD103821	SLD112872	SLD126053	SLD127574	SLD136328
SLD76431	SLD81307	SLD83401	SLD86802	SLD88880	SLD103822	SLD112873	SLD126054	SLD131146	SLD136329
SLD76432	SLD81308	SLD83402	SLD86803	SLD88881	SLD103823	SLD121806	SLD126059	SLD131147	SLD136330
SLD76433	SLD81309	SLD83403	SLD86804	SLD89154	SLD103824	SLD125951	SLD126060	SLD131148	SLD136331
SLD76434	SLD81310	SLD83404	SLD86805	SLD89155	SLD103825	SLD125952	SLD126061	SLD131149	SLD136332
SLD76437	SLD81311	SLD83405	SLD86806	SLD89156	SLD103826	SLD125953	SLD126062	SLD131150	SLD136333
SLD76438	SLD81312	SLD83406	SLD86807	SLD89157	SLD103827	SLD125961	SLD126063	SLD131151	SLD136336
SLD76477	SLD81313	SLD83407	SLD86808	SLD89158	SLD103828	SLD125962	SLD126064	SLD131152	SLD136337
SLD76478	SLD81314	SLD83408	SLD86809	SLD89159	SLD103829	SLD125963	SLD126065	SLD131166	SLD136338
SLD76479	SLD81315	SLD83409	SLD86810	SLD89160	SLD103830	SLD125971	SLD126069	SLD131167	SLD136339
SLD77189	SLD81316	SLD83410	SLD86811	SLD89161	SLD103831	SLD125972	SLD126070	SLD131281	SLD136340

Table F-1-3. Samples Used for SLDS Dataset of Remediated Soil^a (Continued)

SLD136341	SLD136463	SLD152719	SLD152802	SLD174641
SLD136342	SLD136464	SLD152720	SLD155623	SLD174642
SLD136345	SLD136465	SLD152721	SLD155624	SLD179136
SLD136346	SLD136466	SLD152722	SLD155625	SLD179138
SLD136347	SLD136467	SLD152723	SLD155626	
SLD136348	SLD136473	SLD152724	SLD155627	
SLD136349	SLD136474	SLD152725	SLD155628	
SLD136350	SLD136475	SLD152726	SLD155629	
SLD136351	SLD136476	SLD152727	SLD155630	
SLD136352	SLD136477	SLD152728	SLD155631	
SLD136356	SLD136478	SLD152729	SLD155632	
SLD136357	SLD136480	SLD152730	SLD155805	
SLD136358	SLD136481	SLD152731	SLD156527	
SLD136359	SLD136482	SLD152735	SLD156528	
SLD136360	SLD145427	SLD152736	SLD156529	
SLD136361	SLD145429	SLD152737	SLD156530	
SLD136366	SLD145430	SLD152738	SLD156531	
SLD136367	SLD145431	SLD152739	SLD156532	
SLD136376	SLD145432	SLD152740	SLD156533	
SLD136377	SLD145433	SLD152741	SLD156534	
SLD136378	SLD145434	SLD152742	SLD156535	
SLD136379	SLD145435	SLD152743	SLD156536	
SLD136380	SLD145436	SLD152744	SLD156537	
SLD136381	SLD145450	SLD152745	SLD156538	
SLD136382	SLD152656	SLD152746	SLD156539	
SLD136383	SLD152659	SLD152747	SLD156540	
SLD136386	SLD152661	SLD152748	SLD156541	
SLD136387	SLD152665	SLD152749	SLD156542	
SLD136388	SLD152667	SLD152750	SLD156543	
SLD136389	SLD152668	SLD152751	SLD156546	
SLD136401	SLD152670	SLD152752	SLD156547	
SLD136402	SLD152673	SLD152764	SLD156548	
SLD136403	SLD152676	SLD152765	SLD156549	
SLD136404	SLD152679	SLD152766	SLD156550	
SLD136405	SLD152680	SLD152767	SLD156551	
SLD136406	SLD152684	SLD152768	SLD156552	
SLD136417	SLD152686	SLD152769	SLD156553	
SLD136418	SLD152689	SLD152770	SLD156554	
SLD136419	SLD152691	SLD152780	SLD156555	
SLD136420	SLD152695	SLD152781	SLD156556	
SLD136421	SLD152696	SLD152782	SLD156563	
SLD136422	SLD152698	SLD152783	SLD156564	
SLD136423	SLD152701	SLD152784	SLD156565	
SLD136424	SLD152702	SLD152785	SLD156566	
SLD136425	SLD152703	SLD152786	SLD156567	
SLD136433	SLD152704	SLD152787	SLD156568	
SLD136434	SLD152705	SLD152788	SLD156569	
SLD136435	SLD152706	SLD152789	SLD156570	
SLD136436	SLD152707	SLD152790	SLD156571	
SLD136437	SLD152708	SLD152791	SLD156572	
SLD136438	SLD152709	SLD152792	SLD156573	
SLD136439	SLD152710	SLD152793	SLD156574	
SLD136440	SLD152711	SLD152794	SLD156575	
SLD136441	SLD152712	SLD152795	SLD156576	
SLD136448	SLD152713	SLD152796	SLD174635	
SLD136449	SLD152714	SLD152797	SLD174636	
SLD136450	SLD152715	SLD152798	SLD174637	
SLD136451	SLD152716	SLD152799	SLD174638	
SLD136452	SLD152717	SLD152800	SLD174639	
SLD136453	SLD152718	SLD152801	SLD174640	

^a Soil remediated from Plant 6EH, Plant 7N, Plant 7S, Plant 7W, DT-2 West of the Levee, and Destrehan Street East.

Table F-1-4. Samples Used for North St. Louis County VPs Dataset of Remediated Soil^a

HIS00438	HIS00646	HIS00707	HTZ00616	HTZ93572	HTZ119557	HTZ137736	SVP01637	SVP04414	SVP26007
HIS00439	HIS00647	HIS00708	HTZ00617	HTZ93573	HTZ119558	HTZ137737	SVP01638	SVP04415	SVP26011
HIS00440	HIS00648	HIS00709	HTZ00618	HTZ93575	HTZ119575	HTZ137738	SVP01639	SVP04416	SVP26012
HIS00441	HIS00649	HIS00710	HTZ00619	HTZ93584	HTZ119582	HTZ137739	SVP01640	SVP04416-1	SVP26021
HIS00442	HIS00649-1	HIS00711	HTZ27457	HTZ93587	HTZ124137	HTZ137740	SVP01641	SVP04417	SVP26036
HIS00443	HIS00650	HIS00711-1	HTZ69394	HTZ94807	HTZ124138	HTZ137741	SVP01643	SVP04418	SVP26037
HIS00444	HIS00651	HIS00712	HTZ69463	HTZ94809	HTZ124139	HTZ137742	SVP01651	SVP04422	SVP26038
HIS00445	HIS00652	HIS00713	HTZ70864	HTZ94857	HTZ124145	HTZ137745	SVP01652	SVP04423	SVP26046
HIS00446	HIS00653	HIS00714	HTZ70868	HTZ99811	HTZ124146	HTZ137757	SVP01653	SVP04424	SVP26047
HIS00447	HIS00654	HIS00715	HTZ76770	HTZ99814	HTZ124162	HTZ137758	SVP01654	SVP04425	SVP26051
HIS00448	HIS00655	HIS00716	HTZ76840	HTZ99815	HTZ124163	HTZ137759	SVP01655	SVP04430	SVP26052
HIS00449	HIS00656	HIS00717	HTZ76841	HTZ99852	HTZ124166	HTZ137802	SVP01659	SVP04431	SVP26083
HIS00450	HIS00657	HIS00718	HTZ76842	HTZ103342	HTZ124167	HTZ137803	SVP01660	SVP04432	SVP26083-1
HIS00451	HIS00660	HIS00719	HTZ76843	HTZ103343	HTZ124168	HTZ137804	SVP01661	SVP04433	SVP26083-2
HIS00452	HIS00662	HIS00720	HTZ84001	HTZ105677	HTZ124171	SLA81220	SVP01662	SVP04434	SVP26084
HIS00453	HIS00663	HIS00721	HTZ85316	HTZ105680	HTZ124180	SLA81220-1	SVP01663	SVP04435	SVP26088
HIS00454	HIS00664	HIS00722	HTZ85335	HTZ105694	HTZ124181	SLA81229	SVP01664	SVP04437	SVP26089
HIS00455	HIS00665	HIS00723	HTZ85338	HTZ105725	HTZ124182	SLA81230	SVP01665	SVP04438	SVP26093
HIS00456	HIS00666	HIS00724	HTZ85340	HTZ105729	HTZ124208	SLA81231	SVP01666	SVP04440	SVP26094
HIS00457	HIS00667	HIS00725	HTZ85382	HTZ105791	HTZ124244	SLA81236	SVP01667	SVP04440-1	SVP26097
HIS00601	HIS00668	HIS00726	HTZ86370	HTZ105795	HTZ124261	SLA81237	SVP01668	SVP04440-2	SVP26098
HIS00602	HIS00669	HIS00774	HTZ86372	HTZ105796	HTZ124300	SLA81238	SVP01669	SVP04441	SVP26099
HIS00603	HIS00670	HIS00775	HTZ86379	HTZ105797	HTZ124302	SLA81239	SVP01670	SVP04442	SVP26123
HIS00605	HIS00671	HIS00776	HTZ86384	HTZ105798	HTZ128224	SLA81244	SVP01675	SVP04446	SVP26165
HIS00606	HIS00672	HIS00777	HTZ86463	HTZ105799	HTZ130692	SLA86311	SVP01676	SVP04447	SVP26166
HIS00607	HIS00673	HIS91353	HTZ86464	HTZ105800	HTZ130693	SLA86535	SVP01677	SVP04448	SVP26169
HIS00608	HIS00674	HIS91354	HTZ86465	HTZ105801	HTZ130725	SLA86536	SVP01678	SVP04449	SVP26170
HIS00609	HIS00675	HIS91355	HTZ86466	HTZ105802	HTZ130788	SLA86580	SVP01679	SVP04453	SVP26170-1
HIS00610	HIS00676	HIS91356	HTZ86467	HTZ105803	HTZ130798	SLA86585	SVP01680	SVP04457	SVP26170-2
HIS00611	HIS00677	HIS91357	HTZ86468	HTZ105804	HTZ134413	SLA86590	SVP01681	SVP04461	SVP26171
HIS00612	HIS00678	HIS91773	HTZ86469	HTZ105805	HTZ134414	SLA89675	SVP01682	SVP04462	SVP26173
HIS00613	HIS00679	HIS91774	HTZ86470	HTZ105806	HTZ134430	SLA92866	SVP01703	SVP04465	SVP26175
HIS00614	HIS00680	HIS91775	HTZ86471	HTZ105807	HTZ134464	SLA92990	SVP01704	SVP04466	SVP26176
HIS00615	HIS00681	HIS91776	HTZ86518	HTZ105808	HTZ134484	SLA94619	SVP01713	SVP04467	SVP26179
HIS00619	HIS00682	HIS91777	HTZ86519	HTZ105809	HTZ134485	SLA94938	SVP01714	SVP04469	SVP26190
HIS00620	HIS00683	HTR84781	HTZ87333	HTZ105810	HTZ134520	SLA95355	SVP01715	SVP04473	SVP26191
HIS00621	HIS00684	HTR84782	HTZ87335	HTZ105811	HTZ134521	SLA97114	SVP01716	SVP04489	SVP26194
HIS00622	HIS00685	HTR93233	HTZ87336	HTZ108739	HTZ134522	SLA97116	SVP01717	SVP04494	SVP26195
HIS00623	HIS00686	HTR93234	HTZ87381	HTZ108740	HTZ137664	SLA97119	SVP01718	SVP04514	SVP26200
HIS00624	HIS00687	HTR93235	HTZ87382	HTZ108741	HTZ137691	SLA97122	SVP01719	SVP04518	SVP26201
HIS00625	HIS00688	HTR93236	HTZ87383	HTZ108742	HTZ137692	SVP01607	SVP01720	SVP04519	SVP26212
HIS00626	HIS00689	HTR93237	HTZ87384	HTZ108743	HTZ137693	SVP01608	SVP01721	SVP04522	SVP26227
HIS00627	HIS00690	HTZ00028	HTZ87386	HTZ108744	HTZ137703	SVP01609	SVP01722	SVP04525	SVP26228
HIS00628	HIS00691	HTZ00057	HTZ87388	HTZ108745	HTZ137704	SVP01610	SVP01723	SVP04526	SVP26232
HIS00629	HIS00691-1	HTZ00172	HTZ87389	HTZ108746	HTZ137705	SVP01619	SVP01724	SVP04529	SVP26233
HIS00629-1	HIS00692	HTZ00173	HTZ87440	HTZ108747	HTZ137706	SVP01620	SVP01727	SVP04534	SVP26234
HIS00630	HIS00693	HTZ00174	HTZ89039	HTZ108748	HTZ137707	SVP01621	SVP01728	SVP04535	SVP26236
HIS00631	HIS00694	HTZ00175	HTZ89040	HTZ108749	HTZ137708	SVP01622	SVP01729	SVP04537	SVP26289
HIS00634	HIS00695	HTZ00176	HTZ89041	HTZ111216	HTZ137709	SVP01623	SVP01730	SVP04538	SVP26293
HIS00635	HIS00696	HTZ00177	HTZ89042	HTZ111241	HTZ137710	SVP01624	SVP01731	SVP04541	SVP26294
HIS00636	HIS00697	HTZ00178	HTZ89043	HTZ111242	HTZ137711	SVP01627	SVP01732	SVP04541-1	SVP26304
HIS00637	HIS00698	HTZ00179	HTZ89055	HTZ111243	HTZ137712	SVP01628	SVP03562	SVP04542	SVP26321
HIS00638	HIS00699	HTZ00215	HTZ89056	HTZ111273	HTZ137719	SVP01629	SVP04384	SVP04545	SVP26322
HIS00639	HIS00700	HTZ00317	HTZ89057	HTZ111274	HTZ137720	SVP01630	SVP04402	SVP25937	SVP26353
HIS00640	HIS00701	HTZ00318	HTZ89058	HTZ113541	HTZ137721	SVP01631	SVP04404	SVP25996	SVP26358
HIS00641	HIS00702	HTZ00319	HTZ89059	HTZ113542	HTZ137722	SVP01632	SVP04407	SVP25997	SVP26359
HIS00642	HIS00703	HTZ00514	HTZ89060	HTZ119447	HTZ137723	SVP01633	SVP04409	SVP26001	SVP26360
HIS00643	HIS00704	HTZ00516	HTZ93433	HTZ119512	HTZ137733	SVP01634	SVP04410	SVP26002	SVP26363
HIS00644	HIS00705	HTZ00609	HTZ93532	HTZ119555	HTZ137734	SVP01635	SVP04411	SVP26005	SVP26458
HIS00645	HIS00706	HTZ00615	HTZ93533	HTZ119556	HTZ137735	SVP01636	SVP04412	SVP26006	SVP26459

**Table F-1-4. Samples Used for North St. Louis County VPs Dataset of Remediated Soil^a
(Continued)**

SVP28392	SVP28537	SVP65993	SVP66150	SVP69906	SVP79259	SVP79352	SVP80217	SVP81584	SVP88292
SVP28404	SVP28538	SVP65994	SVP66151	SVP69907	SVP79260	SVP79353	SVP80227	SVP81585	SVP88294
SVP28405	SVP28539	SVP65995	SVP66152	SVP69908	SVP79261	SVP79355	SVP80228	SVP81587	SVP88296
SVP28406	SVP28540	SVP65997	SVP66153	SVP69909	SVP79268	SVP79356	SVP80229	SVP81587-1	SVP88298
SVP28407	SVP28545	SVP65998	SVP66154	SVP69910	SVP79269	SVP79357	SVP80230	SVP81589	SVP88300
SVP28408	SVP28546	SVP65999	SVP66155	SVP73265	SVP79270	SVP79358	SVP80231	SVP81591	SVP88302
SVP28409	SVP28576	SVP66000	SVP66156	SVP73277	SVP79274	SVP79365	SVP80232	SVP81595	SVP88304
SVP28410	SVP28577	SVP66001	SVP66157	SVP73285	SVP79275	SVP79366	SVP80233	SVP81605	SVP88306
SVP28411	SVP28578	SVP66002	SVP66158	SVP73286	SVP79276	SVP79367	SVP80246	SVP81606	SVP88307
SVP28412	SVP28579	SVP66003	SVP66160	SVP73287	SVP79279	SVP79368	SVP80247	SVP81608	SVP88310
SVP28413	SVP65896	SVP66004	SVP66162	SVP73289	SVP79280	SVP79369	SVP80248	SVP81611	SVP88311
SVP28420	SVP65897	SVP66005	SVP66163	SVP73290	SVP79281	SVP79370	SVP80249	SVP81612	SVP88312
SVP28423	SVP65898	SVP66006	SVP66164	SVP73291	SVP79282	SVP79371	SVP80250	SVP81613	SVP88316
SVP28424	SVP65899	SVP66007	SVP66165	SVP73291-1	SVP79283	SVP79372	SVP80358	SVP81614	SVP88318
SVP28425	SVP65900	SVP66008	SVP66166	SVP73291-2	SVP79284	SVP79373	SVP80359	SVP81615	SVP88322
SVP28427	SVP65901	SVP66009	SVP66567	SVP73292	SVP79285	SVP79374	SVP80360	SVP81616	SVP88324
SVP28429	SVP65902	SVP66010	SVP66977	SVP73293	SVP79286	SVP79382	SVP80361	SVP81617	SVP88326
SVP28431	SVP65903	SVP66011	SVP66979	SVP73294	SVP79287	SVP79383	SVP80362	SVP81617-1	SVP88330
SVP28433	SVP65905	SVP66012	SVP66981	SVP73295	SVP79288	SVP79401	SVP80363	SVP81619	SVP88332
SVP28435	SVP65920	SVP66013	SVP66982	SVP73299	SVP79302	SVP79402	SVP80364	SVP81623	SVP88334
SVP28436	SVP65922	SVP66014	SVP67386	SVP73300	SVP79303	SVP79403	SVP80365	SVP81624	SVP88336
SVP28440	SVP65923	SVP66018	SVP67387	SVP73307	SVP79307	SVP79404	SVP80721	SVP81631	SVP88338
SVP28441	SVP65926	SVP66019	SVP67389	SVP73309	SVP79308	SVP79405	SVP80722	SVP86831	SVP88340
SVP28442	SVP65927	SVP66022	SVP67391	SVP73311	SVP79309	SVP79406	SVP80723	SVP86832	SVP88341
SVP28446	SVP65944	SVP66024	SVP67392	SVP73317	SVP79310	SVP79407	SVP80724	SVP86833	SVP88342
SVP28447	SVP65945	SVP66025	SVP67393	SVP73318	SVP79312	SVP79408	SVP80725	SVP86978	SVP88346
SVP28448	SVP65948	SVP66026	SVP67394	SVP73319	SVP79313	SVP79409	SVP80726	SVP86979	SVP88348
SVP28449	SVP65949	SVP66030	SVP67395	SVP73320	SVP79314	SVP79410	SVP81499	SVP86980	SVP88349
SVP28450	SVP65950	SVP66031	SVP68497	SVP73327	SVP79315	SVP79411	SVP81500	SVP86981	SVP88350
SVP28454	SVP65951	SVP66034	SVP68498	SVP73328	SVP79317	SVP79412	SVP81503	SVP86982	SVP88351
SVP28456	SVP65956	SVP66035	SVP68499	SVP73329	SVP79318	SVP79413	SVP81504	SVP86983	SVP88352
SVP28457	SVP65957	SVP66038	SVP68841	SVP73330	SVP79319	SVP79414	SVP81505	SVP86984	SVP88354
SVP28460	SVP65962	SVP66039	SVP68845	SVP73331	SVP79320	SVP79415	SVP81505-1	SVP86985	SVP88355
SVP28462	SVP65963	SVP66040	SVP68847	SVP73335	SVP79321	SVP79416	SVP81507	SVP86986	SVP88358
SVP28463	SVP65964	SVP66041	SVP68906	SVP73343	SVP79322	SVP79417	SVP81507-1	SVP86987	SVP88360
SVP28464	SVP65966	SVP66042	SVP68910	SVP73344	SVP79323	SVP79418	SVP81515	SVP86991	SVP88362
SVP28466	SVP65967	SVP66043	SVP68912	SVP73347	SVP79324	SVP79419	SVP81517	SVP86994	SVP88364
SVP28467	SVP65968	SVP66044	SVP68914	SVP73348	SVP79325	SVP79420	SVP81518	SVP86995	SVP88366
SVP28468	SVP65969	SVP66045	SVP68916	SVP73355	SVP79326	SVP79421	SVP81519	SVP86996	SVP88370
SVP28469	SVP65970	SVP66046	SVP68918	SVP73359	SVP79327	SVP79422	SVP81525	SVP86997	SVP88371
SVP28470	SVP65971	SVP66049	SVP68920	SVP73882	SVP79328	SVP79430	SVP81531	SVP86998	SVP88372
SVP28471	SVP65972	SVP66050	SVP68956	SVP73883	SVP79329	SVP79431	SVP81533	SVP87000	SVP88374
SVP28472	SVP65973	SVP66052	SVP68958	SVP73883-1	SVP79330	SVP79432	SVP81535	SVP87001	SVP88375
SVP28473	SVP65976	SVP66055	SVP68960	SVP73883-2	SVP79331	SVP79433	SVP81537	SVP87002	SVP88376
SVP28474	SVP65977	SVP66056	SVP68976	SVP75208	SVP79332	SVP79444	SVP81539	SVP87003	SVP88378
SVP28475	SVP65978	SVP66059	SVP68980	SVP75212	SVP79333	SVP79445	SVP81541	SVP87004	SVP88380
SVP28476	SVP65979	SVP66060	SVP68982	SVP79244	SVP79334	SVP79446	SVP81545	SVP87009	SVP88382
SVP28477	SVP65980	SVP66075	SVP68986	SVP79245	SVP79335	SVP79447	SVP81551	SVP87100	SVP89089
SVP28481	SVP65981	SVP66085	SVP69034	SVP79246	SVP79336	SVP79448	SVP81553	SVP87101	SVP89091
SVP28483	SVP65982	SVP66086	SVP69036	SVP79247	SVP79339	SVP80206	SVP81555	SVP87103	SVP89093
SVP28485	SVP65983	SVP66087	SVP69248	SVP79248	SVP79340	SVP80207	SVP81557	SVP87104	SVP89094
SVP28489	SVP65984	SVP66088	SVP69250	SVP79249	SVP79341	SVP80208	SVP81561	SVP87106	SVP89095
SVP28490	SVP65985	SVP66089	SVP69252	SVP79250	SVP79342	SVP80209	SVP81565	SVP87107	SVP89096
SVP28493	SVP65986	SVP66090	SVP69254	SVP79251	SVP79343	SVP80210	SVP81567	SVP87108	SVP89098
SVP28494	SVP65987	SVP66091	SVP69898	SVP79252	SVP79344	SVP80211	SVP81573	SVP87109	SVP89100
SVP28497	SVP65988	SVP66092	SVP69899	SVP79253	SVP79345	SVP80212	SVP81575	SVP87110	SVP89101
SVP28499	SVP65989	SVP66093	SVP69900	SVP79255	SVP79346	SVP80213	SVP81579	SVP87139	SVP89102
SVP28500	SVP65990	SVP66094	SVP69901	SVP79256	SVP79347	SVP80214	SVP81581	SVP88286	SVP89103
SVP28533	SVP65991	SVP66095	SVP69903	SVP79257	SVP79350	SVP80215	SVP81582	SVP88287	SVP89104
SVP28534	SVP65992	SVP66148	SVP69905	SVP79258	SVP79351	SVP80216	SVP81583	SVP88290	SVP89106

**Table F-1-4. Samples Used for North St. Louis County VPs Dataset of Remediated Soil^a
(Continued)**

SVP89107	SVP93287	SVP95619	SVP96294	SVP100286	SVP100395	SVP100506	SVP100572	SVP100632	SVP100759
SVP89108	SVP93713	SVP95620	SVP96295	SVP100287	SVP100396	SVP100507	SVP100573	SVP100642	SVP100760
SVP93024	SVP94965	SVP95621	SVP96296	SVP100288	SVP100397	SVP100508	SVP100574	SVP100643	SVP100761
SVP93025	SVP94967	SVP95622	SVP96297	SVP100289	SVP100398	SVP100509	SVP100575	SVP100644	SVP100762
SVP93026	SVP94973	SVP95623	SVP96298	SVP100290	SVP100399	SVP100510	SVP100576	SVP100645	SVP100763
SVP93027	SVP95549	SVP95624	SVP96299	SVP100291	SVP100400	SVP100511	SVP100577	SVP100646	SVP100764
SVP93028	SVP95550	SVP95625	SVP96300	SVP100292	SVP100401	SVP100512	SVP100578	SVP100647	SVP100765
SVP93029	SVP95551	SVP95626	SVP96301	SVP100293	SVP100402	SVP100513	SVP100579	SVP100648	SVP100766
SVP93030	SVP95554	SVP95627	SVP96302	SVP100294	SVP100403	SVP100514	SVP100580	SVP100649	SVP100767
SVP93031	SVP95555	SVP95628	SVP96303	SVP100295	SVP100404	SVP100515	SVP100581	SVP100650	SVP100768
SVP93034	SVP95563	SVP95629	SVP96304	SVP100296	SVP100405	SVP100516	SVP100582	SVP100651	SVP100769
SVP93101	SVP95565	SVP95630	SVP96336	SVP100297	SVP100406	SVP100517	SVP100583	SVP100652	SVP100770
SVP93102	SVP95567	SVP95631	SVP96339	SVP100298	SVP100407	SVP100518	SVP100584	SVP100653	SVP100771
SVP93120	SVP95568	SVP95632	SVP96352	SVP100299	SVP100408	SVP100519	SVP100585	SVP100655	SVP100775
SVP93121	SVP95569	SVP95633	SVP96408	SVP100300	SVP100409	SVP100520	SVP100586	SVP100656	SVP100776
SVP93127	SVP95570	SVP95663	SVP96409	SVP100301	SVP100410	SVP100521	SVP100587	SVP100657	SVP100777
SVP93128	SVP95575	SVP95664	SVP96410	SVP100314	SVP100411	SVP100522	SVP100588	SVP100658	SVP100778
SVP93132	SVP95576	SVP95665	SVP96411	SVP100315	SVP100412	SVP100523	SVP100589	SVP100659	SVP100779
SVP93133	SVP95577	SVP95666	SVP96412	SVP100316	SVP100413	SVP100524	SVP100590	SVP100660	SVP100780
SVP93134	SVP95578	SVP95671	SVP96413	SVP100335	SVP100431	SVP100531	SVP100591	SVP100661	SVP100781
SVP93137	SVP95579	SVP95672	SVP96414	SVP100336	SVP100432	SVP100532	SVP100592	SVP100662	SVP100782
SVP93138	SVP95580	SVP96067	SVP96415	SVP100337	SVP100433	SVP100533	SVP100593	SVP100663	SVP100783
SVP93139	SVP95581	SVP96068	SVP96416	SVP100338	SVP100434	SVP100534	SVP100594	SVP100664	SVP100787
SVP93142	SVP95582	SVP96244	SVP96417	SVP100339	SVP100435	SVP100535	SVP100595	SVP100665	SVP100788
SVP93143	SVP95583	SVP96245	SVP96418	SVP100340	SVP100436	SVP100536	SVP100596	SVP100666	SVP100789
SVP93144	SVP95584	SVP96246	SVP96419	SVP100341	SVP100437	SVP100537	SVP100597	SVP100667	SVP100790
SVP93149	SVP95585	SVP96247	SVP96420	SVP100342	SVP100438	SVP100538	SVP100598	SVP100668	SVP100791
SVP93150	SVP95586	SVP96261	SVP96421	SVP100343	SVP100439	SVP100539	SVP100599	SVP100669	SVP100792
SVP93151	SVP95587	SVP96262	SVP96422	SVP100344	SVP100440	SVP100540	SVP100600	SVP100670	SVP100793
SVP93152	SVP95588	SVP96263	SVP96423	SVP100345	SVP100441	SVP100541	SVP100601	SVP100671	SVP100794
SVP93153	SVP95589	SVP96264	SVP96424	SVP100346	SVP100456	SVP100542	SVP100602	SVP100672	SVP100795
SVP93154	SVP95590	SVP96265	SVP96425	SVP100347	SVP100457	SVP100543	SVP100603	SVP100673	SVP100799
SVP93155	SVP95591	SVP96266	SVP96426	SVP100348	SVP100458	SVP100544	SVP100604	SVP100674	SVP100800
SVP93156	SVP95592	SVP96267	SVP96427	SVP100349	SVP100459	SVP100545	SVP100605	SVP100675	SVP100801
SVP93159	SVP95593	SVP96268	SVP96428	SVP100353	SVP100460	SVP100546	SVP100606	SVP100676	SVP100802
SVP93160	SVP95594	SVP96269	SVP96496	SVP100354	SVP100461	SVP100547	SVP100607	SVP100677	SVP100803
SVP93161	SVP95595	SVP96270	SVP96520	SVP100355	SVP100462	SVP100548	SVP100608	SVP100678	SVP100804
SVP93162	SVP95596	SVP96271	SVP96522	SVP100359	SVP100463	SVP100549	SVP100609	SVP100679	SVP100805
SVP93163	SVP95597	SVP96272	SVP96709	SVP100360	SVP100464	SVP100550	SVP100610	SVP100680	SVP100806
SVP93166	SVP95598	SVP96273	SVP96710	SVP100361	SVP100465	SVP100551	SVP100611	SVP100681	SVP100839
SVP93167	SVP95599	SVP96274	SVP96711	SVP100362	SVP100466	SVP100552	SVP100612	SVP100682	SVP100840
SVP93168	SVP95600	SVP96275	SVP96712	SVP100363	SVP100480	SVP100553	SVP100613	SVP100683	SVP100840-1
SVP93169	SVP95601	SVP96276	SVP96713	SVP100364	SVP100481	SVP100554	SVP100614	SVP100684	SVP100840-2
SVP93173	SVP95602	SVP96277	SVP96714	SVP100365	SVP100482	SVP100555	SVP100615	SVP100685	SVP100841
SVP93174	SVP95603	SVP96278	SVP99180	SVP100366	SVP100483	SVP100556	SVP100616	SVP100694	SVP100842
SVP93175	SVP95604	SVP96279	SVP99182	SVP100368	SVP100484	SVP100557	SVP100617	SVP100695	SVP100864
SVP93177	SVP95605	SVP96280	SVP99186	SVP100369	SVP100485	SVP100558	SVP100618	SVP100745	SVP100865
SVP93178	SVP95606	SVP96281	SVP100266	SVP100370	SVP100486	SVP100559	SVP100619	SVP100746	SVP100866
SVP93179	SVP95607	SVP96282	SVP100267	SVP100371	SVP100487	SVP100560	SVP100620	SVP100747	SVP100867
SVP93180	SVP95608	SVP96283	SVP100268	SVP100372	SVP100488	SVP100561	SVP100621	SVP100748	SVP100868
SVP93182	SVP95609	SVP96284	SVP100272	SVP100373	SVP100489	SVP100562	SVP100622	SVP100749	SVP100869
SVP93183	SVP95610	SVP96285	SVP100273	SVP100386	SVP100490	SVP100563	SVP100623	SVP100750	SVP100870
SVP93184	SVP95611	SVP96286	SVP100274	SVP100387	SVP100492	SVP100564	SVP100624	SVP100751	SVP100871
SVP93187	SVP95612	SVP96287	SVP100275	SVP100388	SVP100493	SVP100565	SVP100625	SVP100752	SVP100872
SVP93188	SVP95613	SVP96288	SVP100276	SVP100389	SVP100494	SVP100566	SVP100626	SVP100753	SVP100875
SVP93192	SVP95614	SVP96289	SVP100281	SVP100390	SVP100495	SVP100567	SVP100627	SVP100754	SVP100876
SVP93281	SVP95615	SVP96290	SVP100282	SVP100391	SVP100496	SVP100568	SVP100628	SVP100755	SVP100877
SVP93283	SVP95616	SVP96291	SVP100283	SVP100392	SVP100497	SVP100569	SVP100629	SVP100756	SVP100878
SVP93284	SVP95617	SVP96292	SVP100284	SVP100393	SVP100504	SVP100570	SVP100630	SVP100757	SVP100879
SVP93285	SVP95618	SVP96293	SVP100285	SVP100394	SVP100505	SVP100571	SVP100631	SVP100758	SVP100880

**Table F-1-4. Samples Used for North St. Louis County VPs Dataset of Remediated Soil^a
(Continued)**

SVP100881	SVP100985	SVP107701	SVP113763-1
SVP100882	SVP100986	SVP107702	SVP113763-2
SVP100883	SVP100987	SVP107705	SVP114184
SVP100884	SVP100999	SVP108168	SVP114185
SVP100885	SVP101007	SVP110888	SVP114186
SVP100886	SVP101008	SVP110891	SVP114187
SVP100887	SVP101017	SVP110892	SVP114188
SVP100888	SVP101018	SVP110893	SVP114189
SVP100889	SVP101019	SVP110894	SVP114190
SVP100890	SVP101028	SVP110895	SVP114191
SVP100891	SVP101029	SVP110896	SVP114192
SVP100892	SVP101030	SVP110897	SVP114202
SVP100893	SVP101031	SVP110898	SVP114203
SVP100894	SVP101032	SVP110899	SVP114204
SVP100895	SVP101033	SVP110900	SVP123788
SVP100896	SVP101040	SVP110901	SVP123789
SVP100897	SVP101041	SVP110902	SVP128708
SVP100898	SVP101042	SVP110903	SVP128709
SVP100899	SVP101058	SVP110904	SVP128710
SVP100900	SVP101059	SVP110905	SVP128712
SVP100901	SVP101060	SVP110906	SVP129272
SVP100902	SVP101061	SVP110907	
SVP100903	SVP101062	SVP110908	
SVP100904	SVP101063	SVP110909	
SVP100905	SVP101064	SVP110910	
SVP100906	SVP101066	SVP110911	
SVP100907	SVP101067	SVP110912	
SVP100908	SVP101068	SVP110913	
SVP100910	SVP101069	SVP110914	
SVP100913	SVP101074	SVP110915	
SVP100914	SVP101076	SVP110916	
SVP100915	SVP101077	SVP110917	
SVP100916	SVP101078	SVP110918	
SVP100917	SVP101083	SVP110919	
SVP100918	SVP102181	SVP110920	
SVP100919	SVP102182	SVP110921	
SVP100920	SVP102940	SVP110922	
SVP100921	SVP104519	SVP110923	
SVP100922	SVP104522	SVP110924	
SVP100923	SVP105078	SVP110971	
SVP100938	SVP106009	SVP110972	
SVP100951	SVP106010	SVP110973	
SVP100952	SVP106094	SVP110974	
SVP100953	SVP106099	SVP110975	
SVP100954	SVP106113	SVP110976	
SVP100955	SVP106133	SVP110977	
SVP100956	SVP106135	SVP110978	
SVP100957	SVP106878	SVP111135	
SVP100958	SVP106879	SVP111136	
SVP100959	SVP107672	SVP111137	
SVP100960	SVP107677	SVP111518	
SVP100961	SVP107679	SVP112570	
SVP100962	SVP107680	SVP112704	
SVP100963	SVP107681	SVP112965	
SVP100964	SVP107683	SVP112965-1	
SVP100965	SVP107684	SVP112965-2	
SVP100975	SVP107699	SVP112968	
SVP100976	SVP107700	SVP112969	
SVP100977	SVP107700-1	SVP112970	
SVP100984	SVP107700-2	SVP113763	

^a Soil remediated from VP-40A, VP-01(L), Parcel 10K530087, VP-02(L), IA-12, and IA-13.

Notes:

Soil samples ending in “-1” are duplicate soil samples.

Soil samples ending in “-2” are split soil samples.

Table F-1-5. Samples Used for CWC Dataset of Remediated Soil^a

HTZ180347	HTR193479	SVP164236	HTZ180350	SVP169478	SVP197596
HTZ180349	HTZ183227	SVP187565-2	SVP171336	SVP197426	SVP180586
HTZ180348	HTZ183093	SVP182359	SVP191137	SVP197932	HTR193485
SVP167109	HTZ195370	SVP181873	SVP184156	SVP197925	SVP197407
SVP180592	HTR185266	HTZ183096	SVP162362	SVP194431	SVP198428
SVP180584	HTZ180313	SVP197655	SVP161620	SVP179243	SVP161750
SVP180600	SVP191192	HTZ180405	SVP177365	SVP194439	HTR193472
SVP161588	SVP187562	HTR194037	SVP187564	HTR194035	SVP173270
SVP181845	HTZ183146	HTR192856	SVP197661	SVP198024	SVP197592
SVP179283	HTZ183152	SVP180585	SVP178256	SVP167102	SVP193108
SVP181537	SVP197354	SVP198431	SVP167093	SVP173269	SVP181091
HTZ176987	SVP197595	HTZ195513	SVP194425	SVP193501	HTZ195508
SVP180608	HTR192857	SVP196867	HTR194029	SVP164119	SVP177370
SVP182625-1	HTZ195510	SVP181130	SVP198088	SVP194427	SVP194448
HTZ180345	HTR193477	SVP171305	SVP197926	SVP194435	SVP182353
SVP191191	SVP167089-1	HTR194036	SVP163693	SVP173265	SVP182926
SVP181058	SVP167107	HTZ183147	HTR192863	SVP193495	SVP173264
SVP177371	SVP167091	SVP181758-1	SVP198409	SVP179242	SVP198428-1
HTZ180353	HTZ180344	HTZ195390	SVP171323	SVP198430	SVP181751
HTZ195365	SVP171306	SVP181090	HTR193487	SVP171324	SVP181841
SVP182625-2	HTR193469	SVP198030	SVP178257	SVP180594	SVP198031
HTZ195509	SVP167089	HTZ183156	SVP169482	SVP164235	SVP182923
SVP180593	SVP191184	SVP167108	SVP198080	SVP196488	SVP198037
SVP182625	SVP198081	SVP179244	SVP181057	SVP191136	SVP194421
SVP164129	SVP171301	SVP182558	SVP167090	SVP178303	SVP198441
HTZ183038	HTR193478	SVP169471	SVP179233	SVP194428	SVP193499
HTZ180346	HTZ183039	SVP193498	SVP181055	SVP181827	SVP180595
SVP182358-1	SVP181102	SVP198094	SVP162350-1	SVP181734	SVP198429
SVP179232	SVP181854	SVP191160	SVP162350-2	SVP194424	SVP194423
HTZ180342	HTR193475	SVP177356	SVP173253	SVP194447	SVP167075
HTZ183166	SVP198436	SVP196487	SVP173268	SVP169476	SVP198029
HTR194027	SVP181538	SVP181831	SVP198057	SVP171325	SVP182919
SVP179281	HTZ183155	SVP191303	HTR193474	SVP173249	SVP194445
SVP181852	SVP193500	SVP191159	SVP178265	SVP178266	SVP182918
HTZ176988	SVP187565	SVP181872	SVP181833	SVP182920	SVP181539
SVP181078	HTZ180352	SVP191185	SVP162350	SVP181743	SVP198043
SVP181742-1	HTZ183058	SVP167115	SVP162351	SVP194432	HTZ180399
SVP181856	SVP191078	SVP164069-1	SVP197427	SVP167092	SVP197406
HTZ195368	HTZ183228	SVP191149	SVP181864	SVP181104	SVP191077
HTZ195393	SVP191150	HTZ183233	SVP177367	SVP169477	SVP180609
HTZ180343	SVP181742	SVP164069	HTR185267	SVP194428-1	SVP197654
HTZ183045	SVP197649	SVP180601	SVP197667	SVP197671	SVP198407
SVP182358	HTZ183036	SVP197656	SVP197409	SVP178262	SVP198433
HTZ195495	SVP197591	SVP197549	SVP197931	SVP181056	SVP181846
SVP181851	HTR193480	SVP169472	SVP173266	SVP194451	SVP194440
SVP197650	HTZ183225	SVP169481	SVP198036	SVP182917	HTZ183232
SVP181042	SVP193496	HTZ183153	SVP169470	HTR192862	SVP177354
HTZ195369	HTZ183226	SVP198053	HTZ183041	SVP194416	SVP197428
SVP181839	SVP167101	SVP164120	SVP169475	SVP198087	HTZ183145
HTR185470	SVP181759	SVP198047	SVP173252	SVP198427	SVP197660
HTR194028	SVP181862	SVP182915	HTZ180354	SVP194443	SVP179235
HTR185295	HTZ180374	SVP173254	SVP182564	SVP182914	SVP169473
SVP197405	SVP198023	SVP197425	SVP177367-1	SVP191193	SVP193502
SVP181847	SVP181758	SVP191304	HTZ180404	SVP182912	SVP191032
SVP164077	SVP181750	SVP181080	SVP161621	HTZ183046	SVP198107
HTZ180340	SVP198056	SVP167116	SVP178302	SVP177355	SVP194420
SVP181103	SVP182921	HTR193471	HTR193483	SVP198440	SVP167094
SVP181865	HTR193484	SVP167106	SVP161589	HTR193470	SVP191147
SVP187565-1	SVP181079	SVP167117	HTZ183091	SVP198028	SVP182922
HTZ183154	HTZ183144	HTR193473	SVP164141	SVP194444	SVP173250

Table F-1-5. Samples Used for CWC Dataset of Remediated Soil^a (Continued)

HTZ180347	HTR193479	SVP164236	HTZ180350	SVP169478	SVP197596
HTZ180349	HTZ183227	SVP187565-2	SVP171336	SVP197426	SVP180586
HTZ180348	HTZ183093	SVP182359	SVP191137	SVP197932	HTR193485
SVP167109	HTZ195370	SVP181873	SVP184156	SVP197925	SVP197407
SVP180592	HTR185266	HTZ183096	SVP162362	SVP194431	SVP198428
SVP180584	HTZ180313	SVP197655	SVP161620	SVP179243	SVP161750
SVP180600	SVP191192	HTZ180405	SVP177365	SVP194439	HTR193472
SVP161588	SVP187562	HTR194037	SVP187564	HTR194035	SVP173270
SVP181845	HTZ183146	HTR192856	SVP197661	SVP198024	SVP197592
SVP179283	HTZ183152	SVP180585	SVP178256	SVP167102	SVP193108
SVP181537	SVP197354	SVP198431	SVP167093	SVP173269	SVP181091
HTZ176987	SVP197595	HTZ195513	SVP194425	SVP193501	HTZ195508
SVP180608	HTR192857	SVP196867	HTR194029	SVP164119	SVP177370
SVP182625-1	HTZ195510	SVP181130	SVP198088	SVP194427	SVP194448
HTZ180345	HTR193477	SVP171305	SVP197926	SVP194435	SVP182353
SVP191191	SVP167089-1	HTR194036	SVP163693	SVP173265	SVP182926
SVP181058	SVP167107	HTZ183147	HTR192863	SVP193495	SVP173264
SVP177371	SVP167091	SVP181758-1	SVP198409	SVP179242	SVP198428-1
HTZ180353	HTZ180344	HTZ195390	SVP171323	SVP198430	SVP181751
HTZ195365	SVP171306	SVP181090	HTR193487	SVP171324	SVP181841
SVP182625-2	HTR193469	SVP198030	SVP178257	SVP180594	SVP198031
HTZ195509	SVP167089	HTZ183156	SVP169482	SVP164235	SVP182923
SVP180593	SVP191184	SVP167108	SVP198080	SVP196488	SVP198037
SVP182625	SVP198081	SVP179244	SVP181057	SVP191136	SVP194421
SVP164129	SVP171301	SVP182558	SVP167090	SVP178303	SVP198441
HTZ183038	HTR193478	SVP169471	SVP179233	SVP194428	SVP193499
HTZ180346	HTZ183039	SVP193498	SVP181055	SVP181827	SVP180595
SVP182358-1	SVP181102	SVP198094	SVP162350-1	SVP181734	SVP198429
SVP179232	SVP181854	SVP191160	SVP162350-2	SVP194424	SVP194423
HTZ180342	HTR193475	SVP177356	SVP173253	SVP194447	SVP167075
HTZ183166	SVP198436	SVP196487	SVP173268	SVP169476	SVP198029
HTR194027	SVP181538	SVP181831	SVP198057	SVP171325	SVP182919
SVP179281	HTZ183155	SVP191303	HTR193474	SVP173249	SVP194445
SVP181852	SVP193500	SVP191159	SVP178265	SVP178266	SVP182918
HTZ176988	SVP187565	SVP181872	SVP181833	SVP182920	SVP181539
SVP181078	HTZ180352	SVP191185	SVP162350	SVP181743	SVP198043
SVP181742-1	HTZ183058	SVP167115	SVP162351	SVP194432	HTZ180399
SVP181856	SVP191078	SVP164069-1	SVP197427	SVP167092	SVP197406
HTZ195368	HTZ183228	SVP191149	SVP181864	SVP181104	SVP191077
HTZ195393	SVP191150	HTZ183233	SVP177367	SVP169477	SVP180609
HTZ180343	SVP181742	SVP164069	HTR185267	SVP194428-1	SVP197654
HTZ183045	SVP197649	SVP180601	SVP197667	SVP197671	SVP198407
SVP182358	HTZ183036	SVP197656	SVP197409	SVP178262	SVP198433
HTZ195495	SVP197591	SVP197549	SVP197931	SVP181056	SVP181846
SVP181851	HTR193480	SVP169472	SVP173266	SVP194451	SVP194440
SVP197650	HTZ183225	SVP169481	SVP198036	SVP182917	HTZ183232
SVP181042	SVP193496	HTZ183153	SVP169470	HTR192862	SVP177354
HTZ195369	HTZ183226	SVP198053	HTZ183041	SVP194416	SVP197428
SVP181839	SVP167101	SVP164120	SVP169475	SVP198087	HTZ183145
HTR185470	SVP181759	SVP198047	SVP173252	SVP198427	SVP197660
HTR194028	SVP181862	SVP182915	HTZ180354	SVP194443	SVP179235
HTR185295	HTZ180374	SVP173254	SVP182564	SVP182914	SVP169473
SVP197405	SVP198023	SVP197425	SVP177367-1	SVP191193	SVP193502
SVP181847	SVP181758	SVP191304	HTZ180404	SVP182912	SVP191032
SVP164077	SVP181750	SVP181080	SVP161621	HTZ183046	SVP198107
HTZ180340	SVP198056	SVP167116	SVP178302	SVP177355	SVP194420
SVP181103	SVP182921	HTR193471	HTR193483	SVP198440	SVP167094
SVP181865	HTR193484	SVP167106	SVP161589	HTR193470	SVP191147
SVP187565-1	SVP181079	SVP167117	HTZ183091	SVP198028	SVP182922
HTZ183154	HTZ183144	HTR193473	SVP164141	SVP194444	SVP173250

^a Soil remediated from CWC-56, CWC-85, CWC-86, CWC-87, CWC-88, CWC-91, CWC-93, CWC-95, and CWC-97.

Notes:

Soil samples ending in “-1” are duplicate soil samples.

Soil samples ending in “-2” are split soil samples.

THIS PAGE INTENTIONALLY LEFT BLANK