DEPARTMENT OF THE ARMY
US ARMY RESEARCH, DEVELOPMENT AND ENGINEERING COMMAND
5183 BLACKHAWK ROAD
ABERDEEN PROVING GROUND MD 21010-5424

REPLY TO
ATTENTION OF:

11 May 2006

Dr. Tom McLaughlin, Decommissioning Branch
Division of Waste Management
Office of Nuclear Material Safety and Safeguards
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Dear Dr. McLaughlin,

Reference Nuclear Regulatory Commission (NRC) License No. 19-10306-02, Docket No. 030-36574 for the authorization of Building 7304 located at Fort Belvoir, Virginia.

Provided as enclosure is the Final Status Survey documenting the completion of the decommissioning of Building 7304 for your review in support of the termination of the NRC license.

Questions regarding this action should be addressed to Ms. Joyce Kuykendall, RDECOM Radiation Program Manager, at telephone (410) 436-7118, by email at joyce.kuykendall@us.army.mil, or by facsimile at (410) 612-5377.

Sincerely,

Joyce E. Kuykendall
Health Physicist
RDECOM Radiation Program Manager
and License Radiation Safety Officer

Enclosure

CABRERA SERVICES
RADIOLOGICAL · ENVIRONMENTAL · REMEDIATION

Letter of Transmittal

To: Joyce Kuykendall

Date: 05/12/06

Subject: Final Status Survey Report, Ft. Belvoir Bldg 7304

We are sending the following via:

☒ Next Day Service ☐ U.S. Mail

☐ Second Day Service ☐ Hand Delivery

No.	Copies	Date	Description
1	6	05/12/06	Final Status Survey Report - Hard Copies
	1	05/12/06	Electronic Copy on CD

These are transmitted:

☒ For your use ☐ For review and comment

☐ As requested ☐ Other:

Remarks:

Copy to: File 03-3040.19

Signed: Kimberly Nelson

103 E. Mount Royal Ave. Suite 2B, Baltimore, MD 21202 ▪ Phone: 410.332.8177 ▪ Fax: 410.332.8183
www.cabreraservices.com

FINAL STATUS SURVEY REPORT
BUILDING 7304 VAULT

Fort Belvoir, Virginia

Contract No. DAAA09-02-D-0024
Delivery Order No. 019

Submitted to:
U.S. Army Field Support Command
Environmental Contracting Division
AMSFS-CCE-D Bldg 350 5th Floor
Rock Island, IL 61299-6000

Submitted by:
CABRERA SERVICES, INC.
103 East Mount Royal Avenue
Baltimore, MD 21202

CABRERA SERVICES
RADIOLOGICAL · ENVIRONMENTAL · REMEDIATION

May 2006

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APPENDICES

ACRONYMS AND ABBREVIATIONS

AFSC	Army Field Support Command
ALARA	as low as reasonably achievable
^{241}Am	Americium-241
bgs	below ground surface
^{14}C	Carbon-14
CABRERA	Cabrera Services, Inc.
CAD	Computer-aided drawing
CD	compact disc
CECOM	Communications-Electronics Command
CFR	Code of Federal Regulations
cm	centimeters
^{137}Cs	Cesium-137
DCGL	Derived Concentration Guideline Level
EDD	electronic data deliverable
EMC	elevated measurement comparison
EPA	Environmental Protection Agency
FIDLER	Field Instrument for the Detection of Low-Energy Radiation
FR	Federal Register
FSM	Field Site Manager
FSS	Final Status Survey
ft	feet
GIS	Geographical information systems
GPS	Global Positioning System
GWS	gamma walkover surveys
^{3}H	tritium
HP	Health Physicist
in	inches
LLRW	Low level radioactive waste
LTR	License Termination Rule
m/s	meters per second
m^2	square meter
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
mrem/yr	millirem per year
NAD	Normalized absolute difference
NaI	sodium iodide
NRC	Nuclear Regulatory Commission
ORISE	Oak Ridge Institute for Science and Education

PC	Personal computer
pCi/g	picocuries per gram
PE	Project Engineer
PM	Project Manager
^{147}Pm	Promethium-147
QA	Quality assurance
QAPP	Quality Assurance Project Plan
QC	Quality control
RDECOM	Research, Development, and Engineering Command
ROCs	radionuclides of concern
SOR	Sum of Ratios
STL	Severn Trent Laboratories
SU	Survey unit
TEDE	Total Effective Dose Equivalent
^{232}Th	Thorium-232
pCi/g	picocuries per gram
U. S.	United States
yd^3	cubic yards

EXECUTIVE SUMMARY

This *Final Status Survey (FSS) Report* presents results of the FSS conducted by Cabrera Services, Inc. (CABRERA) to support the radiological decommissioning of the Building 7304 vault at Fort Belvoir, Virginia. Activities described in this report were conducted in accordance with the *Decommissioning Plan: Building 7304 - Fort Belvoir, Virginia* (CABRERA, April 2004c). This report has been prepared by CABRERA for the United States (U.S.) Army Field Support Command (AFSC), under Contract No. DAAA09-02-D-0024, Delivery Order 019. The Building 7304 vault at Fort Belvoir was used by the Army as a radioactive waste storage area to support research operations. This facility was administered under source materials license no. 45-00953-01 (NRC, 2004). This license was terminated on July 28, 2004. The Army Research, Development, and Engineering Command (RDECOM, formerly, Soldier, Biological, and Chemical Command) holds the current source material license for this facility under U.S. Nuclear Regulatory Commission (NRC) License No. 19-10306-02 (NRC, 2004).

Decommissioning fieldwork was initiated at the Site in September 2005, in accordance with the *Decommissioning Plan* (CABRERA, April 2004c) and under the conditions as stated in the current NRC license. Field activities included the remediation of contaminated structures and soils, performance of remediation support surveys, backfill of the remediated area, and performance of final status surveys conducted in accordance with guidance presented in the *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM; NRC, 2000)*.

Gamma walkover surveys were performed and soil samples were collected in two Class 1 survey units (SU) and one Class 2 SU. Net analytical results were within pertinent NRC screening limits for the radionuclides of concern (ROC) ^{3}H, ^{14}C, ^{137}Cs, ^{147}Pm, ^{241}Am, and ^{232}Th.

Final status survey analytical sample results were statistically evaluated using the Wilcoxon Rank Sum (WRS) Test. Results of the statistical evaluation support the release of this site for unrestricted use.

In order to confirm that residual radioactivity is within acceptable limits, a dose assessment was performed using RESRAD dose modeling code, version 6.3 (Argonne National Laboratory, 2005). Both the resident farmer and industrial use scenarios were evaluated for completeness, however, due to the site's location on an active military installation, and its size (less than one acre), the resident farmer future use scenario is considered very unlikely. Both the average and maximum reported FSS sample concentrations for each ROC were used as radionuclide concentration inputs. The estimated total dose for each scenario remains within the NRC dose

limit of 25 millirem per year (mrem/yr) and EPA dose standard of 15 mrem/yr, for all but the most conservative assumptions (i.e. resident farmer with maximum ROC residual concentrations). An industrial use scenario with maximum ROC residual concentration inputs provides a realistic, yet conservative critical group dose scenario. This specific scenario results in an estimated dose to the industrial use critical group of 2.7 mrem/yr.

1.0 INTRODUCTION

This *Final Status Survey (FSS) Report* presents results of the FSS conducted by Cabrera Services, Inc. (CABRERA) to support the radiological decommissioning of the Building 7304 vault at Fort Belvoir, Virginia (herein after, the Site). Activities described in this report were conducted in accordance with the *Decommissioning Plan: Building 7304 - Fort Belvoir, Virginia* (CABRERA, April 2004c). This report has been prepared by CABRERA for the United States (U.S.) Army Field Support Command (AFSC), under Contract No. DAAA09-02-D-0024, Delivery Order 019.

The Building 7304 vault at Fort Belvoir was used by the Army as a radioactive waste storage area to support operations at the site Research and Development (R&D) Facility. The Army Research Command (RDECOM, formerly, Soldier, Biological, and Chemical Command) holds the current source materials license for this facility under U.S. Nuclear Regulatory Commission (NRC) License No. 19-10306.02 (NRC, 2004). This license, as amended in 2005, allows for the decommissioning activities as summarized in this document. The facility was managed under the former NRC License Number 45-00953-01 (NRC, 2001), which was terminated in 2004. Copies of both licenses are included in Appendix A.

RDECOM ceased the use of this vault for the storage of radioactive material in 2002, and is in the process of terminating its license in accordance with NRC decommissioning requirements described in Title 10 of the *Code of Federal Regulations (CFR)*, Part 30.36. The objective of this decommissioning process is to meet the NRC release criteria for unrestricted use, as specified in 10 CFR 20, Subpart E, *Radiological Criteria for License Termination.* This report documents the activities conducted by CABRERA to support the decommissioning process, and presents the results of the FSS conducted to confirm that the NRC release criteria have been met.

1.1 Site Description and Background

The Building 7304 vault Site is located within the Fort Belvoir Military Reservation in Fairfax County, Virginia, approximately 16 miles south-southwest of the center of Washington, D.C. (see Figure 1-1). The Site is on the western shore of the Potomac River, near Gunston Point at the southern end of a peninsula. It is adjacent to the U.S. Army Communications-Electronics

Fort Belvoir

CABRERA SERVICES RADIOLOGICAL · ENVIRONMENTAL · REMEDIATION WWW.CABRERASERVICES.COM	Fort Belvoir , VA LOCATION MAP	Date: 04-26-06 Project #: 03-3040.19 File Name: 03-3040.19-1-1 Prepared By: JDM	Figure 1-1

C01

Command (CECOM) R&D Facility, behind Building 7363 on Totten Road, as shown in Figure 1-2. Appendix B includes photographs of the Site, depicting pre-decommissioning conditions, as well as conditions during decommissioning and following restoration of the site.

Prior to its demolition, the Building 7304 vault was a concrete bunker-style building enclosed by an earthen cover approximately three feet (ft) thick. The vault was 16 ft long, 12 ft wide, and 8 ft tall, and housed a series of shielded wall and floor containments. The structure included an external walkway and doorway surrounded by an 8 ft high shield wall. The vault was constructed on a hillside such that its entrance was at street level, facing the rear parking lot for Building 7363.

The Army ceased using the vault for the storage of radioactive material in 2002 and began planning for its decommissioning. In January 2003, all radioactive and solid wastes were removed from the structure and shipped to appropriate offsite disposal facilities. Radiological survey and sampling activities were conducted in April 2003 to characterize residual contamination at the Site, as discussed in Section 3.0. Results of the characterization survey indicated elevated radioactivity within the vault, as well as on some exterior surfaces (i.e. shield wall and door) and in the floor of the subgrade storage pits (Cabrera, 2004a).

Based on the characterization results, it was determined that the contamination levels exceeded the NRC screening criteria and, thus, the vault could not be released for unrestricted use without decontamination and/or removal of the contaminated structure and associated drains, piping, and soils. Various options were considered, and the recommended technical approach was presented in the *Decommissioning Plan, Building 7304,* (CABRERA, April 2004c). The plan proposed the dismantlement and removal of the vault structure, concrete foundation, subsurface drainage system associated with the vault (including the exterior building drains, floor drains, and piping), and soils impacted above the radiological screening guidelines. This contaminated material was shipped to a licensed disposal facility. The area was then subject to a FSS and subsequent restoration of the excavated area.

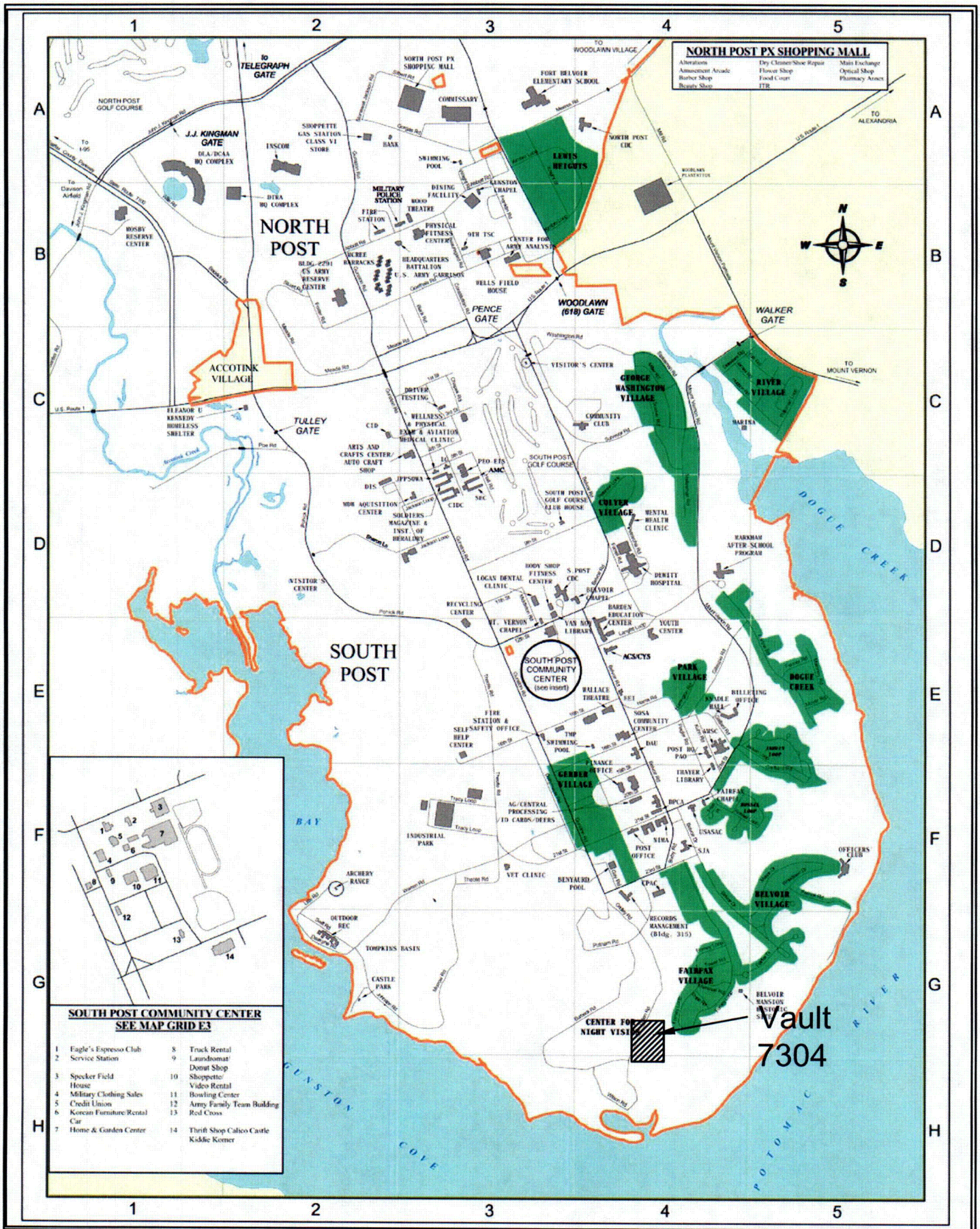


FIGURE 1-2	SITE LOCATION, BLD 7304 FORT BELVOIR, VA	CABRERA SERVICES RADIOLOGICAL · ENVIRONMENTAL · REMEDIATION WWW.CABRERASERVICES.COM	Project #: 03-3040.19 File #: 03-3040.19-1-2	Date: 04-26-06

C02

The Army submitted the *Decommissioning Plan* (CABRERA, April 2004c) to the NRC for review and approval in April 2004, along with a request for a license amendment authorizing its implementation. Upon the receipt of NRC's approval of the plan and the issuance of a license amendment in 2004, CABRERA remediated the Site and conducted the FSS as described in the *Decommissioning Plan*. A general description and results of these activities are presented within this report.

1.2 Characterization Survey

Characterization survey and sampling activities were conducted at the Site in April 2003, in support of the decommissioning process. Characterization activities were conducted in accordance with the *Characterization Survey Plan* (CABRERA, 2003). Detailed results of the characterization effort are presented in the *Final Report: Characterization Survey, Building 7304 vault, Fort Belvoir, Virginia* (CABRERA, 2004a). Samples were submitted for laboratory analysis of gross alpha and beta, gamma spectroscopy, and tritium, carbon-14, and ^{147}Pm.

The characterization results indicated elevated concentrations of the following radioisotopes: tritium (^{3}H), Carbon-14 (^{14}C), Cesium-137 (^{137}Cs), Promethium-147 (^{147}Pm), Americium-241 (^{241}Am), and Thorium-232 (^{232}Th). Radioactivity was detected at levels above the specified action limits on interior and exterior surfaces of the vault, within the individual floor and wall vaults, and in the surface soils in the floor of the subgrade pits. The highest levels of contamination observed consisted of ^{137}Cs on the vault floor and in the underlying soil, and ^{3}H inside the wall vaults and within sediment in the floor of the subgrade storage pits. Contamination outside of the vault was minimal, and was concentrated on the concrete pad directly outside the vault doorway. There was no indication of significant contamination inside the floor drain inside the vault; however, the remainder of the drainage and piping system was inaccessible and was not surveyed.

1.3 Radionuclides of Concern

Primary radionuclides of concern (ROCs) for the decommissioning of the Building 7304 vault have been established based on the radioisotopes confirmed to be present during the 2003 characterization survey (Table 1-1).

TABLE 1-1: RADIONUCLIDES OF CONCERN

• ^{3}H	• ^{147}Pm
• ^{14}C	• ^{241}Am
• ^{137}Cs	• ^{232}Th

*based on Characterization Survey results (Cabrera, 2004a)

2.0 DECOMMISSIONING ACTIVITIES

Decommissioning fieldwork was initiated at the Site in September 2005 in accordance with the *Decommissioning Plan* (CABRERA, April 2004c). Field activities included the remediation of contaminated structures and soils, performance of remediation support surveys, backfill of the remediated area, and performance of final status surveys conducted in accordance with guidance presented in the *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM; NRC, 2000)*.

Remediation of the contaminated structures and soils involved removal of the earthen cover overlying the vault structure; the demolition and removal of the vault, external walkway, shield wall, and subgrade exterior drainage and system, as well as the excavation of soils surrounding and underlying the vault and drainage system. Removal of the drainage system was determined necessary following the identification of elevated ROC activity (primarily tritium) in and around the drainage pipe underlying the vault. Oak Ridge Institute for Science and Education (ORISE) conducted an in-process inspection survey in October, 2005, at the request of the NRC (ORISE, 2005). The in-process survey confirmed the presence of residual tritium contamination in the vicinity of the drain pipe and in soils from the floor of the excavation at that time, indicating the need for additional soil removal and excavation and removal of the drain pipe system and surrounding soils.

Specific activities performed in support of the remediation process included excavating and removing non-impacted soils that surrounded the vault, demolishing the vault structures, re-sizing the rubble to meet disposal facility acceptance criteria, and excavating impacted soil beneath the structure and surrounding the drain pipe.

Wastes generated during the demolition activities were packaged and shipped to appropriate offsite disposal facilities based on their radioactive characteristics. Approximately 250 tons of low-level radioactive waste (LLRW), consisting of building debris and soils, was shipped to Energy Solutions of Utah (formerly EnviroCare of Utah) for disposal under Contract Number 3116-01 (Manifests 3116-01-01 through -13). The remainder of the demolition waste, consisting of excess soils from the overlying earthen cover, was disposed of as special waste at the King

George Landfill in King George County, Virgina. Records of all waste shipments and disposal facility receipts are included in Appendix C.

The total remediation footprint was approximately 641 square meters (m^2). This encompassed the footprint of the structure (including the exterior walkway and shield wall), as well as an additional 1.5 meters on three sides of the structure where exterior drains and piping were buried. Due to the presence of tritium contamination in the drain pipe and surrounding soils, it was determined that the entire pipeline would be excavated to its discharge point along the adjacent hill slope. The FSS was adjusted accordingly to accommodate the additional area of excavation. The average depth of final excavation was approximately eight feet below grade. Following removal of the structures and soil from within this area, backfill was placed to bring the excavated area up to grade, the area was seeded to re-establish vegetation, and the security fence, parking areas, and other site features were restored in coordination with the Building 7363 facility manager.

Upon the completion of demolition and removal activities, a FSS was conducted to verify that the remediation was effective in reducing residual contamination sufficiently to meet the NRC unrestricted release criteria. The FSS consisted of gamma walkover surveys (GWS) and the collection and analysis of a discrete number of systematic and biased soil samples. Sample results have been tabulated by Survey Unit and are included in Appendix D. The FSS was conducted in accordance with the *Final Status Survey Plan, Building 7304 vault, Fort Belvoir, Virginia* (CABRERA, 2004b), as described in Section 3.0 and in accordance with MARSSIM guidance.

3.0 FINAL STATUS SURVEY DESIGN

This section summarizes the design of final status surveys conducted in the vault area following its remediation, as described in the *Final Status Survey Plan, Building 7304 Vault, Fort Belvoir, Virginia* (CABRERA, 2004b). The survey design discussed below is based on the technical guidance and statistical methods presented in *MARSSIM* (NRC, 2000), as presented in *NUREG-1757, Consolidated NMSS Decommissioning Guidance, Vol. 2* (NRC, 2003b).

3.1 Derived Concentration Guideline Levels

Decommissioning planning was conducted in accordance with guidance presented in NUREG-1757, *Consolidated NMSS Decommissioning Guidance, Volumes 1 and 2,* (NRC, 2003a and 2003b). This section describes the establishment of derived concentration guideline levels (DCGLs) that were used to guide site decommissioning activities. DCGLs, expressed for soils in picocuries per gram (pCi/g), represent the residual radioactivity concentrations (above background) in soils that correspond to the allowable residual radiation dose limit, considering the collective risks to human health associated with anticipated potential exposure scenarios and pathways to a potential future site population. Demonstrating that residual radioactivity remaining at the site is statistically within site-specific DCGLs maintains compliance with acceptable risk to a potential future site population.

The NRC has established a radiation dose limit of 25 millirem per year (mrem/yr) above background as the allowable annual dose to the public contributed by residual radioactivity at a site released for unrestricted use. In 10 CFR 20, Subpart E, *Radiological Criteria for License Termination*, the following release criteria are specified:

1. Residual radioactivity that is distinguishable from background and results in a total effective dose equivalent (TEDE) to an average member of the critical group that does not exceed 25 mrem/yr, including that from groundwater sources of drinking water; and
2. Residual radioactivity that has been reduced to as low as reasonably achievable (ALARA) levels.

Determination of ALARA levels must take into account consideration of any detriments, such as deaths from transportation accidents, expected to potentially result from excavation and waste disposal activities.

The NRC standard of 25 mrem/yr is applicable to the decommissioning of the vault and, therefore, has been used as the basis for demonstrating that the remediated vault area should be released for unrestricted use. Application of this DCGL ensures that the potential dose to the average member of the critical group will not exceed 25 mrem in any one year over a 1,000-year period.

In order to provide as much useful FSS information as possible, the Environmental Protection Agency's (EPA) standard of 15 mrem/yr was also be considered during the evaluation of FSS results.

The License Termination Rule (LTR) presented in 10 CFR 20, Subpart E, specifies an allowable dose limit of 25 mrem/yr. Supplemental information regarding the implementation of the LTR, including screening criteria for building surfaces and soil, has been published in the following Federal Register (FR) notices:

- FR Volume 63, Number 222, November 18, 1998 (NRC, 1998);
- FR Volume 64, Number 234, December 7, 1999 (NRC, 1999); and
- FR Volume 65, Number 114, June 13, 2000 (NRC, 2000b).

In accordance with NUREG 1757, *Consolidated NMSS Decommissioning Guidance, Vol. 2* (NRC, 2003b), soil screening criteria for ROCs not addressed in the preceding FR documents have been obtained from Table 6.91 of NUREG/CR-5512, *Residual Radioactive Contamination from Decommissioning, Parameter Analysis, Vol. 3* (NRC, 1999b). These screening criteria were used to establish instrument/analysis sensitivity requirements for decommissioning activities.

As described in the guidance presented in FR Volume 65, Number 114 (NRC, 2000b), the use of the soil screening values presented in FR Volume 64, Number 234 (NRC, 1999) may be used to demonstrate compliance with the LTR for soils under specific guidelines. The four guidelines by which soils may be deemed acceptable for release for unrestricted use are as follows:

1. The residual radioactivity has been reduced to levels that are ALARA;
2. The residual radioactivity is contained in the top layer of the surface soil (i.e., within approximately 30 cm or 12 inches [in.] from the surface, in accordance with NUREG-1757, Volume 2 [NRC, 2003b]);

3. The unsaturated zone and the groundwater are initially free of radiological contamination; and
4. The vertical saturated hydraulic conductivity at the specific site is greater than the infiltration rate.

During the course of decommissioning and removal of contaminated soils beneath the footprint of the vault and along the drain pipe, residual contamination exceeding the soil screening criterium for tritium was confirmed. As a result, an iterative process was used to extend the excavation to depth until subsurface soil (i.e., greater than 30 cm or 12 in below the surface) values no longer exceeded screening criteria. Based on survey results and available information, it is believed that these four guidelines have been met for soils remaining in the vault area after remediation activities. Therefore, under the guidance presented in the FR documents mentioned above and in NUREG-1757, Volume 1 (NRC, 2003a), the soil screening criteria presented in FR Volume 64, Number 234 (NRC, 1999) are appropriate for use in developing DCGLs to demonstrate compliance with the 25 mrem/yr dose limit.

A dose assessment has also been performed using RESRAD version 6.3 (Argonne National Laboratory, 2005) and final status survey sample results to determine total dose of residual ROC activity within site survey units. The results of this dose assessment are discussed in Section 4.4 and the RESRAD modeling runs are included in Appendix E.

The DCGLs used to support decommissioning of the Building 7304 vault are presented in Table 3-1.

TABLE 3-1: BUILDING 7304 VAULT DECOMMISSIONING DCGLS

Radionuclide	DCGL (pCi/g)
Tritium	110
Carbon-14	12.0
Promethium-147	8.2E3
Cesium-137	11.0
Americium-241	2.10
Thorium-232	1.10

DCGL = Derived Concentration Guideline Level
pCi/g = picocuries per gram

3.2 Survey Unit Classification and Delineation

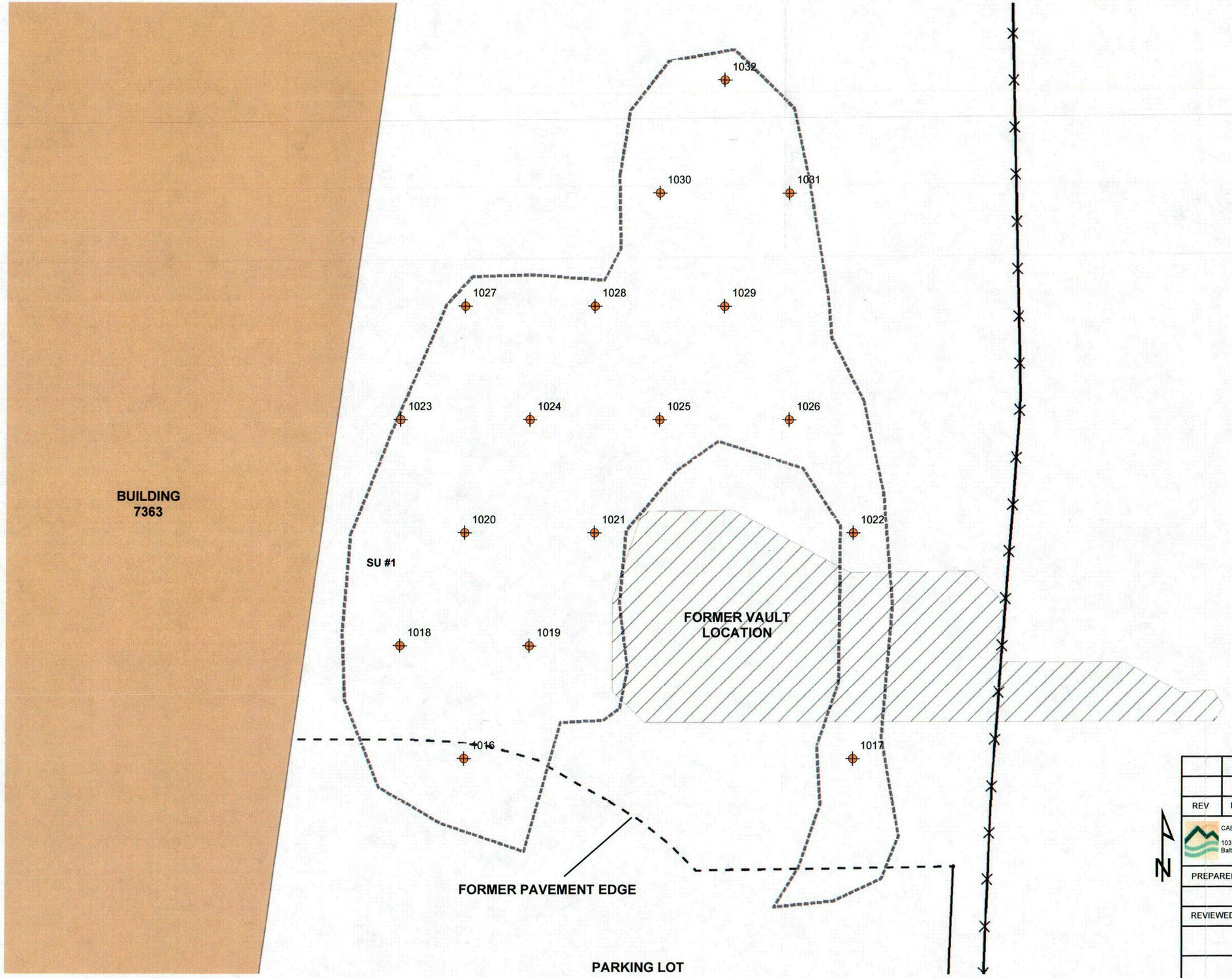
As discussed in *MARSSIM* (NRC, 2000), areas undergoing a FSS should be subdivided into survey units (SUs), classified according to their potential for residual radioactivity. Potential classifications for SUs are defined as follows:

- **Non-Impacted Areas:** Areas that have no reasonable potential for residual contamination;
- **Impacted Areas:** Any area not classified as non-impacted (i.e., areas with a possibility of containing residual radioactivity in excess of natural background or fallout levels);
- **Class 1 Areas:** Impacted areas that have, or had prior to remediation, a potential for contamination (based on site operating history) or known contamination (based on previous radiological surveys) above the DCGL used for non-parametric statistical testing (i.e., wide area DCGL [$DCGL_w$]);
- **Class 2 Areas:** Impacted areas that, prior to remediation, were not likely to have concentrations of residual radioactivity exceeding the $DCGL_w$; and
- **Class 3 Areas:** Impacted areas that have a low probability of containing residual radioactivity.

One Class 2 and two Class 1 SUs were established in the field and numbered SU #1, SU #2, and SU #3, respectively. These SUs are depicted in Figures 3-1 and 3-2. SU #1 (Class 2 SU) consisted of the overburden soil that was formerly covering the vault structure. SU #2 (Class 1 SU) was the footprint of the vault itself and SU #3 (Class 1 SU) was the footprint of the drainage pipe running from the vault to the discharge point on the adjoining hill slope. SU #1 had an area of 258 m^2, SU#2 had an area of 86 m^2, and SU #3 had an area of 456 m^2.

3.3 Gamma Walkover Surveys

A GWS was performed over 100% of the Class 1 SUs (SUs #2 and #3), as possible, consistent with *MARSSIM* (NRC, 2000) guidance, in order to identify areas of elevated gamma fluence. A GWS was also performed over 100% of the Class 2 SU (SU #1).



Legend

- SAMPLE LOCATIONS
- FENCE
- SURVEY UNIT #1
- SURVEY UNIT # 2

N

REV	DATE	DESCRIPTION	BY

CABRERA SERVICES
103 E. Mount Royal Ave, 2B
Baltimore, Maryland 21202

U.S. ARMY FIELD SUPPORT COMMAND
ENVIRONMENTAL CONTRACTING DIVISION
ROCK ISLAND, ILLINOIS

PREPARED BY: JDM

REVIEWED BY: EB/KN

FORT BELVOIR VIRGINIA

FORT BELVOIR VAULT 7304
FINAL STATUS SURVEY

CLASS 2 SU #1 SAMPLE LOCATIONS

CONTRACT # DAAA09-02-D-0024/DO019

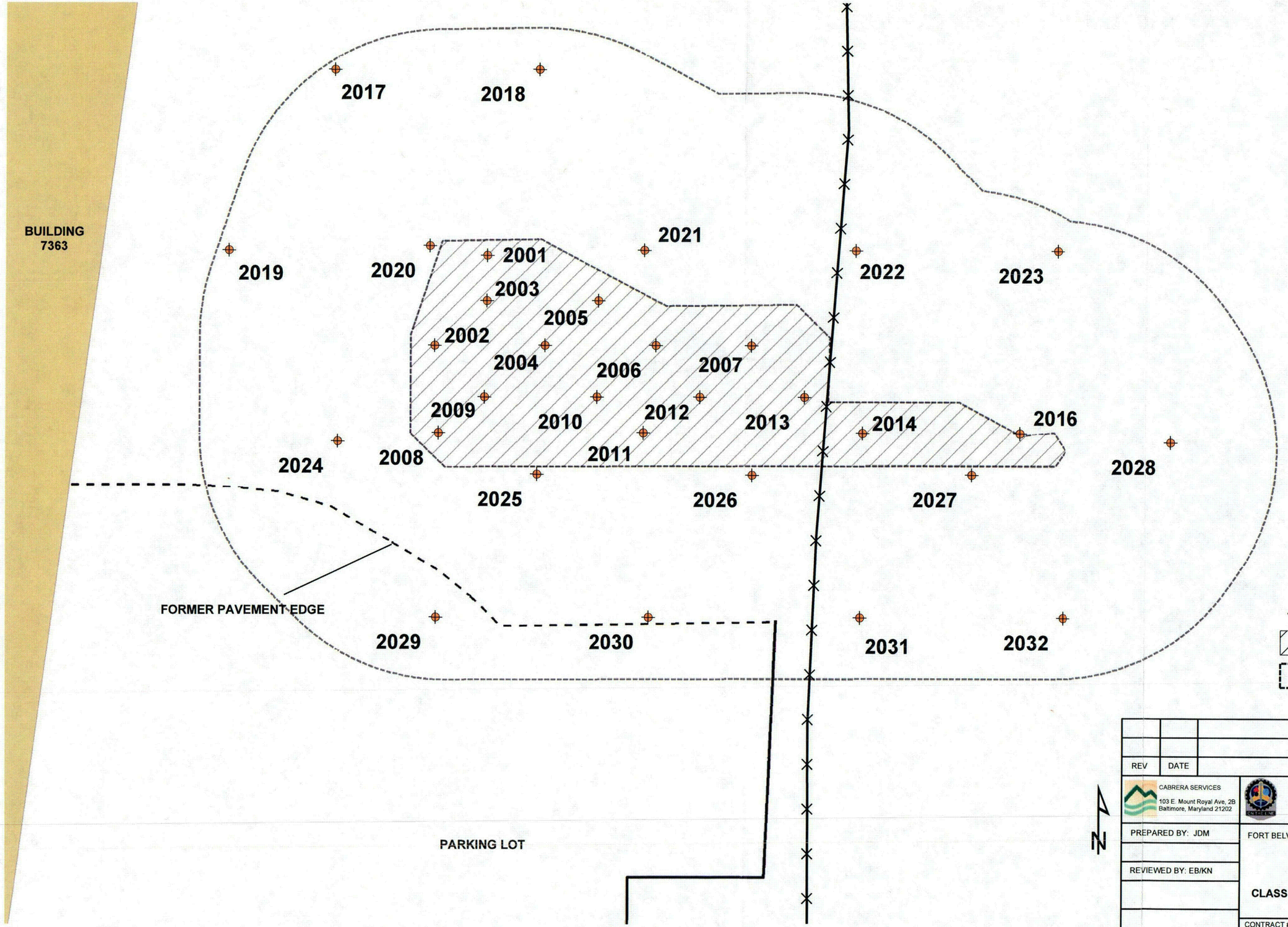
DRAWING # 03-3040.19-SU1

3-1

SCALE: 0 0.5 1 2 3 Meters

DATE: 3/30/2006

C03



Legend

- SAMPLE LOCATIONS
- FENCE
- SURVEY UNIT #2
- SURVEY UNIT #3

REV	DATE	DESCRIPTION	BY

CABRERA SERVICES
103 E. Mount Royal Ave, 2B
Baltimore, Maryland 21202

U.S. ARMY FIELD SUPPORT COMMAND
ENVIRONMENTAL CONTRACTING DIVISION
ROCK ISLAND, ILLINOIS

PREPARED BY: JDM

REVIEWED BY: EB/KN

FORT BELVOIR — VIRGINIA

FORT BELVOIR VAULT 7304
FINAL STATUS SURVEY

CLASS 1 SU #2 & SU #3 SAMPLE LOCATIONS

CONTRACT #	DRAWING #	
DAAA09-02-D-0024/DO019	03-3040.19-SU2/3	3-2

SCALE: 0 0.5 1 2 3 Meters — DATE: 3/30/2006

C04

3.3.1 Instrumentation

The following instruments were used to perform the GWS:

- Field Instrument for the Detection of Low-Energy Radiation (FIDLER) sodium iodide (NaI) detector connected to a Ludlum Model 2221 rate-meter/scalar;
- GPS: Trimble Pathfinder Pro – XR

3.3.2 Methodology

The GWS was performed by walking straight parallel lines over the area while moving the detector in a serpentine motion, approximately 10 centimeters (cm) above the ground surface. Walking speed was maintained at approximately 0.5 meters per second (m/s), and survey passes were approximately one meter apart. Radioactivity measurements were logged at one-second intervals, and each measurement was position-correlated using the GPS coordinates.

Upon completion of the survey, records were downloaded from the datalogger into a personal computer (PC) file and transmitted to the project Health Physicist (HP) for processing. The data were reviewed for accuracy and processed by means of statistical analyses (i.e., calculation of mean, standard deviation, and distribution) and geospatial imaging (i.e., color-coded graphical representation of radioactivity distributed over the SU).

3.4 Soil Sampling

This section describes the collection and analysis of surface soil samples from each SU at both systematic and biased sampling locations.

3.4.1 Systematic Surface Soil Samples

According to *MARSSIM* (NRC, 2000), a minimum number of systematic soil sample locations are required to obtain sufficient statistical confidence that the conclusions drawn from the analytical data are correct. To support the release of this site for unrestricted use, an expectation of radionuclide concentrations near or at background levels was assumed. The minimum number of required sample locations was calculated based on the distribution of residual radionuclide concentrations relative to the $DCGL_w$ and the acceptable decision error limits (α and β). For the

vault area, a minimum of 16 samples was determined to be necessary. The derivation of this number is described in detail in the *FSS Plan* (CABRERA, 2004b).

Locations of the systematic samples were established using a uniform triangular grid based on the area of the SUs and the required number of samples (n=16). The required sample spacing was calculated using Equation 5-7 from *MARSSIM* (NRC, 2000). To identify sample locations, a computer-aided drawing (CAD) program was used to lay out a triangular grid with the indicated spacing over the SU. A random starting point for the grid was established using a computer-generated random coordinate set. The coordinates of each vertex on the triangular grid were computed and used as the systematic sample locations, as indicated in Figure 3-2. These coordinates were transmitted to the field crew, who marked each sample location with a pin flag based on GPS readings. A total of 17 samples were collected from the overburden soil in the Class 2 SU #1 (samples 1016-1032). A total of 16 samples were collected from the inner Class 1 SU #2 (samples 2001-2016). A total of 16 samples were collected from the outer Class 1 SU #3 (samples 2017-2032).

3.4.2 Soil Sampling in the Reference Area

Soil samples were collected in a Reference Area approximately 60 meters from the Site determine the amount of radioactivity naturally present in site soils with similar characteristics and geography. These samples were collected and processed using techniques identical to the systematic samples collected in SUs #1-3. Reference Area soil samples were collected from 0 to 12 in. below ground surface (bgs) at each location. The Reference Area sample results (REF1-REF16) were used with systematic sample results in the evaluation of the WRS test.

3.4.3 Soil Sample Collection and Analysis

A total of 49 surface soil samples were collected from 0 to 12 in. bgs at each systematic sampling location. Soil samples were collected using a hand auger, in accordance with CABRERA Standard Operating Procedure *OP-005: Volumetric and Material Sampling.* Samples were shipped by CABRERA to Severn Trent Laboratories (STL) in Earth City, Missouri for radionuclide analysis.

Analytical results are summarized in Appendix D. Sample locations are shown on Figures 3-1 and 3-2.

4.0 FINAL STATUS SURVEY RESULTS

This section presents the results of survey and sampling activities conducted as part of this FSS.

4.1 Gamma Walkover Survey Results

GWS were performed in 100% of SUs #1-3. There were no areas of significantly elevated gamma fluence detected during GWS. Raw GWS results are presented in Appendix D.

4.2 Soil Sample Results

Soil samples were collected from approximately 15-30 cm below surface. Analytical results are presented in Appendix D.

4.2.1 SU #1 – Overburden Soil

Locations for soil samples are presented in Figures 3-1. A total of 17 soil samples (Locations 1016-1032) were collected from 15-30cm below surface from the overburden soil area and sent offsite to STL for radiological analysis. ROC screening limits were not exceeded.

4.2.2 SU #2 – Inner Class 1 SU

Locations for soil samples are presented in Figure 3-2. A total of 16 soil samples (Locations 2001-2016) were collected from 15-30 cm within the Inner Class 1 area and sent offsite to STL for radiological analysis. ROC screening limits were not exceeded.

4.2.3 SU #3 – Outer Class 1 SU

Locations for soil samples are presented in Figure 3-2. A total of 16 soil samples (Locations 2017-2032) were collected from 15-30 cm within the Outer Class 1 area and sent offsite to STL for radiological analysis. ROC screening limits were not exceeded.

4.3 MARSSIM - Based Evaluation of FSS Results

FSS results were evaluated in accordance with MARSSIM guidance. No net sample result exceeded the $DCGL_w$ for each ROC and therefore comparison to the DCGL elevated measurement criteria, $DCGL_{EMC}$, is not required.

4.3.1 Unity Rule Evaluation of Results

Multiple ROCs exist for this FSS and each contributes to the dose limit on which each ROC $DCGL_w$ is based. Therefore, when evaluating whether multiple ROCs exceed the $DCGL_w$ release criterion, it is necessary to use the Unity Rule as provided in MARSSIM Equation 4-3. Under the Unity Rule, each sample result is divided by the specific $DCGL_w$ for the pertinent ROC. The resulting ratios for all ROC results are then added for each sample, commonly referred to as the Sum of the Ratios (SOR). As shown in Appendix C, one FSS result exceeds the SOR $DCGL_w$ of 1, but no FSS results exceed the net SOR $DCGL_w$ of 1. This is due to the fact that background activity for each ROC is subtracted for net SOR calculations.

4.3.2 Wilcoxon Rank Sum Test

The Wilcoxon Rank Sum (WRS) Test is used to statistically evaluate whether reported sample results meet $DCGL_w$ criteria for each SU when ROC activity also exist in natural background. WRS Test results, presented in Appendix D, show that SU sample results meet the $DCGL_w$, when accounting for natural background sample results, and that the Fort Belvoir 7304 vault area is suitable for unrestricted release.

For SU #1, a Class 2 SU, the WRS critical value was 317.7 and the sum of the reference area ranks was 408. Sample results for this SU passed the WRS test.

For SU #2, a Class 1 SU, the WRS critical value was 307.6 and the sum of the reference area ranks was 392. Sample results for this SU passed the WRS test.

For SU #3, a Class 1 SU, the WRS critical value was 307.6 and the sum of the reference area ranks was 392. Sample results for this SU passed the WRS test.

4.4 RESRAD Dose Assessment

Four separate RESRAD simulations were conducted using FSS analytical sample results to provide an assessment of potential dose to the average member of the industrial use and resident farmer critical groups. The current use and most likely, future use scenarios are industrial, given that the site is located on a viable, active military installation, and the size of the vault area site is smaller than a typical farm. However, for the sake of completeness doses for both critical groups

were modeled. The latest available version of RESRAD, version 6.3) was used for the dose assessment (Argonne National Laboratory, August 2005). CABRERA utilized information provided in NUREG-5512 as inputs to RESRAD evaluations. The four separate RESRAD simulations are presented in Appendix E.

4.4.1 RESRAD Results

RESRAD results show that one resident farmer and both industrial use critical group scenarios meet the 25 mrem/yr NRC dose limit as follows:

- The industrial scenario using the maximum sample result for six ROCs resulted in a maximum dose of 2.6 mrem/yr at 50 years.
- The industrial scenario using the average sample result for six ROCs. The maximum dose was 1.3 mrem/yr at 67 years.
- The resident farmer scenario using the maximum sample concentration reported for the six ROCs resulted in a maximum dose of 33.8 mrem/yr at 26 years.
- The resident farmer scenario using the average sample concentration reported for the six ROCs resulted in a maximum dose of 14.0 mrem/yr at 29 years.

4.4.2 RESRAD Specific Settings

As previously specified, CABRERA utilized information provided in NUREG-5512 as inputs to RESRAD evaluations. Specific RESRAD settings used for each of the two critical groups as follows:

Specific dose pathways and settings utilized for industrial use scenario:

- External exposure to penetrating radiation from volume soil sources while outdoors.
- External exposure to penetrating radiation from volume soil sources while indoors.
- Inhalation exposure to resuspended contaminated soil while outdoors.
- Inhalation exposure to resuspended surface sources of contaminated soil tracked indoors.

- Direct ingestion of contaminated soil.

- Occupancy data were set to 0.1712 for the indoor time fraction and 0.0571 for the outdoor time fraction. These are conservative values based on an assumption of 50 working weeks per year, with 75 percent of time spent indoors and 25 percent of time spent outdoors.

Specific dose pathways utilized for the resident farmer scenario:

- External exposure to penetrating radiation from volume soil sources while outdoors.

- External exposure to penetrating radiation from volume soil sources while indoors.

- Inhalation exposure to resuspended contaminated soil while outdoors.

- Inhalation exposure to resuspended surface sources of contaminated soil tracked indoors.

- Ingestion of drinking water from a groundwater source.

- Ingestion of plant products grown in contaminated soil.

- Ingestion of plant products irrigated with contaminated groundwater.

- Ingestion of animal products grown onsite (i.e., after animals ingest contaminated drinking water, plant products, and soil).

- Ingestion of fish and aquatic foods from a contaminated surface water source.

- Direct ingestion of contaminated soil.

- Occupancy data were set to 0.6571 for the indoor time fraction and 0.1101 for the outdoor time fraction. These are conservative values based on assumptions as listed on page 3-34 in NUREG 5512, Volume 4.

5.0 QUALITY ASSURANCE/QUALITY CONTROL

Field activities conducted as part of the decommissioning effort were performed in accordance with written procedures and/or protocols in order to ensure consistent, repeatable results. Data generated during the FSS met the Quality Assurance (QA)/Quality Control (QC) requirements outlined in the *FSS Plan* (CABRERA, 2004b).

5.1 Survey Instrumentation Quality Control

The CABRERA Project HP was responsible for determining the instrumentation required to complete the requirements of this FSS. Only instrumentation approved by the CABRERA Project HP was used to collect radiological data. The CABRERA Project HP was responsible for ensuring individuals were appropriately trained to use project instrumentation and other equipment, and that instrumentation met the required detection sensitivities. Instrumentation were operated in accordance with either a written procedure or manufacturers' manual, as determined by the CABRERA Project HP. The procedure and/or manual provided guidance to field personnel on the proper use and limitations of the instrument.

5.1.1 Calibration Requirements

Instruments used during project performance had current calibration and maintenance records on site for review and inspection. The records included the following:

- name of the equipment
- equipment identification (model and serial number)
- manufacturer
- date of calibration
- calibration due date

Instrumentation was maintained and calibrated to manufacturers' specifications to ensure that required traceability, sensitivity, accuracy and precision of the equipment/instruments was maintained. Instruments were under current calibration. The calibration records for each instrument used during this characterization survey are presented in Appendix D.

5.1.2 Instrument QC Source Checks

Prior to daily use, project instrumentation was QC checked by comparing instrument response to a benchmark response. Prior to the commencement of field operations, site reference locations

were selected for performance of these checks; subsequent QC checks were performed at these locations. QC source checks consisted of a one-minute integrated count with the designated source positioned in a reproducible geometry performed at the reference location. Prior to the start of initial surveys, this procedure was repeated at least ten times to establish average instrument response. The QC results for each instrument used during this characterization survey are presented in Appendix D.

5.1.2.1 Direct Radiation Measurement Instrumentation QC

Instrument responses to designated QC check sources were recorded and evaluated against the average established at the start of the field activities. An acceptance criterion of ± 20% was required for direct measurement detectors. A QC count outside the respective screening limit required informing the Project Manager (PM), or designee, a detector evaluation and could have resulted in the detection system being removed from service for corrective action. Direct measurement detectors that were used during field activities passed QC evaluations daily. The QC results for each instrument used during this characterization survey are presented in Appendix D.

5.1.2.2 Smear analysis instrumentation QC

The detector used to analyze smears was the Ludlum 2929/43-10-1. Instrument response to designated QC check sources were recorded and evaluated against the average established at the start of the field activities. An acceptance criterion of ±2 sigma for an investigation level and ±3 sigma for a screening limit were established for this project. The Project Engineer (PE) performing QC checks investigated results exceeding the ±2 sigma criteria and noted the results in the project QC data file. If QC check results exceed ±3 sigma criterion, the PE noted this occurrence in the data file and contacted the CABRERA PM, or designee, for further instructions. The CABRERA PM, or designee, made appropriate corrections to instrument readings if response was deviated by factors beyond personnel control, such as large humidity or temperature changes. The CABRERA PM, or designee, had authority to decide whether or not the instrument was acceptable to use or must be removed from service. The Ludlum 2929/43-10-1 that was used during field activities passed QC evaluations daily. The QC results for the instruments used during this characterization survey are presented in Appendix D.

5.1.3 Calibration Requirements

Instruments used during the characterization survey had current calibration and maintenance records on site for review and inspection. The records included, the following:

- name of the equipment
- equipment identification (model and serial number)
- manufacturer
- date of calibration
- calibration due date

Instrumentation was maintained and calibrated to manufacturers' specifications to ensure that required traceability, sensitivity, accuracy and precision of the equipment/instruments was maintained. Instruments were under current calibration. The calibration records for each instrument used during this characterization survey are presented in Appendix D.

5.2 Differential Global Positioning System Quality Control

GPS units were used directly to generate geospatial reference for sample points and other pertinent FSS data. GPS point features was collected at the beginning and end of the day at a fixed location established at the beginning of the FSS. Results of these feature counts were compared to the mean of a series of sequential initial positions. This data was entered into a spreadsheet and examined to confirm less than one-meter variability. The GPS Trimble unit that was used during field activities passed QC evaluations daily. Results of daily field checks are provided as Appendix D.

6.0 HEALTH AND SAFETY

Health and safety measures were employed during conduct of FSS activities, in accordance with the project Health and Safety Plan (CABRERA, 2004d). These measures were designed to protect Cabrera personnel and certain

6.1 General Health and Safety Measures

Daily health and safety activities were performed in accordance with the project Health and Safety Plan. The Health and Safety Plan was reviewed by CABRERA project personnel prior to the performance of characterization survey activities. No lost time injuries or incidents took place during the decommissioning and find status survey field effort.

6.2 Radiological Health and Safety Measures

General radiological health and safety measures were performed in accordance with the project Health and Safety Plan (CABRERA, 2004d) and CABRERA Standard Operating Procedures.

7.0 SUMMARY OF RESULTS AND CONCLUSIONS

Final Status Surveys were conducted at the Building 7304 vault, following decommissioning activities, in accordance with MARSSIM guidance. FSS analytical sample results, as presented in Appendix D, did not exceed the net SOR $DCGL_w$ of one. Analytical sample results were statistically evaluated using the WRS Test. Results of the statistical evaluation support the release of this site for unrestricted use.

A dose assessment was performed using RESRAD for both the resident farmer and industrial use scenarios. The average and maximum reported FSS concentrations for each ROC were used as radionuclide concentration inputs. The following is a summary of the RESRAD results:

- The industrial use scenario using maximum sample concentrations resulted in a maximum dose of 2.6 mrem/yr.
- The industrial scenario using the average sample concentration resulted in a maximum dose of 1.3 mrem/yr.
- The resident farmer scenario using maximum sample concentrations resulted in a maximum dose of 33.8 mrem/yr.
- The resident farmer scenario using average sample concentrations reported a maximum dose of 14.0 mrem/yr.

The RESRAD dose estimation results listed above show that the resident farmer scenario, using average concentration inputs and industrial use critical group scenario using both average and maximum concentration inputs, meet the 25 mrem/yr NRC dose limit and the 15 mrem/yr EPA dose standard. The resident farmer scenario using maximum concentration inputs exceeds the NRC and EPA dose standards.

The results indicate that estimated dose from site residual ROCs remains within NRC and EPA dose standards for all but the most conservative assumptions, i.e., a resident farmer scenario and maximum residual concentration inputs for each ROC. However, this most conservative resident farmer scenario is not a realistic portrayal of this site's probable future use. It is anticipated that assuming an industrial use scenario with maximum ROC residual concentration inputs provides

an accurate yet conservative critical group dose scenario. This specific (most likely) scenario results in an estimated dose to the industrial use critical group of 2.7 mrem/yr.

8.0 REFERENCES

Argonne National Laboratory, 2005. *RESRAD Dose Modeling Code version 6.3.* Argonne National Laboratory.

CABRERA, 2003. *Characterization Plan, Building 7304 vault, Fort Belvoir, Virginia.* Cabrera Services, Inc. March 2003.

CABRERA, 2004a. *Final Report: Characterization Survey, Building 7304 vault, Fort Belvoir, Virginia.* Cabrera Services, Inc. March 2004.

CABRERA, 2004b. *Final Status Survey Plan, Building 7304 vault, Fort Belvoir, Virginia.* Cabrera Services, Inc. March 2004.

CABRERA, 2004c. *Decommissioning Plan: Building 7304 - Fort Belvoir, Virginia.* Cabrera Services, Inc. April 2004.

CABRERA, 2004d. *Health and Safety Plan: Building 7304 - Fort Belvoir, Virginia.* Cabrera Services, Inc. April 2004.

NRC, 1998. *Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions.* NUREG-1507. Nuclear Regulatory Commission. June 1998.

NRC, 1999. *Residual Radioactive Contamination from Decommissioning, Parameter Analysis.* NUREG-CR-5512, Volume 3. U.S. Nuclear Regulatory Commission. October 1999.

NRC, 2000. *Multi-Agency Radiation Survey and Site Investigation Manual* (MARSSIM), NUREG-1575. U.S. Nuclear Regulatory Commission, U.S. Department of Defense, U.S. Environmental Protection Agency, and U.S. Department of Energy. August 2000.

NRC, 2001 *Materials License No. 45-00953-01*, U.S. Nuclear Regulatory Commission. With amendments through July 28, 2004.

NRC, 2003a. *Consolidated NMSS Decommissioning Guidance: Characterization, Survey, and Determination of Radiological Criteria.* NUREG-1757, Vol. 1. U.S. Nuclear Regulatory Commission. September 2003.

NRC, 2003b. *Consolidated NMSS Decommissioning Guidance: Characterization, Survey, and Determination of Radiological Criteria.* NUREG-1757, Vol. 2. U.S. Nuclear Regulatory Commission. September 2003.

NRC, 2004 *Materials License No. 19-10306-02,* US Nuclear Regulatory Commission. Amended June 29, 2005.

Oak Ridge Institute of Science and Education (ORISE), 2005. *In-Process Inspection Survey Results for the Building 7304 Vault Grounds at Ft Belvoir, Virginia (Docket No. 030-36574, RFTA No. 05-003).* Report to US Nuclear Regulatory Commission, Mr. Tom McLaughlin, November 7, 2005.

APPENDIX A

NUCLEAR MATERIALS LICENSE NOS. 45-00953-01 AND 19-10306-02

UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION I
475 ALLENDALE ROAD
KING OF PRUSSIA, PENNSYLVANIA 19406-1415

July 28, 2004

Docket No. 03006511 License No. 45-00953-01
Control No. 135001

MG John C. Doesburg
Commander
Department of the Army
US Army Research, Development and Engineering Command
5183 Blackhawk Road
Aberdeen Proving Ground, MD 21010-5424

SUBJECT: DEPARTMENT OF THE ARMY, ISSUANCE OF LICENSE TERMINATION, CONTROL NO. 135001

Dear MG Doesburg:

Please find enclosed Amendment No. 43 terminating License No. 45-00953-01. This action was prompted by your letter dated April 2, 2004 that requested a change in your mailing address to the U.S. Army Research, Development and Engineering Command at Aberdeen Proving Ground, Maryland. Concurrent with termination of this license, new NRC License No. 19-10306-02 has been issued under a separate cover letter mailed this date.

Your cooperation with us is appreciated.

Sincerely,

Kathy Dolce Modes
Health Physicist
Nuclear Materials Safety Branch 2
Division of Nuclear Materials Safety

Enclosure:
Amendment No. 43

cc:
Joyce Kuykendall, Radiation Safety Officer

NRC FORM 374 U.S. NUCLEAR REGULATORY COMMISSION

Amendment No. 43

MATERIALS LICENSE

Licensee

1. Department of the Army
   U.S. Army Soldier and Biological Chemical Command

2. AMSSB-RCB-RSR
   5905 Putnam Road
   Ft. Belvoir, Virginia 22060-5448

3. License number 45-00953-01

4. Expiration date Not Applicable

5. Docket No. 030-08511
   Reference No. 19-10306-02

In accordance with the letter dated April 2, 2004, this license is hereby terminated.

For the U.S. Nuclear Regulatory Commission

Date July 28, 2004

By

Kathy Dolce Modes
Nuclear Materials Safety Branch 2
Division of Nuclear Materials Safety
Region I
King of Prussia, Pennsylvania 19406

78864305

NRC FORM 374 U.S. NUCLEAR REGULATORY COMMISSION PAGE 1 OF 1 PAGES

Amendment No. 43

MATERIALS LICENSE

Licensee

1. Department of the Army
   U.S. Army Soldier and Biological Chemical Command

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   5905 Putnam Road
   Ft. Belvoir, Virginia 22060-5448

3. License number 45-00953-01

4. Expiration date Not Applicable

5. Docket No. 030-06511
   Reference No. 19-10306-02

In accordance with the letter dated April 2, 2004, this license is hereby terminated.

For the U.S. Nuclear Regulatory Commission

Date July 28, 2004

By *Original signed by Kathy Dolce Modes*

Kathy Dolce Modes
Nuclear Materials Safety Branch 2
Division of Nuclear Materials Safety
Region I
King of Prussia, Pennsylvania 19406

78964305

NRC FORM 374 U.S. NUCLEAR REGULATORY COMMISSION PAGE 1 OF 6 PAGES

MATERIALS LICENSE

Pursuant to the Atomic Energy Act of 1954, as amended, the Energy Reorganization Act of 1974 (Public Law 93-438), and Title 10, Code of Federal Regulations, Chapter I, Parts 30, 31, 32, 33, 34, 35, 36, 39, 40, and 70, and in reliance on statements and representations heretofore made by the licensee, a license is hereby issued authorizing the licensee to receive, acquire, possess, and transfer byproduct, source, and special nuclear material designated below; to use such material for the purpose(s) and at the place(s) designated below; to deliver or transfer such material to persons authorized to receive it in accordance with the regulations of the applicable Part(s). This license shall be deemed to contain the conditions specified in Section 183 of the Atomic Energy Act of 1954, as amended, and is subject to all applicable rules, regulations, and orders of the Nuclear Regulatory Commission now or hereafter in effect and to any conditions specified below.

Licensee

1. Department of the Army
U.S. Army Research, Development and Engineering Command (RDECOM)

2. ATTN: AMSRD-MSF
5183 Blackhawk Road
Aberdeen Proving Ground, Maryland 21010-5424

3. License number 19-10305-02

4. Expiration date September 30, 2010

5. Docket No. 030-36574
Reference No. 45-00953-01/03008511

6. Byproduct, source, and/or special nuclear material	7. Chemical and/or physical form	8. Maximum amount that licensee may possess at any one time under this license
A. Any byproduct material with atomic numbers 5-95, inclusive	A. Sealed, plated or foil sources and gas or liquid sources in sealed or closed containers.	A. Not to exceed 185 gigabecquerels (GBq) [5 curies (Ci)] per radionuclide and 370 GBq (10 Ci) total
B. Hydrogen 3	B. Sealed luminous sources	B. Not to exceed 925 GBq (25 Ci) per source and 18.5 terabecquerels (TBq) [500 curies] total
C. Any byproduct material with atomic numbers 1-96	C. Any	C. Not to exceed 370 megabecquerels (MBq) [10 millicuries (mCi)] per radionuclide and 3.7 GBq (100 mCi) total except as specified in Condition 20
D. Any special nuclear material	D. Any	D. Not to exceed 370 kilobecquerels (kBq) [10 microcuries (uCi)] per radionuclide and 3.7 MBq (100 uCi) total

MATERIALS LICENSE
SUPPLEMENTARY SHEET

License Number
19-10308-02

Docket or Reference Number
030-36574
45-00953-01/03006511

9. Authorized use:

A. and B. Research and development as defined in 10 CFR 30.4; teaching and training of students; calibration and checking of the licensee's instruments; and demonstration of items being developed and/or tested. Preparation of low level counting standards. Quality control and prototype testing of manufactured items utilizing licensed materials.

C. and D. Taking of, and analysis of, leak and wipe samples from Department of Army radioactive commodities.

CONDITIONS

10. Licensed material may be used or stored at the licensee's facilities located at U.S. Army Research Development and Engineering Command, Fort Belvoir, Virginia and at temporary job sites of the licensee anywhere in the United States.

11. A. Licensed material shall only be used by, or under the supervision of, individuals designated, in writing, by the Radiation Safety Committee. The licensee shall maintain records of individuals designated as users for 3 years following the last use of licensed material by the individual.

B. The Radiation Safety Officer for this license is Joyce E. Kuykendall.

12. The licensee shall not use licensed material in or on human beings.

13. The licensee shall not use licensed material in field applications where it is released except as provided otherwise by specific condition of this license.

14. A. Sealed sources shall be tested for leakage and/or contamination at intervals not to exceed the intervals specified in the certificate of registration issued by the U.S. Nuclear Regulatory Commission under 10 CFR 32.210 or under equivalent regulations of an Agreement State.

B. Notwithstanding Paragraph A of this Condition, sealed sources designed to primarily emit alpha particles shall be tested for leakage and/or contamination at intervals not to exceed 3 months.

C. Each sealed source fabricated by the licensee shall be inspected and tested for construction defects, leakage, and contamination prior to any use or transfer as a sealed source.

MATERIALS LICENSE
SUPPLEMENTARY SHEET

License Number
19-10306-02

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D. In the absence of a certificate from a transferor indicating that a leak test has been made within the intervals specified in the certificate of registration issued by the U.S. Nuclear Regulatory Commission under 10 CFR 32.210 or under equivalent regulations of an Agreement State, prior to the transfer, a sealed source received from another person shall not be put into use until tested and the test results received.

E. Sealed sources need not be tested if they contain only hydrogen-3; or they contain only a radioactive gas; or the half-life of the isotope is 30 days or less; or they contain not more than 100 microcuries of beta- and/or gamma-emitting material or not more than 10 microcuries of alpha-emitting material.

F. Sealed sources need not be tested if they are in storage and are not being used; however, when they are removed from storage for use or transferred to another person and have not been tested within the required leak test interval, they shall be tested before use or transfer. No sealed source shall be stored for a period of more than 10 years without being tested for leakage and/or contamination.

G. The leak test shall be capable of detecting the presence of 0.005 microcurie (185 becquerels) of radioactive material on the test sample. If the test reveals the presence of 0.005 microcurie (185 becquerels) or more of removable contamination, a report shall be filed with the U.S. Nuclear Regulatory Commission in accordance with 10 CFR 30.50(c)(2); and the source shall be removed immediately from service and decontaminated, repaired, or disposed of in accordance with Commission regulations.

H. Tests for leakage and/or contamination, including leak test sample collection and analysis, shall be performed by the licensee or by other persons specifically licensed by the U.S. Nuclear Regulatory Commission or an Agreement State to perform such services.

I. Records of leak test results shall be kept in units of microcuries and shall be maintained for 5 years.

15. Sealed sources or detector cells containing licensed material shall not be opened or sources removed from source holders by the licensee.

16. The licensee shall conduct a physical inventory every six months, or at other intervals approved by the U.S. Nuclear Regulatory Commission, to account for all sources and/or devices received and possessed under the license. Records of inventories shall be maintained for 5 years from the date of each inventory and shall include the radionuclides, quantities, manufacturer's name and model numbers, and the date of the inventory.

MATERIALS LICENSE
SUPPLEMENTARY SHEET

License Number: 19-10306-02
Docket or Reference Number: 030-36574 45-00953-01/03006511

17. Maintenance, repair, cleaning, replacement, and disposal of foils contained in detector cells shall be performed only by the device manufacturer or other persons specifically authorized by the U.S. Nuclear Regulatory Commission or an Agreement State to perform such services.

18. A. Detector cells containing a titanium tritide foil or a scandium tritide foil shall only be used in conjunction with a properly operating temperature control mechanism which prevents the foil temperatures from exceeding that specified in the certificate of registration referred to in 10 CFR 32.210.

B. When in use, detector cells containing a titanium tritide foil or a scandium tritide foil shall be vented to the outside.

20. In addition to the possession limits in item 8, the licensee shall further restrict the possession of licensed material to quantities below the limit specified in 10 CFR 30.35(d) or 40.36(b) or 70.25(d) for establishing decommissioning financial assurance.

21. Radioactive waste possessed under this license shall be stored in accordance with the statements, representations, and procedures included with the licensee's waste storage plan described in the application dated March 31, 1998.

22. The licensee is authorized to transport licensed material in accordance with the provisions of 10 CFR Part 71, "Packaging and Transportation of Radioactive Material."

NRC FORM 374A U.S. NUCLEAR REGULATORY COMMISSION

License Number
19-10306-02

Docket or Reference Number
030-36574
45-00953-01/03006511

MATERIALS LICENSE
SUPPLEMENTARY SHEET

23. Except as specifically provided otherwise in this license, the licensee shall conduct its program in accordance with the statements, representations, and procedures contained in the documents, including any enclosures, listed below. The U. S. Nuclear Regulatory Commission's regulations shall govern unless the statements, representations, and procedures in the licensee's application and correspondence are more restrictive than the regulations.

A. Application dated March 31, 1989.

B. Belvoir R & D Center Regulation 385-11 dated July 26, 1988.

C. Letters dated:
1) April 10, 1990
2) February 2, 1994
3) March 3, 1994 [extend expiration date]
4) August 5, 1997 and June 1, 1998 [mailing address change and appointment of new RSO]
5) December 24, 1997 [fax clarifying mailing address change]
6) February 5, 1999 [change address; add alt. RSO (R. Bhat); change H-3 bioassay freq; change use rooms (Rms. 8, 016, 009 of Bldg 329, and change Bldgs 304 and 363C to 7304 and 7365]
7) February 26, 1999 [additional information clarifying items requested in 2/5/99 letter]
8) November 22, 1999 [final survey report to support release of Bldgs 363 and 7365C]
9) June 9, 2000 [renewal]
10) August 22, 2000 [fax describing leak test procedures]
11) May 8, 2001 [add location of use (Aberdeen); change RSO (J. Kuykendall); delete alt. RSOs (R. Bhat and L. Bender)]
12) December 7, 2001 [e-mail clarifying L/C 10 description]
13) April 3, 2003 [remove location of use (Aberdeen)]
14) April 2, 2004 [change licensee address from Ft. Belvoir to RDECOM, APG, Maryland]

For the U.S. Nuclear Regulatory Commission

Date July 28, 2004

By Kathy Dolce Modes

Kathy Dolce Modes
Nuclear Materials Safety Branch 2
Division of Nuclear Materials Safety
Region I
King of Prussia, Pennsylvania 19406

78970111

NUCLEAR MATERIALS LICENSE NO. 19-10306-02

June 29, 2005

Brigadier General Roger A. Nadeau
Department of the Army
U.S. Army Research Development and Engineering Command
5183 Blackhawk Road
Aberdeen Proving Ground, MD 21010-5424

SUBJECT: AMENDMENT NO. 2 TO SOURCE MATERIAL LICENSE NO. 19-10306-02 AUTHORIZING DECOMMISSIONING OF BUILDING 7304 AT FORT BELVOIR (TAC NO. L52638)

Dear Brigadier General Nadeau:

I am responding to the letter from Major General John Doesburg, dated May 17, 2004, requesting that the U.S. Nuclear Regulatory Commission (NRC) amend Material License No. 19-10306-02 to place Building 7304 into an active decommissioning status. The NRC staff has evaluated the Army's request and has developed an environmental assessment (EA) (See ADAMS ML050630024) to support the review of the Army's proposed decommissioning plan and license amendment request, in accordance with the requirements of 10 CFR Part 51. Based on the staff evaluation, the conclusion of the EA is a Finding of No Significant Impact (FONSI) on human health and the environment for the proposed licensing action. A Safety Evaluation Report was also prepared for this licensing action and is included as an attachment. Approval of this decommissioning plan by the NRC does not relieve you from complying with other applicable Federal, State, and local regulations governing the decommissioning and remediation of this facility.

Enclosed is License No. 19-10306-02, Amendment No. 2, authorizing the decommissioning of Building 7304. The authorized use under this license is changed to read:

9. Authorized use:

   For activities related to decommissioning and characterization of contaminated facilities, equipment, and land, and maintenance of control over licensed materials in accordance with statements, representations, and conditions contained in the application submitted by letter dated May 17, 2004, and supplemented by a letter dated Nov. 1, 2004 (regarding a change in the licensing official).

No other use of radioactive materials is authorized under the current license amendment. License conditions 10, 12, 13, 14, 15, 17, 18, and 23 are deleted from the license. All other license conditions shall remain the same.

If you have any questions, please contact Tom McLaughlin, of my staff at (301) 415-5869.

Sincerely,

/RA/

Daniel M. Gillen, Deputy Director
Decommissioning Directorate
Division of Waste Management
and Environmental Protection
Office of Nuclear Material Safety
and Safeguards

Docket No.: 030-36574
License No.: 19-10306-02

Enclosures:
1. Amendment No. 2 to License 19-10306-02
2. Safety Evaluation Report

No other use of radioactive materials is authorized under the current license amendment. License conditions 10, 12, 13, 14, 15, 17, 18, and 23 are deleted from the license. All other license conditions shall remain the same.

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Docket No.: 030-36574
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1. Amendment No. 2 to License 19-10306-02
2. Safety Evaluation Report

DISTRIBUTION:
DCD r/f BSmith OGC

ML050960044 *See previous concurrence

OFC	DWMEP:PM	DWMEP:SC	OGC	DWMEP:DD
NAME	TMcLaughlin*	KGruss*	STreby	DGillen
DATE	04/13/05	0413/05	06/15/05	06/28/05

OFFICIAL RECORD COPY

ENCLOSURE 1

2

MATERIALS LICENSE

Pursuant to the Atomic Energy Act of 1954, as amended, the Energy Reorganization Act of 1974 (Public Law 93-438), and Title 10, Code of Federal Regulations, Chapter I, Parts 30, 31, 32, 33, 34, 35, 36, 39, 40, and 70, and in reliance on statements and representations heretofore made by the licensee, a license is hereby issued authorizing the licensee to receive, acquire, possess, and transfer byproduct, source, and special nuclear material designated below; to use such material for the purpose(s) and at the place(s) designated below; to deliver or transfer such material to persons authorized to receive it in accordance with the regulations of the applicable Part(s). This license shall be deemed to contain the conditions specified in Section 183 of the Atomic Energy Act of 1954, as amended, and is subject to all applicable rules, regulations, and orders of the Nuclear Regulatory Commission now or hereafter in effect and to any conditions specified below.

Licensee	
1. Department of the Army U.S. Army Research, Development and Engineering Command (RDECOM)	3. License number 19-10306-02
2. ATTN: AMSRD-MSF 5183 Blackhawk Road Aberdeen Proving Ground, Maryland 21010-5424	4. Expiration date September 30, 2010 5. Docket No. 030-36574 Reference No. 45-00953-01/03006511

6. Byproduct, source, and/or special nuclear material	7. Chemical and/or physical form	8. Maximum amount that licensee may possess at any one time under this license
A. Any byproduct material with atomic numbers 5-95, inclusive	A. Sealed, plated or foil sources and gas or liquid sources in sealed or closed containers	A. Not to exceed 185 gigabecquerels (GBq) [5 curies (Ci)] per radionuclide and 370 GBq (10 Ci) total
B. Hydrogen 3	B. Sealed luminous sources	B. Not to exceed 925 GBq (25 Ci) per source and 18.5 terabecquerels (TBq) [500 curies] total
C. Any byproduct material with atomic numbers 1-96	C. Any	C. Not to exceed 370 megabecquerels (MBq) [10 millicuries (mCi)] per radionuclide and 3.7 GBq (100 mCi) total except as specified in Condition 20
D. Any special nuclear material	D. Any	D. Not to exceed 370 kilobecquerels (kBq) [10 microcuries (uCi)] per radionuclide and 3.7 MBq (100 uCi) total

MATERIALS LICENSE
SUPPLEMENTARY SHEET

License Number
19-10306-02

Docket or Reference Number
030-36574
45-00953-01/03006511

2

9. Authorized use:

For activities related to decommissioning and characterization of contaminated facilities, equipment, and land, and maintenance of control over licensed materials in accordance with statements, representations, and conditions contained in the application submitted by letter dated May 17, 2004, and supplemented by a letter dated Nov. 1, 2004 (regarding a change in the licensing official)

CONDITIONS

10. Deleted by this Amendment

11. The licensee shall maintain records of individuals designated as users for 3 years following the last use of licensed material by the individual.

12. Deleted by this Amendment

13. Deleted by this Amendment

14. Deleted by this Amendment

15. Deleted by this Amendment

16. The licensee shall conduct a physical inventory every six months, or at other intervals approved by the U.S. Nuclear Regulatory Commission, to account for all sources and/or devices received and possessed under the license. Records of inventories shall be maintained for 5 years from the date of each inventory and shall include the radionuclides, quantities, manufacturer's name and model numbers, and the date of the inventory.

17. Deleted by this Amendment

18. Deleted by this Amendment

19. Moved to License Condition 23 when license was reissued as 19-10306-02 on July 28, 2004.

20. In addition to the possession limits in Item 8, the licensee shall further restrict the possession of licensed material to quantities below the limit specified in 10 CFR 30.35(d) or 40.36(b) or 70.25(d) for establishing decommissioning financial assurance.

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MATERIALS LICENSE **SUPPLEMENTARY SHEET**		License Number 19-10306-02
		Docket or Reference Number 030-36574 45-00953-01/03006511
		2

21. Radioactive waste possessed under this license shall be stored in accordance with the statements, representations, and procedures included with the licensee's waste storage plan described in the application dated March 31, 1989.

22. The licensee is authorized to transport licensed material in accordance with the provisions of 10 CFR Part 71, "Packaging and Transportation of Radioactive Material."

23. Deleted by this Amendment

For the U.S. Nuclear Regulatory Commission

Date _____ By _____

Daniel M. Gillen, Deputy Director
Decommissioning Directorate
Division of Waste Management
and Environmental Protection
Office of Nuclear Material Safety
and Safeguards

ENCLOSURE 2

DOCKET NO: 030-36574

LICENSE NO: 19-10306-02

FACILITY: FORT BELVOIR, VIRGINIA

SUBJECT: SAFETY EVALUATION REPORT FOR DECOMMISSIONING OF BUILDING 7304 AT FORT BELVOIR, VA (TAC #52638)

1. EXECUTIVE SUMMARY

In a letter dated May 24, 2004, the U.S. Army Research Development and Engineering Command, (the licensee) forwarded a Decommissioning Plan (DP) (See ADAMS ML041490071) for Building 7304 at its Fort Belvoir, VA facility, for U.S. Nuclear Regulatory Commission (NRC) staff review and approval. The decommissioning objective of the licensee is unrestricted use as defined in the License Termination Rule (LTR), as Subpart E to 10 Code of Federal Regulations (CFR) Part 20. For the decommissioning of Building 7304, a dose objective of 25 mrem/year (0.25 mSv/year) above background is the basis for demonstrating that the site can be released for unrestricted use.

The purpose of this safety evaluation report (SER) is to (1) evaluate the licensee's proposed request to remediate Building 7304 and the soil beneath the building floor, to determine whether unrestricted release criteria will be met and (2) decide if decommissioning activities will be conducted in a safe manner in accordance with NRC regulations. This safety evaluation has been developed in conjunction with an environmental assessment (EA) (See ADAMS ML050810012) which evaluates the potential environmental impacts associated with this action. If this action is approved, the licensee would remediate Building 7304 using the methods and criteria proposed in the May 2004 DP.

The decommissioning activities include the demolition and removal of Building 7304 structure, concrete foundation, subsurface drainage system, and any soils impacted above the radiological screening criteria published by NRC in the Federal Register. There will be no liquid effluents released during the decommissioning activities and no concern about the potential for groundwater contamination.

2. FACILITY OPERATING HISTORY

NRC staff has reviewed the information in the Facility Operating History section of the DP for Building 7304, license number 19-10306-02, located at Fort Belvoir, Virginia, according to the Consolidated NMSS Decommissioning Guidance, Volume 1, Section 16.2 (Facility Operating History). Based on this review, NRC staff has determined that the licensee has provided sufficient information to aid NRC staff in evaluating the licensee's determination of the radiological status of the facility and the licensee's planned decommissioning activities, to ensure that the decommissioning can be conducted in accordance with NRC requirements.

Radioactive materials were used in several other buildings at Fort Belvoir under the NRC license and have already been successfully decommissioned.

3. FACILITY DESCRIPTION

Building 7304 is a concrete bunker-style building measuring 12 feet by 16 feet enclosed within an earthen cover approximately 3 feet thick. The entire area to be remediated is approximately 500 square feet. This includes an additional 4 feet on three sides of the structure and approximately 60 square feet in the front of the building for the removal of the exterior walkway and shield wall. There is a floor drain that may discharge directly into the ground beneath the Building 7304 structure. The floor drain pipe, the exterior foundation drain, and the underlying soil will be surveyed and remediated upon building demolition and excavation. The licensee assumes that the removal of the drain line will not require activities in excess of shallow trenching.

Building 7304 has been used as a radioactive waste storage area in support of the Fort Belvoir research laboratory. All radioactive materials were removed from Building 7304 and transported to offsite facilities for disposal. A Form 314 was submitted to NRC (See ADAMS ML050120350) describing the disposition of all the removed waste material. A Characterization Survey (See ADAMS ML041490105) was performed on Building 7304 which showed elevated levels of tritium, carbon-14, cesium-137, promethium-147, americium-241, and thorium-232. Elevated levels of radioactivity were detected at the interior of Building 7304 floor, the soil beneath the floor, at wall storage vaults, and at floor storage vaults. These elevated levels indicate the need for the removal of the Building 7304 structure and any underlying soil with concentrations above the soil screening criteria, then transport of building materials (or debris) and soil to an authorized disposal facility.

4. RADIOLOGICAL STATUS OF FACILITY

NRC staff has reviewed the information in the Facility Radiological Status section of the DP for Building 7304 according to the Consolidated NMSS Decommissioning Guidance, Volume 1, Section 16.4 (Facility Radiological Status). Based on this review, NRC staff has determined that the licensee has described the types and activity of radioactive material contamination at its facility sufficiently to allow the NRC staff to evaluate the potential safety issues associated with remediating the facility, whether the remediation activities and radiation control measures proposed by the licensee are appropriate for the type of radioactive material present at the facility, and whether the licensee's waste management practices are appropriate.

5. DOSE MODELING

The staff has reviewed the dose modeling analyses for the removal of Building 7304 and soil impacted above the soil screening guidelines as part of the review of the Army's DP, using the Consolidated NMSS Decommissioning Guidance, Volume 2, Section 5.1.2 (Surface Soil Evaluation Criteria). The staff concludes that the dose estimate calculated using the default screening analysis is appropriate for the decommissioning option and exposure scenario assumed. In addition, this dose estimate provides reasonable assurance that the dose criterion in 10 CFR 20.1402 will be met. This conclusion is based on the modeling effort performed by the staff in initially developing the default screening analysis.

In determining the dose to the average member of the critical group, the licensee has used the assumptions inherent in the screening analysis and the parameter uncertainties have been previously evaluated on a generic basis by the staff as part of establishing the default screening analysis.

6. PLANNED DECOMMISSIONING ACTIVITIES

NRC staff has reviewed the decommissioning activities described in the DP for Building 7304 according to the Consolidated NMSS Decommissioning Guidance, Volume 1, Section 17.1 (Planned Decommissioning Activities). Based on this review, NRC staff has determined that the licensee has provided sufficient information to allow the NRC staff to evaluate the licensee's planned decommissioning activities. The NRC staff concludes that the decommissioning can be conducted in accordance with NRC requirements.

7. PROJECT MANAGEMENT AND ORGANIZATION

NRC staff has reviewed the description of the decommissioning project management organization, position descriptions, management and safety position qualification requirements and the manner in which the licensee will use contractors during the decommissioning of its facility according to the Consolidated NMSS Decommissioning Guidance, Volume 1, Section 17.2 (Project Management and Organization). Based on this review, NRC staff has determined that the licensee has provided sufficient information to allow the NRC staff to evaluate the licensee's decommissioning project management organization and structure. The NRC staff concludes that the decommissioning can be conducted safely and in accordance with NRC requirements.

8. HEALTH AND SAFETY PROGRAM DURING DECOMMISSIONING

8.1 Radiation Safety Controls and Monitoring for Workers

8.1.1 Workplace Air Sampling Program

NRC staff has reviewed the Workplace Air Sampling Program information in the DP for Building 7304 according to the Consolidated NMSS Decommissioning Guidance, Volume 1, Section 17.3.1.1 (Workplace Air Sampling Program). Based on this review, NRC staff has determined that the licensee has provided sufficient information on: the frequency of air samples taken in work areas, the types of air sampling equipment to be used and where they will be located in the work areas, calibration of flow meters, minimum detectable activities (MDA) of equipment to be used for analysis of radionuclides collected during air sampling, and action levels for airborne radioactivity (and corrective actions to be taken when these levels are exceeded). The NRC staff concludes that the licensee's air sampling program will comply with 10 CFR 20.1204, 20.1501(a)-(b), 20.1502(b), 20.1703, and Regulatory Guide 8.25.

8.1.2 Respiratory Protection Program

NRC staff has reviewed the Respiratory Protection Program information in the DP for Building 7304 according to the Consolidated NMSS Decommissioning Guidance, Volume 1, Section 17.3.1.2 (Respiratory Protection Program). Based on this review, NRC staff has determined that the licensee has provided sufficient information to implement an acceptable respiratory protection program. The NRC staff concludes that the licensee's program will comply with 10 CFR 20.1101, and 10 CFR 20.1701 to 20.1704 and Appendix A of 10 CFR Part 20.

8.1.3 Internal Exposure Determination

NRC staff has reviewed the Internal Exposure information in the DP for Building 7304 according to the Consolidated NMSS Decommissioning Guidance, Volume 1, Section 17.3.1.3 (Internal Exposure Determination). Based on this review, NRC staff has determined that the licensee has provided sufficient information on methods to calculate internal dose of a worker based upon measurements from air samples or bioassay samples. The NRC staff concludes that the licensee's program to determine internal exposure will comply with 10 CFR 20.1101, 20.1201, 20.1204 and 20.1502.

8.1.4 External Exposure Determination

NRC staff has reviewed the External Exposure information in the DP for Building 7304 according to the Consolidated NMSS Decommissioning Guidance, Volume 1, Section 17.3.1.4 (External Exposure Determination). Based on this review, NRC staff has determined that the licensee has provided sufficient information on methods to measure or calculate the external dose of a worker. The NRC staff concludes that the licensee's program to determine external exposure will comply with the requirements of 10 CFR 20.1101, 20.1201, 20.1203, 20.1501, 20.1502 and 20.1601.

8.1.5 Summation of Internal and External Exposures

NRC staff has reviewed the Summation of Internal and External Exposures information in the DP for Building 7304 according to the Consolidated NMSS Decommissioning Guidance, Volume 1, Section 17.3.1.5 (Summation of Internal and External Exposures). Based on this review, NRC staff has determined that the licensee has provided sufficient information on its program for summation of internal and external exposures. The NRC staff concludes that the licensee's program will comply with the requirements of 10 CFR 20.1202, 20.1208 and 20.2106.

8.1.6 Contamination Control Program

NRC staff has reviewed the Contamination Control Program information in the DP for Building 7304 according to the Consolidated NMSS Decommissioning Guidance, Volume 1, Section 17.3.1.6 (Contamination Control Program). Based on this review, NRC staff has determined that the licensee has provided sufficient information to control contamination on skin, on protective and personal clothing, on fixed and removable contamination on work surfaces, on transport vehicles, on equipment, and on packages. The NRC staff concludes that the licensee's contamination control program will comply with 10 CFR 20.1501, 20.1702, 20.1906.

8.1.7 Instrumentation Program

NRC staff has reviewed the Instrumentation Program information in the DP for Building 7304 according to the Consolidated NMSS Decommissioning Guidance, Volume 1, Section 17.3.1.7 (Instrumentation Program). Based on this review, NRC staff has determined that the licensee has provided sufficient information on the sensitivity and the calibration of instruments and equipment to be used to make quantitative measurements of ionizing radiation during surveys. The NRC staff concludes that the licensee's instrumentation program will comply with 10 CFR 20.1501.

8.2 Nuclear Criticality Safety

NRC staff has reviewed the Nuclear Criticality Safety information in the DP for Building 7304 according to the definition of Special Nuclear Material found in 10 CFR 70.4. Based on this review, NRC staff has determined that the licensee has provided sufficient information and concludes that the radionucides identified at the site will not trigger or sustain a critical reaction.

8.3 Health Physics Audits and Recordkeeping Program

NRC staff has reviewed the description of the licensee's audit and recordkeeping program which the licensee will utilize during the decommissioning of its facility according to the Consolidated NMSS Decommissioning Guidance, Volume 1, Section 17.3.3 (Health Physics Audits, Inspections, and Recordkeeping Program). Based on this review, NRC staff has determined that the licensee has provided sufficient information to allow the NRC staff to evaluate the licensee's executive management and radiation safety officer (RSO) audit and recordkeeping program to determine if the decommissioning can be conducted safely and in accordance with NRC requirements (10 CFR 20.1101 and 20.2102).

9. ENVIRONMENTAL MONITORING AND CONTROL PROGRAM

NRC staff has reviewed the Environmental Monitoring and Control Program information in the DP for Building 7304 according to the Consolidated NMSS Decommissioning Guidance, Volume 1, Section 17.4 (Environmental Monitoring and Control Program). Based on this review, NRC staff has determined that the licensee has provided sufficient information on its environmental ALARA evaluation program, effluent monitoring program, and effluent control program. The NRC staff concludes that the licensee will comply with 10 CFR 20.

10. RADIOACTIVE WASTE MANAGEMENT PROGRAM

NRC staff has reviewed the Radioactive Waste Management Program information in the DP for Building 7304 according to the Consolidated NMSS Decommissioning Guidance, Volume 1, Section 17.5 (Radioactive Waste Management Program). Based on this review, NRC staff has determined that the licensee's programs for the management of radioactive waste generated during decommissioning operations ensure that the waste will be managed in accordance with NRC requirements (10 CFR Part 20, Subpart K, 10 CFR 61.55, 61.56, 61.57 and 71.5) and in a manner that is protective of public health and safety.

11. QUALITY ASSURANCE PROGRAM

NRC staff has reviewed the Quality Assurance Program in the DP for Building 7304 according to the Consolidated NMSS Decommissioning Guidance, Volume 1, Section 17.6 (Quality Assurance Program). Based on this review, NRC staff has determined that the licensee's Quality Assurance Program is sufficient to ensure that information submitted to support the decommissioning of its facility should be of sufficient quality. The NRC staff concludes that the licensee's planned decommissioning activities can be conducted in accordance with NRC requirements contained in 10 CFR 30.63(g)(4)(ii), 40.42(g)(4)(ii), 40.28(b)(3), 70.22(f), 70.38(g)(4)(ii), and 72.54(g)(6).

12. FACILITY RADIATION SURVEYS

12.1 Release Criteria

NRC staff has reviewed the Release Criteria information in the Final Status Survey Plan (an appendix in the DP) for Building 7304 according to the Consolidated NMSS Decommissioning Guidance, Volume 2, Section 4.1 (Release Criteria). Based on this review, NRC staff has determined that the licensee has adequately summarized the DCGLs and area factors used for survey design and for demonstrating compliance with the radiological criteria for license termination.

12.2 Characterization Surveys

NRC staff has reviewed the information in the Characterization Survey (an appendix in the DP) for Building 7304 according to the Consolidated NMSS Decommissioning Guidance, Volume 2, Section 4.2 (Characterization Surveys). This review has determined that the radiological characterization of the site is adequate to: permit planning for remediation that will be effective and will not endanger the workers, demonstrate that it is unlikely that significant quantities of residual radioactivity have not gone undetected, and provide information that will be used to design the final status survey.

12.3 Final Status Survey Design

NRC staff has reviewed the information in the Final Status Survey Plan (an appendix in the DP) for Building 7304 according to the Consolidated NMSS Decommissioning Guidance, Volume 2, Section 4.4 (Final Status Survey Design). Based on this review, NRC staff has determined that the licensee's final status survey design is adequate to demonstrate compliance with the radiological criteria for license termination contained in 10 CFR 20.1501(a), 30.36(g)(4)(iv), 40.42(g)(4)(iv), 70.38(g)(4)(iv), and 72.54(g)(4).

STATE CONSULTATION

The Virginia Department of Environmental Protection was notified of the proposed decommissioning of Building 7304 and it did not object.

CONCLUSIONS

Based on the considerations discussed above, the NRC staff concludes that: (1) there is reasonable assurance that the health and safety of the public will not be endangered by the proposed decommissioning activities; and (2) such activities will be conducted in compliance with NRC regulations.

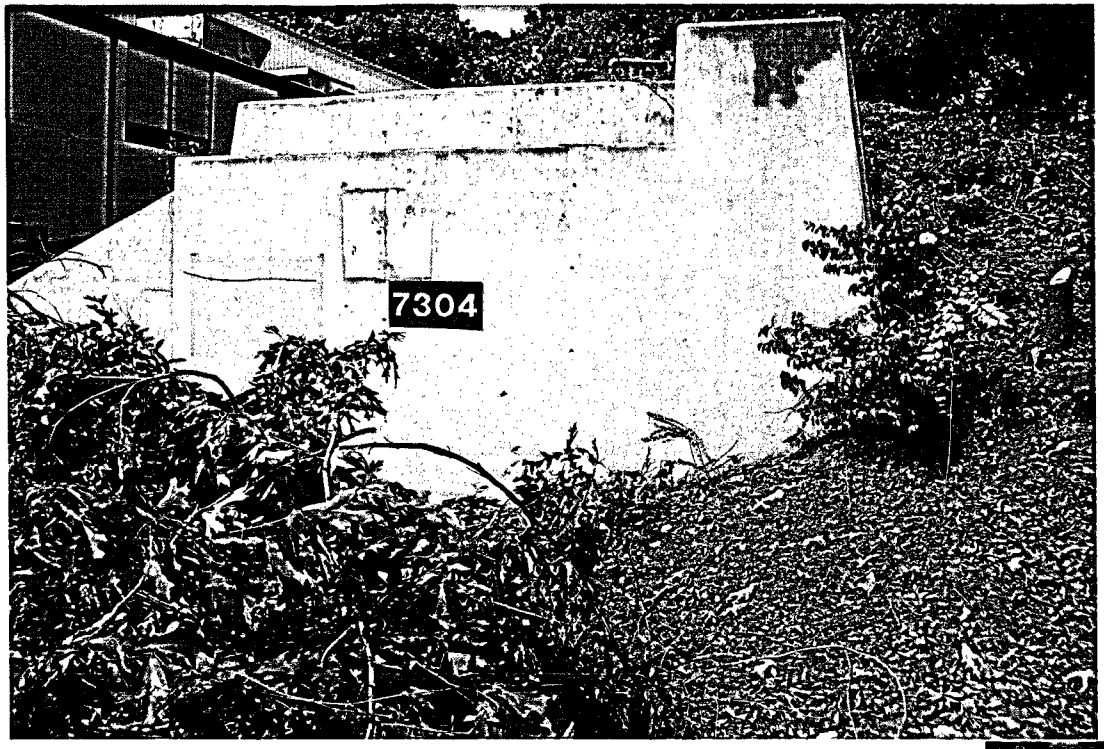
REFERENCES

1. 10 CFR Part 20, License Termination Rule. "Radiological Criteria for License Termination." June 1997.

2. NUREG-1757, Volume 1, Revision 1. "Consolidated NMSS Decommissioning Guidance: Decommissioning Process for Materials Licensees." September, 2003.

3. NUREG-1757, Volume 2. "Consolidated NMSS Decommissioning Guidance: Characterization, Survey, and Determination of Radiological Criteria." September, 2003.

APPENDIX B
SITE PHOTOGRAPHS

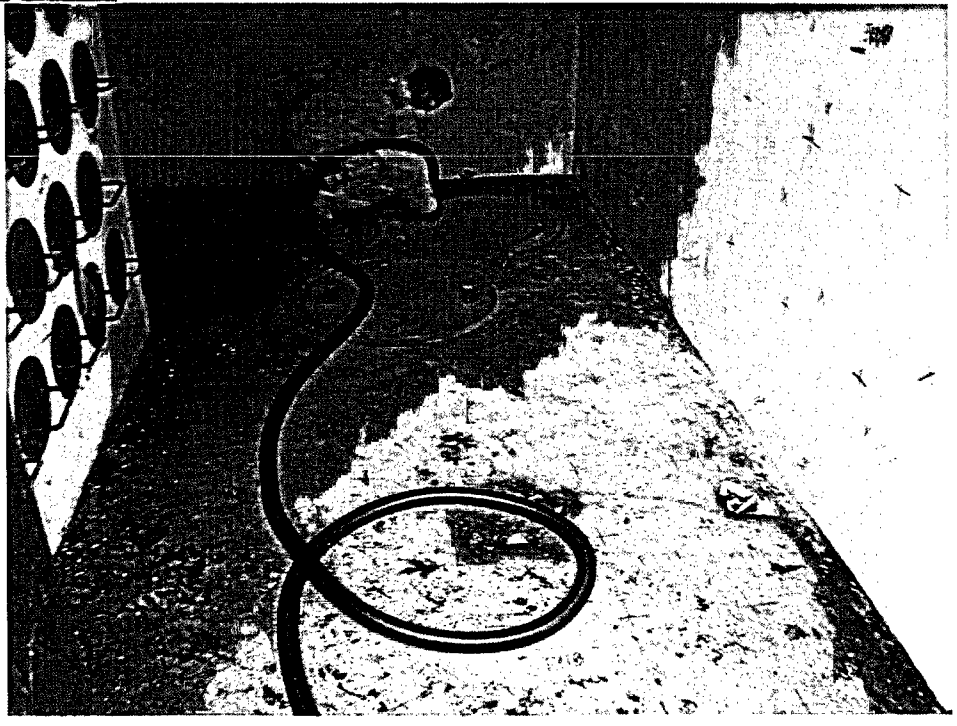


Exterior of Vault

Retaining Wall Pre-demolition

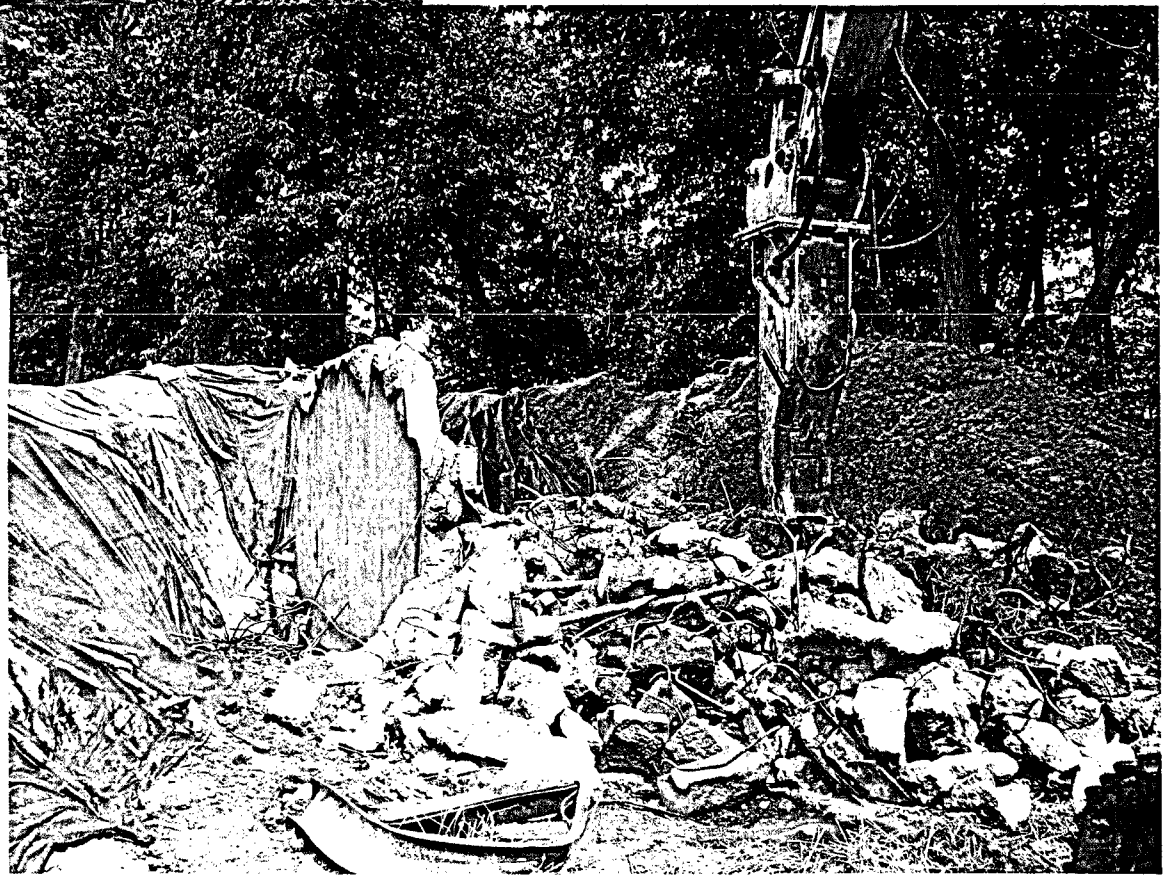
Vault Interior Pre-demolition

Note contaminated wall storage and manhole covers over subgrade storage pits



Exterior of Vault

Retaining wall and earthen cover



Building 7304 Vault

Structure during demolition

APPENDIX C
RECORDS OF WASTE SHIPMENT AND DISPOSAL FACILITY RECEIPT (TO BE PROVIDED)

ENVIROCARE OF UTAH, LLC
SAFE AND SECURE

RADIOACTIVE WASTE PROFILE RECORD

EC-0230, Revision 5

A. GENERATOR AND WASTE STREAM INFORMATION

GENERAL: Complete this form for one waste stream. Contact Envirocare at (801) 532-1330 if you have any questions while completing this form. Please indicate "N/A" if a category does not apply.

1. GENERATOR INFORMATION

Generator Name: US Army Garrison - Ft. Belvoir EPA ID #:

Generator Contact: Patrick McLaughlin Title: Chief, Environmental and Natural Resources Division

Mailing Address: 9430 Jackson Loop, Suite 107, Fort Belvoir, VA 22060-5116

Utah Site Access Permit #: 0209001622

Phone: 703 806 3193 Fax: Email: patrick.mclaughlin@us.army.mil

Contractor Name: Cabrera Services Location of Waste (City, State): Ft. Belvoir, Virginia

Name & Title of Person Completing Form: Peter Garger Project Manager Phone: 410 332-8177 x17 Email: pgarger@cabreraservices.com

2. WASTE STREAM INFORMATION

Waste Stream ID: 3116-01 Waste Stream Name: demolition debris Ft Belvoir Vault 7304 State of Origin: VA

Revision: 0 Date: 8/8/05 Volume (ft³): 2916 Delivery Date: approx 10/15/05

CHECK APPROPRIATE BOXES BELOW. Please verify the required forms requested below are completed and submitted with the Radioactive Waste Profile Record.

HAZARDOUS WASTE: Is the waste classified as hazardous waste as defined by 40 CFR 261?

N ☒ If NO, complete and attach the "Low-Level Radioactive Waste Certification Attachment".

Y ☐ If YES, complete and attach the "Hazardous Waste Certification Attachment" and check applicable box below.
Has the waste been treated to meet applicable treatment standards per 40 CFR 268? Y ☐ N ☐
Is the waste to be treated by Envirocare? Y ☐ N ☐

LOW-LEVEL RADIOACTIVE WASTE: Is the radioactive waste defined as Low-Level Radioactive Waste in accordance with the Low-Level Radioactive Waste Policy Amendments Act of 1985 or in DOE Order 435.1?

Y ☒ If YES, a current copy of a LLRW Compact Export letter authorizing export must be submitted if applicable. This authorization is applicable for non-DOE LLRW (i.e., Mixed Waste, NORM/NARM, 11e.(2) material, and waste from DOE do not require a Compact Export Letter).

N ☐ If NO, check appropriate box: NORM/NARM ☐ 11e.(2) Byproduct Material ☐ Other:

SPECIAL NUCLEAR MATERIAL: Does the waste stream contain material with uranium enriched in U-235 or any of the following radionuclides: U-233, Pu-236, Pu-238, Pu-239, Pu-240, Pu-241, Pu-242, Pu-243, or Pu-244?

Y ☐ N ☒ If Yes, complete and attach the "SNM Exemption Certification" form (EC-0230-SNM). Supporting statements, analytical results, and documentation must be included with the submittal.

PCB WASTE: Does the waste contain Polychlorinated Biphenyls (PCB) that are regulated for disposal per 40 CFR 761?

Y ☐ N ☒ If Yes, complete and attach the "PCB Waste Certification" form (EC-98279).

ASBESTOS: Does the waste contain Asbestos Containing Material?

Y ☐ N ☒ If Yes, Asbestos Containing Material must be managed in accordance with applicable federal regulations. Provide a detailed description of the waste containing asbestos in Section B.5 of the waste profile.

ENVIROCARE OF UTAH, LLC
SAFE AND SECURE

RADIOACTIVE WASTE PROFILE RECORD

EC-0230, Revision 5

B. WASTE PHYSICAL PROPERTIES & PACKAGE INFORMATION

1. GENERAL CHARACTERISTICS

Does the waste contain free liquids? Y ☐ N ☒ If Yes, what is the percent of free liquid by waste volume? ____ %

If Yes, is the liquid aqueous (water-based)? Y ☐ N ☐

Does the waste contain absorbent? Y ☐ N ☒ Density range of the waste: 50 - 150 g/cc ☐ lb/ft³ ☒

List percentage of waste type by volume: Soil 35 % Concrete & Metal 60 % DAW 5 % Resins ____ % Sludge ____ %

Other constituents and percentage by volume? ____

2. MATERIAL SIZE

Gradation of Material: Indicate the percentage of waste material that would pass through the following grid sizes. For example, 95% of the material would pass through a 12" square, 90% passes through a 4" square, 80% passes through a 1" square, etc.

12" 95 % 4" 20 % 1" 5 % 1/4" 0 % 1/40" 0 % 1/200" 0 %

Does the waste stream contain oversize debris (i.e., no dimension < 10 inches and any dimension > 12 feet)? Y ☐ N ☒
If Yes, include a detailed description (i.e., weight, size, drawings, etc.) of the oversize debris in the narrative of Section B.5.

3. MOISTURE CONTENT

For soil or soil-like materials, please use Std. Proctor Method ASTM D-698 to determine the optimum moisture content. The waste material must not exceed 3 percentage points above optimum moisture upon arrival at Envirocare's disposal facility unless approved by Envirocare.

Optimum Moisture Content: ____ % at Maximum Dry Density (lb/ft³): ____

Average Moisture Content: ____ % Moisture Content Range: ____ % - ____ %

N/A construction debris

4. WASTE SHIPPING & PACKAGING

Transportation Mode: ☐ Highway ☒ Rail

Shipping & Container Packages: (Check all that apply) ☐ Drums* (≤ 85 gallons) ☐ Boxes (≤ 100 ft³) ☐ Soft-Sided Bags (≤ 10 yd³)

☒ Intermodal ☐ Sealand ☐ Gondola** ☐ Box Car

Other:

*Palletized drums are preferred by the disposal site. Please specify in the "Other" field if drums will not be palletized.
**Dimensions of gondola railcars must be between 48 to 65 feet in length and 8.5 to 12.5 feet in height as measured from the top of the rail to the top of the railcar unless approved by Envirocare.

5. NARRATIVE DESCRIPTION AND HISTORY OF WASTE

Please submit a narrative description and history of the waste as an attachment to the Radioactive Waste Profile Record. This attachment should include the following:

- Process that generated the waste
- Waste material physical composition and characteristics
- Radiological and chemical characterization method
- Basis for determining manifested radionuclide concentrations
- Description and amounts of absorbents, if applicable
- Basis of non-hazardous or hazardous waste determinations
- Treatment processes, if applicable
- Product information or Material Safety Data Sheets associated with the waste as applicable
- Information requested in other sections of this form

Narrative Description and History of Waste
Fort Belvoir Vault 7304 Demolition

Ft. Belvoir Bldg 7304 Vault was used to store radioactive materials in support of the Ft. Belvoir research lab. CABRERA SERVICES, INC has been contracted by the US Army Field Support Command to perform decommissioning of the Vault. The Vault is concrete construction, bunker-style building enclosed within an earthen covering approximately 3 feet thick. All stored radioactive materials were removed and shipped to an off site disposal facility prior to the initiation of the characterization survey. Results of the characterization survey performed by CABRERA SERVICES, INC indicate the presence of elevated levels of tritium (H-3), carbon 14 (C-14), cesium 137 (Cs-137), promethium 147 (Pm-147), americium 241 (Am-241) and thorium 232 (Th-232). The extent of the radioactive contamination onsite is expected to be limited to the surface paint and concrete for most of the radionuclides present at the site. There is a possibility that the H-3 contamination has migrated into the concrete structure however the whole Vault will be demolished and shipped as Low Level Radioactive Waste (LLRW).

The scope of the decommissioning activities on the site will include the deconstruction and removal of the Vault structure, concrete foundation, subsurface drainage system associated with the Vault (including the exterior building drains, floor drains and piping), and soils impacted above the radiological screening guidelines. All debris generated will be sized to less than 10 inches to meet the Envirocare of Utah LLRW acceptance criteria.

Direct radioactivity measurements and smears were performed during the characterization survey on the interior walls, floor, ceiling, wall vaults, floor vaults, outside walkway, and outside shield wall. Alphanumeric grids were created, and surface scans were performed over 100% of the grids. The location of the highest activity was located within each grid, and biased integrated alpha and beta measurements and smears analyzed for alpha and beta activity were taken in this location. The attached table provides a summary of the maximum and average measurements of direct radiation readings and surface smears for each survey area. Direct radiation measurement action levels were exceeded at the following areas: interior vault floor, wall vaults, wall vault plugs, floor vaults and the exterior floor.

Regarding the interior vault floor, the fixed alpha action level of the interior vault floor was exceeded in three of 140 measurement locations, and the fixed beta action level was exceeded in three of 140 measurement locations. The integrated fixed low-energy beta activity measurements were not exceeded in any of the 140 interior vault floor measurement locations.

The fixed alpha action level was exceeded at all 74 measurement locations in the wall storage vaults, floor storage vaults, and on the wall storage vault plugs. The fixed beta action level was exceeded at one of the 74 measurement locations.

The fixed alpha action level was exceeded at six of 125 outside floor measurement locations. These locations are concentrated around the entrance to the vault.

Transferable radioactivity action levels were exceeded at the following areas: interior vault floor, wall vaults, and wall vault plugs. Regarding the interior vault floor, two alpha smear results exceeded the transferable alpha activity action level, and no beta smear results exceeded the transferable beta radioactivity action level. One smear was collected from each of 33 wall storage vaults and plugs. Of these smears, 17 alpha smear results exceeded the transferable alpha radioactivity action level, and no beta smear results exceeded the transferable beta radioactivity action level.

Three volumetric composite samples were collected and submitted to an offsite laboratory for gamma spectroscopy and H-3/C-14 analysis. One composite sample was collected from the wall vault, one from the interior vault floor and a third from the soil beneath the floor vaults. The wall vault composite sample consisted of loose material and chipped concrete from inside the wall storage vaults. The wall vault composite sample results were elevated for H-3 and C-14. The interior floor composite sample consisted of scrapings and loose material collected from the interior floor. The interior floor composite results were elevated for Cs-137, Pm-147, and Th-232 via Actinium -228 (Ac-228) progeny, Am-241 was slightly elevated. The floor vault soil sample was elevated for H-3, C-14 and Cs-137. The table below provides a summary of the radionuclides and activities present in the composite samples.

Sample	Nuclide	Activity (pCi/g)
Wall vault	H-3	50,800
	C-14	41
Floor vault	Cs-137	940
	Pm-147	8.1
	Th-232	23
	Am-241	0.08
Floor vault soil	H-3	123
	C-14	22
	Cs-137	63

The surface soil within the Vault area is a small hill comprised of the earthen covering for the bunker structure. The soil covering is approximately three ft. thick. A Gamma Walkover Survey (GWS) and volumetric soil sampling was performed in this area. Neither the GWS nor the volumetric soil sampling indicated any radioactivity above action levels.

A small amount of paint in the vault has been determined to be lead based. While this should not make the demolition debris hazardous for lead, TCLP lead analysis will be performed on several composite samples of demolition debris containing the painted surfaces. This information will be submitted to Envirocare prior to shipment of the material.

Table 4-1 Summary of Action Levels and Maximum and Average Radioactivity and Contamination Results in the Vault Structure

	Direct Radiation Survey Integrated Measurements (disintegrations per minute [dpm]/100 square centimeters [cm^2])						Smears (dpm/100 cm^2)			
Area	Alpha (maximum)	Alpha (average)	Beta (maximum)	Beta (average)	Low Energy Beta (maximum)	Low Energy Beta (average)	Alpha	Beta	H-3	C-14
Background										
Action Level	27		28,000		1.8 E6		3	2,800	1.7 E7	4 E5
Interior Vault Floor	43	7.4	291,122	5,167	< 1.8 E6	< 1.8 E6	4	< 2,800	< 1.7 E7	< 4 E5
Interior Vault North Wall	< 27	< 27	< 28,000	< 28,000	< 1.8 E6	< 1.8 E6	< 3	< 2,800	< 1.7 E7	< 4 E5
Interior Vault South Wall	< 27	< 27	< 28,000	< 28,000	< 1.8 E6	< 1.8 E6	< 3	< 2,800	< 1.7 E7	< 4 E5
Interior Vault East Wall	< 27	< 27	< 28,000	< 28,000	< 1.8 E6	< 1.8 E6	< 3	< 2,800	< 1.7 E7	< 4 E5
Interior Vault West Wall	< 27	< 27	< 28,000	< 28,000	< 1.8 E6	< 1.8 E6	< 3	< 2,800	< 1.7 E7	< 4 E5
Interior Vault Ceiling	< 27	< 27	< 28,000	< 28,000	–	–	< 3	< 2,800	< 1.7 E7	< 4 E5
Roof Vent	< 27	< 27	< 28,000	< 28,000	–	–	< 3	< 2,800	< 1.7 E7	< 4 E5
Floor Drain	< 27	< 27	< 28,000	< 28,000	< 1.8 E6	< 1.8 E6	< 3	< 2,800	< 1.7 E7	< 4 E5
Wall Vaults	2,320	371	597,607	20,280	–	–	117	< 2,800	–	–
Wall Vault Plugs	3,503	518	< 28,000	< 28,000	–	–	117	< 2,800	–	–
Floor vaults	158	88	< 28,000	< 28,000	–	–	< 3	< 2,800	–	–
Exterior North Wall	< 27	< 27	56,835	5,794	–	–	< 3	< 2,800	< 1.7 E7	< 4 E5
Exterior South Wall	< 27	< 27	< 28,000	< 28,000	–	–	< 3	< 2,800	< 1.7 E7	< 4 E5
Exterior East Wall	< 27	< 27	< 28,000	< 28,000	–	–	< 3	< 2,800	< 1.7 E7	< 4 E5
Exterior Floor	35	9.7	< 28,000	< 28,000	–	–	< 3	< 2,800	< 1.7 E7	< 4 E5
Note: Blank tabular information indicates that samples were not taken at these locations.										

ENVIROCARE OF UTAH, LLC
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RADIOACTIVE WASTE PROFILE RECORD

EC-0230, Revision 5

Waste Stream ID: 3116-01 Revision: 0 Date of Revision: 8/8/05

C. RADIOLOGICAL INFORMATION

Obtain sufficient samples to adequately determine a range and weighted average of activity in the waste. Attach the gamma spectroscopy or radiochemistry data supporting the radionuclide information listed below.

1. Does the waste material contain accessible surfaces with contact dose rates greater than 500 mR/hr? Y ☐ N ☒
2. Does the waste material contain any of the following isotopes: Aluminum-26, Berkelium-247, Calcium-41, Californium-250, Chlorine-36, Rhenium-187, Terbium-157, or Terbium-158? Y ☐ N ☒
3. Please list the following information for each isotope associated with the waste. Provide an explanation in the narrative description of Section B.5 if the waste contains localized "hot spots" or elevated concentrations that significantly exceed the upper concentration range. If additional space is needed, provide an Attachment C.3 to this profile record formatted as below.

Isotope	Manifested Upper Concentration (pCi/g)	Weighted Avg. per Container (pCi/g)	Isotope	Manifested Upper Concentration (pCi/g)	Weighted Avg. per Container (pCi/g)
H-3	50,800	33,063			
C-14	41	34.4			
Cs-137	940	633.1			
Pm-147	8.1	5.3			
Th-232	23	15.0			
Am-241	0.08	0.05			

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Demolition Debris from Ft. Belvoir, VA Vault 7304

RADIOACTIVE WASTE PROFILE RECORD

EC-0230, Revision 5

LOW-LEVEL RADIOACTIVE WASTE CERTIFICATION ATTACHMENT

This form is required only if the checkbox for Hazardous Waste on page one has been checked No. Otherwise, complete the Hazardous Waste Certification Attachment instead of this attachment. Envirocare may waive the chemical laboratory analyses if the material is not amenable to chemical sampling and analysis (e.g., debris items including metal pieces, concrete, plastic, etc.). Justification for waiving the chemical analyses must be provided in Section B.5.

D. MINIMUM REQUIRED CHEMICAL ANALYSIS

The following parameters must be analyzed by a Utah or NELAC certified laboratory. Typical SW-846 analytical methods have been listed. Other approved methods are acceptable. Attach the most recent or applicable chemical analytical results representing the waste.

1. GENERAL CHEMICAL PARAMETERS

		SW-846 Analytical Methods
pH:	5.8	Method 9045 Please provide the range of the pH analyses performed.
PFLT:	pass Pass / Fail	Method 9095 Not applicable for liquid radioactive waste streams.
Reactive Sulfide:	ND mg/kg	Method 9034
Reactive Cyanide:	ND mg/kg	Method 9014

N/A demolition debris

2. 40 CFR 261.24 Table 1 – Contaminants of Toxicity Characteristic

★ 4 composite samples analyzed, all results are highest among samples analyzed

Metals plus Zinc: Methods 6010 & *7470 (Envirocare's GWQDP requires zinc analysis) ☒ TCLP (mg/L) or ☐ Total (mg/kg)

Arsenic ND	Chromium 0.037	Selenium ND
Barium 0.807	Lead ND	Silver ND
Cadmium ND	*Mercury ND	Zinc 0.028

Organics, Pesticides/Herbicides: Methods 8081/*8151 ☒ TCLP (mg/L) or ☐ Total (mg/kg)

Endrin ND	Toxaphene ND	Chlordane ND
Lindane ND	*2,4-D ND	Heptachlor ND
Methoxychlor ND	*2,4,5-TP Silvex ND	

Organics, Semi-Volatile: Method 8270 ☒ TCLP (mg/L) or ☐ Total (mg/kg)

o-Cresol ND	Hexachlorobenzene ND	Pentrachlorophenol ND
m-Cresol ND	Hexachlorobutadiene ND	Pyridine ND
p-Cresol ND	Hexachloroethane ND	2,4,5-Trichlorophenol ND
Total Cresol ND	Nitrobenzene ND	2,4,6-Trichlorophenol ND
2,4-Dinitrotoluene ND		

Organics, Volatile: Method 8260 ☒ TCLP (mg/L) or ☐ Total (mg/kg)

Benzene ND	1,4-Dichlorobenzene ND	Methyl ethyl keytone ND
Carbon Tetrachloride ND	1,2-Dichloroethane ND	Tetrachloroethylene ND
Chlorobenzene ND	1,1-Dichloroethylene ND	Trichloroethylene 0.07
Chloroform ND	Vinyl Chloride ND	

3. Was the waste at the point of generation a RCRA hazardous waste per 40 CFR 261? Y ☐ N ☒

If Yes, list former hazardous waste codes and former underlying hazardous constituents. List worst-case concentrations for each hazardous constituent. If additional space is needed, provide an Attachment D.3 to this profile record formatted as below. Attach the most recent chemical analytical results demonstrating compliance with applicable treatment standards.

If No, indicate "N/A" in Section D.3 below.

ENVIROCARE of UTAH, LLC
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RADIOACTIVE WASTE PROFILE RECORD

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D. 3.	Former EPA HW Codes or Underlying Hazardous Constituents	Treatment Standard (mg/kg unless noted as mg/L TCLP or Technology Code)	Worst Case Concentration (mg/kg unless noted as mg/L TCLP)
	N/A		

4. OTHER CHEMICAL CONSTITUENTS

List any other chemical constituents of concern (e.g., PCBs, chelating agents, etc.) and worst-case concentrations. If additional space is needed, provide an Attachment D.4 to this profile record formatted as below.

Other Chemical Constituents	Worst-Case Concentration (mg/kg unless noted as mg/L TCLP)	Other Hazardous Constituents	Worst-Case Concentration (mg/kg unless noted as mg/L TCLP)

5. LABORATORY CERTIFICATION

☒ UTAH or NELAC CERTIFIED
The Utah or NELAC certified laboratory holds a current certification for the applicable chemical test methods insofar as such official certifications are given. Please provide a copy of the laboratory's current certification letter for each parameter analyzed and each method used for chemical analyses required by this form.

☐ OTHER LABORATORY CERTIFICATION (Describe below)

6. CERTIFICATION

I certify that sample results representative of the waste described in this profile were or shall be obtained using state- and EPA-approved analytical methods. I also certify that where necessary representative samples were or shall be provided to Envirocare and to qualified laboratories for the analytical results reported herein. I further certify that the waste described in this record is not prohibited from land disposal in 40 CFR 268 (unless prior arrangements are made for treatment at Envirocare) and that all applicable treatment standards are clearly indicated on this form. I also certify that the information provided on this form is complete, true, and correct and is accurately supported and documented by any laboratory testing as required by Envirocare. I certify that the results of any said testing have been submitted to Envirocare. I certify that the waste does not contain any prohibited items listed in Envirocare's Radioactive Material License.

Generator's Signature: [signature] Title: Chief, Environmental and Natural Resource Division Date: 28 Nov 05

Low-Level Radioactive Waste Certification Attachment

APPENDIX D

SURVEY AND SAMPLING RESULTS AND INSTRUMENT QA/QC RECORDS

Fort Belvoir 7304
FSS Analytical Results
Survey Unit #1

Sample Locations	Americium-241				Carbon-14			
	Gross Result (pCi/g)[a]	Flag[b]	MDC (pCi/g)[a]	Ratio to DCGLw[c]	Gross Result (pCi/g)[a]	Flag[b]	MDC (pCi/g)[a]	Ratio to DCGLw[c]
1016	0.045 ± 0.058	U	0.076	0.021	-0.04 ± -0.45	U	1	-0.003
1017	0.01 ± 0.042	U	0.077	0.005	-0.009 ± -0.34	U	1	-0.001
1018	-0.0006 ± 0.042	U	0.082	0.000	-0.09 ± -0.59	U	1	-0.008
1019	0.043 ± 0.052	U	0.066	0.020	-0.004 ± -0.13	U	1	0.000
1020	0.037 ± 0.046	U	0.058	0.018	-0.07 ± -0.37	U	1	-0.006
1021	-0.007 ± 0.035	U	0.079	-0.003	0.46 ± 0.66	U	1	0.038
1022	0.016 ± 0.036	U	0.06	0.008	-0.05 ± -0.5	U	1	-0.004
1023	0.018 ± 0.035	U	0.055	0.009	0.29 ± 0.75	U	1.1	0.024
1024	-0.012 ± 0.031	U	0.069	-0.006	0.2 ± 0.77	U	1	0.017
1025	0.01 ± 0.039	U	0.073	0.005	0 ± 0	U	1	0.000
1026	-0.008 ± 0.029	U	0.063	-0.004	0.12 ± 0.94	U	1	0.010
1027	-0.014 ± 0.04	U	0.089	-0.007	-0.13 ± -0.48	U	1	-0.011
1028	-0.003 ± 0.048	U	0.094	-0.001	0.22 ± 0.68	U	1	0.018
1029	0.014 ± 0.036	U	0.063	0.007	1.24 ± 0.62	J	0.99	0.103
1030	0.005 ± 0.027	U	0.059	0.002	-0.48 ± -0.51	U	1.1	-0.040
1031	0.0008 ± 0.034	U	0.075	0.000	-0.01 ± -0.25	U	1	-0.001
1032	0.003 ± 0.042	U	0.08	0.001	-0.13 ± -0.6	U	1	-0.011

Footnotes:

[a] Results and MDCs reported at 95% confidence level

[b] Flags are:

"U" - Results are less than the sample detection limit

"J" - Result is greater than the sample detection limit but less than the stated reporting limit

[c] Ratio to DCGLw is the result divided by respective DCGLw

[d] Where a thorium result was not reported by the laboratory, the highest Th-232 MDC result of 0.6 pCi/g was used

[e] Sum of Ratios (SOR) is the sum of all "Ratio to DCGLw" values for each sample location

[f] Net SOR is the sum of sample net ratios to DCGLw, where each net ratio is the net result minus average background divided by the respective DCGLw; net results were set to zero if negative

Fort Belvoir 7304
FSS Analytical Results
Survey Unit #1

Sample Locations	Cesium-137				Promethium-147			
	Gross Result (pCi/g)[a]	Flag[b]	MDC (pCi/g)[a]	Ratio to DCGLw[c]	Gross Result (pCi/g)[a]	Flag[b]	MDC (pCi/g)[a]	Ratio to DCGLw[c]
1016	0.012 ± 0.041	U	0.082	0.001	20 ± 17	U	31	0.002
1017	0.03 ± 0.046	U	0.098	0.003	8 ± 19	U	52	0.001
1018	0.02 ± 0.047	U	0.1	0.002	47 ± 22		44	0.006
1019	0.085 ± 0.053	U	0.11	0.008	23 ± 15	U	27	0.003
1020	0.062 ± 0.056	U	0.12	0.006	4 ± 11	U	29	0.000
1021	-0.044 ± 0.045	U	0.068	-0.004	-10 ± -29	U	32	-0.001
1022	0.269 ± 0.091		0.074	0.024	29 ± 18	U	33	0.004
1023	-0.012 ± 0.046	U	0.084	-0.001	0.8 ± 4.4	U	28	0.000
1024	0.026 ± 0.049	U	0.1	0.002	16 ± 16	U	31	0.002
1025	-0.004 ± 0.043	U	0.079	0.000	-3 ± -62	U	30	0.000
1026	0.028 ± 0.046	U	0.094	0.003	41 ± 18		31	0.005
1027	0.013 ± 0.037	U	0.076	0.001	15 ± 15	U	29	0.002
1028	0.037 ± 0.047	U	0.1	0.003	46 ± 21		35	0.006
1029	0.013 ± 0.036	U	0.071	0.001	34 ± 19		34	0.004
1030	0.02 ± 0.044	U	0.088	0.002	28 ± 18	U	31	0.003
1031	0.028 ± 0.034	U	0.077	0.003	6 ± 12	U	30	0.001
1032	0.003 ± 0.043	U	0.084	0.000	37 ± 21		34	0.005

Footnotes:

[a] Results and MDCs reported at 95% confidence level

[b] Flags are:

"U" - Results are less than the sample detection limit

"J" - Result is greater than the sample detection limit but less than the stated reporting limit

[c] Ratio to DCGLw is the result divided by respective DCGLw

[d] Where a thorium result was not reported by the laboratory, the highest Th-232 MDC result of 0.6 pCi/g was used

[e] Sum of Ratios (SOR) is the sum of all "Ratio to DCGLw" values for each sample location

[f] Net SOR is the sum of sample net ratios to DCGLw, where each net ratio is the net result minus average background divided by the respective DCGLw; net results were set to zero if negative

Fort Belvoir 7304
FSS Analytical Results
Survey Unit #1

Sample Locations	Thorium-232				Tritium				SOR[e]	Net SOR[f]
	Gross Result (pCi/g)[a,d]	Flag[b]	MDC (pCi/g)[a]	Ratio to DCGLw[c]	Gross Result (pCi/g)[a]	Flag[b]	MDC (pCi/g)[a]	Ratio to DCGLw[c]		
1016	0.6			0.545	3.61 ± 0.67		0.61	0.033	0.60	0.06
1017	0.48 ± 0.22		0.24	0.436	2.54 ± 0.56		0.59	0.023	0.47	0.03
1018	0.83 ± 0.3		0.31	0.755	1.57 ± 0.47	J	0.6	0.014	0.77	0.02
1019	0.5 ± 0.26		0.25	0.455	13.2 ± 1.6		0.6	0.120	0.61	0.15
1020	0.68 ± 0.27		0.26	0.618	0.54 ± 0.38	U	0.59	0.005	0.64	0.03
1021	0.6			0.545	9.4 ± 1.2		0.6	0.085	0.66	0.12
1022	0.56 ± 0.27		0.23	0.509	39.1 ± 4.2		0.6	0.355	0.90	0.39
1023	0.6			0.545	-0.12 ± 0.38	U	0.59	-0.001	0.58	0.03
1024	0.51 ± 0.26		0.27	0.464	9.6 ± 1.2		0.6	0.087	0.57	0.11
1025	0.62 ± 0.31		0.27	0.564	28 ± 3.1		0.6	0.255	0.82	0.26
1026	0.6			0.545	1.17 ± 0.44	J	0.61	0.011	0.57	0.03
1027	0.6			0.545	0.39 ± 0.38	U	0.61	0.004	0.53	0.01
1028	0.57 ± 0.26		0.23	0.518	0.35 ± 0.35	U	0.59	0.003	0.55	0.03
1029	0.6			0.545	0.72 ± 0.41	J	0.61	0.007	0.67	0.12
1030	0.35 ± 0.25		0.24	0.318	1.09 ± 0.43	J	0.6	0.010	0.30	0.02
1031	0.55 ± 0.23		0.21	0.500	1.2 ± 0.44	J	0.6	0.011	0.51	0.01
1032	0.6			0.545	0.31 ± 0.36	U	0.6	0.003	0.54	0.01

Footnotes:

[a] Results and MDCs reported at 95% confidence level

[b] Flags are:

"U" - Results are less than the sample detection limit

"J" - Result is greater than the sample detection limit but less than the stated reporting limit

[c] Ratio to DCGLw is the result divided by respective DCGLw

[d] Where a thorium result was not reported by the laboratory, the highest Th-232 MDC result of 0.6 pCi/g was used

[e] Sum of Ratios (SOR) is the sum of all "Ratio to DCGLw" values for each sample location

[f] Net SOR is the sum of sample net ratios to DCGLw, where each net ratio is the net result minus average background divided by the respective DCGLw; net results were set to zero if negative

Fort Belvoir 7304
FSS Analytical Results
Survey Unit #2

Sample Locations	Americium-241				Carbon-14			
	Gross Result (pCi/g)[a]	Flag[b]	MDC (pCi/g)[a]	Ratio to DCGLw[c]	Gross Result (pCi/g)[a]	Flag[b]	MDC (pCi/g)[a]	Ratio to DCGLw[c]
2001	-0.004 ± 0.025	U	0.052	-0.002	-0.64 ± -0.66	U	1.3	-0.053
2002	-0.015 ± 0.031	U	0.07	-0.007	-0.49 ± -0.67	U	1.3	-0.041
2003	-0.004 ± 0.024	U	0.05	-0.002	-0.16 ± -0.59	U	1.3	-0.013
2004	0.025 ± 0.039	U	0.056	0.012	-0.11 ± -0.51	U	1.3	-0.009
2005	0.004 ± 0.054	U	0.097	0.002	-0.35 ± -0.65	U	1.3	-0.029
2006	0.005 ± 0.044	U	0.078	0.002	-0.2 ± -0.55	U	1.3	-0.017
2007	0.0006 ± 0.027	U	0.061	0.000	-0.22 ± -0.63	U	1.3	-0.018
2008	0.01 ± 0.033	U	0.06	0.005	-0.1 ± -0.5	U	1.3	-0.008
2009	0.031 ± 0.044	U	0.062	0.015	-0.7 ± -0.69	U	1.2	-0.058
2010	-0.068 ± 0.071	U	0.14	-0.032	0.25 ± 0.82	U	1.3	0.021
2011	0.049 ± 0.08	U	0.11	0.023	-0.04 ± -0.49	U	1.3	-0.003
2012	0.0006 ± 0.029	U	0.064	0.000	0.19 ± 0.72	U	0.98	0.016
2013	0.05 ± 0.1	U	0.15	0.024	0.22 ± 0.66	U	0.98	0.018
2014	0.052 ± 0.099	U	0.14	0.025	0.09 ± 0.95	U	0.98	0.008
2015	0.009 ± 0.097	U	0.15	0.004	0.23 ± 0.62	U	0.98	0.019
2016	0.02 ± 0.13	U	0.19	0.010	0.2 ± 0.61	U	0.97	0.017

Footnotes:

[a] Results and MDCs reported at 95% confidence level

[b] Flags are:

"U" - Results are less than the sample detection limit

"J" - Result is greater than the sample detection limit but less than the stated reporting limit

[c] Ratio to DCGLw is the result divided by respective DCGLw

[d] Where a thorium result was not reported by the laboratory, the highest Th-232 MDC result of 0.6 pCi/g was used

[e] Sum of Ratios (SOR) is the sum of all "Ratio to DCGLw" values for each sample location

[f] Net SOR is the sum of sample net ratios to DCGLw, where each net ratio is the net result minus average background divided by the respective DCGLw; net results were set to zero if negative

Fort Belvoir 7304
FSS Analytical Results
Survey Unit #2

Sample Locations	Cesium-137				Promethium-147			
	Gross Result (pCi/g)[a]	Flag[b]	MDC (pCi/g)[a]	Ratio to DCGLw[c]	Gross Result (pCi/g)[a]	Flag[b]	MDC (pCi/g)[a]	Ratio to DCGLw[c]
2001	-0.01 ± 0.037	U	0.068	-0.001	0.5 ± 1.7	U	2.7	0.000
2002	-0.028 ± 0.033	U	0.053	-0.003	0.5 ± 1.7	U	2.6	0.000
2003	0.011 ± 0.038	U	0.079	0.001	0.8 ± 1.7	U	2.7	0.000
2004	-0.006 ± 0.052	U	0.098	-0.001	1.1 ± 1.5	U	2.5	0.000
2005	-0.007 ± 0.03	U	0.058	-0.001	-0.04 ± -2.4	U	3.1	0.000
2006	0.004 ± 0.031	U	0.064	0.000	0.4 ± 1.5	U	2.4	0.000
2007	0.014 ± 0.041	U	0.085	0.001	-0.2 ± -1.4	U	2.5	0.000
2008	0.006 ± 0.032	U	0.065	0.001	1.6 ± 1.6	U	2.5	0.000
2009	-0.012 ± 0.036	U	0.066	-0.001	0.9 ± 1.6	U	2.5	0.000
2010	0.012 ± 0.038	U	0.078	0.001	-0.5 ± -1.3	U	2.2	0.000
2011	0.012 ± 0.033	U	0.073	0.001	0 ± 0	U	2.6	0.000
2012	-0.002 ± 0.039	U	0.077	0.000	-1.2 ± -1.6	U	2.5	0.000
2013	-0.005 ± 0.036	U	0.068	0.000	-2.1 ± -1.4	U	2.3	0.000
2014	-0.004 ± 0.043	U	0.082	0.000	-1.4 ± -1.4	U	2.4	0.000
2015	-0.009 ± 0.037	U	0.074	-0.001	-0.6 ± -1.6	U	2.5	0.000
2016	0.128 ± 0.064	J	0.056	0.012	-0.7 ± -1.6	U	2.5	0.000

Footnotes:

[a] Results and MDCs reported at 95% confidence level

[b] Flags are:

"U" - Results are less than the sample detection limit

"J" - Result is greater than the sample detection limit but less than the stated reporting limit

[c] Ratio to DCGLw is the result divided by respective DCGLw

[d] Where a thorium result was not reported by the laboratory, the highest Th-232 MDC result of 0.6 pCi/g was used

[e] Sum of Ratios (SOR) is the sum of all "Ratio to DCGLw" values for each sample location

[f] Net SOR is the sum of sample net ratios to DCGLw, where each net ratio is the net result minus average background divided by the respective DCGLw; net results were set to zero if negative

Fort Belvoir 7304
FSS Analytical Results
Survey Unit #2

Sample Locations	Thorium-232				Tritium				SOR[e]	Net SOR[f]
	Gross Result (pCi/g)[a,d]	Flag[b]	MDC (pCi/g)[a]	Ratio to DCGLw[c]	Gross Result (pCi/g)[a]	Flag[b]	MDC (pCi/g)[a]	Ratio to DCGLw[c]		
2001	0.6			0.545	43.6 ± 4.6		0.3	0.396	0.89	0.40
2002	0.6			0.545	3.39 ± 0.54		0.31	0.031	0.53	0.03
2003	0.32 ± 0.17		0.2	0.291	42.7 ± 4.5		0.3	0.388	0.66	0.39
2004	0.6			0.545	16.3 ± 1.9		0.3	0.148	0.70	0.16
2005	0.6			0.545	14.3 ± 1.6		0.3	0.130	0.65	0.13
2006	0.61 ± 0.24		0.21	0.555	1.85 ± 0.41	J	0.3	0.017	0.56	0.02
2007	0.29 ± 0.19		0.2	0.264	0.19 ± 0.18	U	0.3	0.002	0.25	0.00
2008	0.6			0.545	16.2 ± 1.9		0.3	0.147	0.69	0.15
2009	0.5 ± 0.26		0.2	0.455	5.33 ± 0.79		0.31	0.048	0.46	0.06
2010	0.61 ± 0.24		0.22	0.555	6.03 ± 0.86		0.31	0.055	0.60	0.08
2011	0.6			0.545	8.7 ± 1.1		0.3	0.079	0.65	0.10
2012	0.47 ± 0.23		0.21	0.427	7.27 ± 0.95		0.33	0.066	0.51	0.08
2013	0.6			0.545	2.08 ± 0.42		0.33	0.019	0.61	0.06
2014	1.16 ± 0.37		0.34	1.055	3.91 ± 0.62		0.35	0.036	1.12	0.28
2015	0.52 ± 0.23		0.18	0.473	0.07 ± 0.19	U	0.32	0.001	0.50	0.02
2016	0.6			0.545	0.1 ± 0.21	U	0.33	0.001	0.58	0.03

Footnotes:

[a] Results and MDCs reported at 95% confidence level

[b] Flags are:

"U" - Results are less than the sample detection limit

"J" - Result is greater than the sample detection limit but less than the stated reporting limit

[c] Ratio to DCGLw is the result divided by respective DCGLw

[d] Where a thorium result was not reported by the laboratory, the highest Th-232 MDC result of 0.6 pCi/g was used

[e] Sum of Ratios (SOR) is the sum of all "Ratio to DCGLw" values for each sample location

[f] Net SOR is the sum of sample net ratios to DCGLw, where each net ratio is the net result minus average background divided by the respective DCGLw; net results were set to zero if negative

Fort Belvoir
FSS Analytical Results
Survey Unit #3

Sample Locations	Americium-241				Carbon-14			
	Gross Result (pCi/g)[a]	Flag[b]	MDC (pCi/g)[a]	Ratio to DCGLw[c]	Gross Result (pCi/g)[a]	Flag[b]	MDC (pCi/g)[a]	Ratio to DCGLw[c]
2017	0.03 ± 0.1	U	0.15	0.014	0.27 ± 0.64	U	0.98	0.023
2018	-0.035 ± 0.058	U	0.12	-0.017	0.25 ± 0.95	U	1.3	0.021
2019	-0.005 ± 0.023	U	0.05	-0.002	0.32 ± 0.78	U	1.3	0.027
2020	0.011 ± 0.035	U	0.064	0.005	-0.34 ± -0.73	U	1.2	-0.028
2021	0.0006 ± 0.027	U	0.06	0.000	-0.04 ± -0.36	U	1.3	-0.003
2022	0.001 ± 0.037	U	0.072	0.000	-0.88 ± -0.69	U	1.2	-0.073
2023	-0.01 ± 0.029	U	0.065	-0.005	-0.19 ± -0.66	U	1.3	-0.016
2024	0.018 ± 0.045	U	0.074	0.009	0.37 ± 0.58	U	0.97	0.031
2025	0.003 ± 0.027	U	0.06	0.001	0.45 ± 0.62	U	0.98	0.038
2026	0.019 ± 0.041	U	0.065	0.009	0.75 ± 0.61	U	0.97	0.063
2027	-0.019 ± 0.034	U	0.076	-0.009	-0.11 ± -0.41	U	0.98	-0.009
2028	0.085 ± 0.069	J	0.07	0.040	-0.02 ± -0.19	U	0.98	-0.002
2029	-0.006 ± 0.035	U	0.08	-0.003	0.18 ± 0.71	U	0.98	0.015
2030	-0.023 ± 0.037	U	0.084	-0.011	0.62 ± 0.67	U	0.99	0.052
2031	0 ± 0	U	0.09	0.000	0.14 ± 0.67	U	0.98	0.012
2032	-0.024 ± 0.039	U	0.086	-0.011	0.56 ± 0.61	U	0.97	0.047

Footnotes:

[a] Results and MDCs reported at 95% confidence level

[b] Flags are:

"U" - Results are less than the sample detection limit

"J" - Result is greater than the sample detection limit but less than the stated reporting limit

[c] Ratio to DCGLw is the result divided by respective DCGLw

[d] Where a thorium result was not reported by the laboratory, the highest Th-232 MDC result of 0.6 pCi/g was used

[e] Sum of Ratios (SOR) is the sum of all "Ratio to DCGLw" values for each sample location

[f] Net SOR is the sum of sample net ratios to DCGLw, where each net ratio is the net result minus average background divided by the respective DCGLw; net results were set to zero if negative

Fort Belvoir
FSS Analytical Results
Survey Unit #3

Sample Locations	Cesium-137				Promethium-147			
	Gross Result (pCi/g)[a]	Flag[b]	MDC (pCi/g)[a]	Ratio to DCGLw[c]	Gross Result (pCi/g)[a]	Flag[b]	MDC (pCi/g)[a]	Ratio to DCGLw[c]
2017	-0.019 ± 0.038	U	0.069	-0.002	-1 ± -1.4	U	2.4	0.000
2018	-0.014 ± 0.045	U	0.083	-0.001	-1.2 ± -1.5	U	2.4	0.000
2019	0.044 ± 0.048	U	0.11	0.004	0.2 ± 1.3	U	2.1	0.000
2020	-0.014 ± 0.043	U	0.079	-0.001	0.4 ± 1.6	U	2.5	0.000
2021	0.004 ± 0.037	U	0.075	0.000	0.7 ± 1.3	U	2.2	0.000
2022	-0.012 ± 0.048	U	0.088	-0.001	0.8 ± 1.5	U	2.4	0.000
2023	0.019 ± 0.047	U	0.098	0.002	0.09 ± 2.5	U	2.4	0.000
2024	0.24 ± 0.11		0.15	0.022	0.9 ± 1.5	U	2.4	0.000
2025	0.023 ± 0.057	U	0.11	0.002	0.06 ± 1.8	U	2.5	0.000
2026	0.071 ± 0.053	U	0.11	0.006	0.4 ± 1.5	U	2.6	0.000
2027	-0.01 ± 0.041	U	0.08	-0.001	-0.1 ± -1.7	U	2.3	0.000
2028	-0.034 ± 0.049	U	0.081	-0.003	-1.1 ± -1.6	U	2.6	0.000
2029	0.012 ± 0.044	U	0.086	0.001	-0.9 ± -1.4	U	2.4	0.000
2030	0.166 ± 0.066	J	0.057	0.015	-1.8 ± -1.7	U	2.8	0.000
2031	0.029 ± 0.049	U	0.1	0.003	-1.4 ± -1.6	U	2.5	0.000
2032	0.024 ± 0.04	U	0.082	0.002	-1.2 ± -1.5	U	2.4	0.000

Footnotes:

[a] Results and MDCs reported at 95% confidence level

[b] Flags are:

"U" - Results are less than the sample detection limit

"J" - Result is greater than the sample detection limit but less than the stated reporting limit

[c] Ratio to DCGLw is the result divided by respective DCGLw

[d] Where a thorium result was not reported by the laboratory, the highest Th-232 MDC result of 0.6 pCi/g was used

[e] Sum of Ratios (SOR) is the sum of all "Ratio to DCGLw" values for each sample location

[f] Net SOR is the sum of sample net ratios to DCGLw, where each net ratio is the net result minus average background divided by the respective DCGLw; net results were set to zero if negative

Fort Belvoir
FSS Analytical Results
Survey Unit #3

Sample Locations	Thorium-232				Tritium				SOR[e]	Net SOR[f]
	Gross Result (pCi/g)[a,d]	Flag[b]	MDC (pCi/g)[a]	Ratio to DCGLw[c]	Gross Result (pCi/g)[a]	Flag[b]	MDC (pCi/g)[a]	Ratio to DCGLw[c]		
2017	0.6			0.545	0.42 ± 0.22	J	0.31	0.004	0.58	0.04
2018	0.6			0.545	0.59 ± 0.25	J	0.34	0.005	0.55	0.03
2019	0.49 ± 0.26		0.29	0.445	4.4 ± 0.65		0.32	0.040	0.51	0.07
2020	0.6			0.545	1.49 ± 0.34	J	0.3	0.014	0.53	0.02
2021	0.6 ± 0.3		0.19	0.545	0.97 ± 0.28	J	0.31	0.009	0.55	0.01
2022	0.43 ± 0.22		0.24	0.391	0.52 ± 0.23	J	0.31	0.005	0.32	0.01
2023	0.47 ± 0.23		0.27	0.427	0.43 ± 0.23	J	0.32	0.004	0.41	0.00
2024	0.6			0.545	0.29 ± 0.32	U	0.48	0.003	0.61	0.04
2025	0.6			0.545	-0.36 ± 0.28	U	0.52	-0.003	0.58	0.04
2026	0.6			0.545	-0.13 ± 0.31	U	0.51	-0.001	0.62	0.07
2027	0.6 ± 0.26		0.27	0.545	0.14 ± 0.24	U	0.4	0.001	0.53	0.00
2028	0.6			0.545	5.02 ± 0.76		0.39	0.046	0.63	0.09
2029	0.6			0.545	0.04 ± 0.3	U	0.4	0.000	0.56	0.02
2030	0.6			0.545	-0.25 ± 0.31	U	0.52	-0.002	0.60	0.05
2031	0.6			0.545	-0.34 ± 0.29	U	0.52	-0.003	0.56	0.01
2032	0.36 ± 0.23		0.21	0.327	-0.1 ± 0.19	U	0.42	-0.001	0.36	0.05

Footnotes:

[a] Results and MDCs reported at 95% confidence level

[b] Flags are:

"U" - Results are less than the sample detection limit

"J" - Result is greater than the sample detection limit but less than the stated reporting limit

[c] Ratio to DCGLw is the result divided by respective DCGLw

[d] Where a thorium result was not reported by the laboratory, the highest Th-232 MDC result of 0.6 pCi/g was used

[e] Sum of Ratios (SOR) is the sum of all "Ratio to DCGLw" values for each sample location

[f] Net SOR is the sum of sample net ratios to DCGLw, where each net ratio is the net result minus average background divided by the respective DCGLw; net results were set to zero if negative

Fort Belvoir 7304
FSS Analytical Results
Reference Area

Sample Locations	Americium-241				Carbon-14			
	Gross Result (pCi/g)[a]	Flag[b]	MDC (pCi/g)[a]	Ratio to DCGLw[c]	Gross Result (pCi/g)[a]	Flag[b]	MDC (pCi/g)[a]	Ratio to DCGLw[c]
REF 1	0.031 ± 0.049	U	0.071	0.015	-0.11 ± -0.4	U	1	-0.009
REF 10	-0.027 ± 0.099	U	0.17	-0.013	0.15 ± 0.8	U	1.2	0.013
REF 11	0.01 ± 0.066	U	0.11	0.005	0.09 ± 1.1	U	1.2	0.008
REF 12	-0.004 ± 0.06	U	0.11	-0.002	0.27 ± 0.76	U	1.2	0.023
REF 13	0.01 ± 0.15	U	0.23	0.005	0.31 ± 0.7	U	1.2	0.026
REF 14	-0.04 ± 0.12	U	0.19	-0.019	0.53 ± 0.73	U	1.2	0.044
REF 15	0.015 ± 0.092	U	0.15	0.007	-0.05 ± -0.69	U	1.2	-0.004
REF 16	-0.008 ± 0.029	U	0.064	-0.004	0.37 ± 0.73	U	1.2	0.031
REF 2	-0.004 ± 0.026	U	0.054	-0.002	0.32 ± 0.7	U	1.2	0.027
REF 3	0 ± 0	U	0.03	0.000	0.19 ± 0.72	U	1.2	0.016
REF 4	-0.004 ± 0.027	U	0.055	-0.002	0.53 ± 0.71	U	1.2	0.044
REF 5	-0.004 ± 0.026	U	0.055	-0.002	0.03 ± 0.86	U	1.2	0.003
REF 6	0.003 ± 0.031	U	0.069	0.001	0.19 ± 0.72	U	1.2	0.016
REF 7	0.07 ± 0.11	U	0.15	0.033	-0.26 ± -0.64	U	1.2	-0.022
REF 8	-0.075 ± 0.092	U	0.18	-0.036	0.27 ± 0.66	U	1.2	0.023
REF 9	-0.009 ± 0.065	U	0.12	-0.004	0.39 ± 0.77	U	1.2	0.033

[a] Results and MDCs reported at 95% confidence level

[b] Flags are:

"U" - Results are less than the sample detection limit

"J" - Result is greater than the sample detection limit but less than the stated reporting limit

[c] Ratio to DCGLw is the result divided by respective DCGLw

[d] Where a thorium result was not reported by the laboratory, the highest Th-232 MDC result of 0.6 pCi/g was used

[e] Sum of Ratios (SOR) is the sum of all "Ratio to DCGLw" values for each sample location

[f] Net SOR is the sum of sample net ratios to DCGLw, where each net ratio is the net result minus average background divided by the respective DCGLw; net results were set to zero if negative

Fort Belvoir 7304
FSS Analytical Results
Reference Area

Sample Locations	Cesium-137				Promethium-147			
	Gross Result (pCi/g)[a]	Flag[b]	MDC (pCi/g)[a]	Ratio to DCGLw[c]	Gross Result (pCi/g)[a]	Flag[b]	MDC (pCi/g)[a]	Ratio to DCGLw[c]
REF 1	0.43 ± 0.14		0.11	0.039	15 ± 13	U	23	0.002
REF 10	0.59 ± 0.17		0.13	0.054	-20 ± -11	U	19	-0.002
REF 11	0.095 ± 0.092	U	0.19	0.009	0.2 ± 4.2	U	17	0.000
REF 12	0.073 ± 0.082	U	0.16	0.007	-7 ± -10	U	15	-0.001
REF 13	0.082 ± 0.08	U	0.16	0.007	-3.4 ± -9.2	U	15	0.000
REF 14	0.126 ± 0.073	U	0.16	0.011	-16 ± -19	U	29	-0.002
REF 15	0.51 ± 0.15		0.14	0.046	0.5 ± 3.5	U	14	0.000
REF 16	0.23 ± 0.11		0.09	0.021	5 ± 11	U	23	0.001
REF 2	0.52 ± 0.16		0.15	0.047	-78 ± -95	U	140	-0.010
REF 3	0.169 ± 0.091	J	0.11	0.015	-5.2 ± -7	U	12	-0.001
REF 4	0.157 ± 0.094	U	0.21	0.014	-26 ± -23	U	37	-0.003
REF 5	0.052 ± 0.073	U	0.15	0.005	-1 ± -12	U	14	0.000
REF 6	0.107 ± 0.089	U	0.12	0.010	-9 ± -12	U	18	-0.001
REF 7	0.101 ± 0.089	U	0.19	0.009	-6 ± -18	U	23	-0.001
REF 8	0.7 ± 0.16		0.11	0.064	5.5 ± 6.9	U	12	0.001
REF 9	0.29 ± 0.12		0.14	0.026	7.9 ± 8	U	15	0.001

[a] Results and MDCs reported at 95% confidence level

[b] Flags are:

"U" - Results are less than the sample detection limit

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[c] Ratio to DCGLw is the result divided by respective DCGLw

[d] Where a thorium result was not reported by the laboratory, the highest Th-232 MDC result of 0.6 pCi/g was used

[e] Sum of Ratios (SOR) is the sum of all "Ratio to DCGLw" values for each sample location

[f] Net SOR is the sum of sample net ratios to DCGLw, where each net ratio is the net result minus average background divided by the respective DCGLw; net results were set to zero if negative

Fort Belvoir 7304
FSS Analytical Results
Reference Area

Sample Locations	Thorium-232				Tritium				SOR[e]	Net SOR[f]
	Gross Result (pCi/g)[a,d]	Flag[b]	MDC (pCi/g)[a]	Ratio to DCGLw[c]	Gross Result (pCi/g)[a]	Flag[b]	MDC (pCi/g)[a]	Ratio to DCGLw[c]		
REF 1	0.6			0.545	0.25 ± 0.36	U	0.58	0.002	0.59	N/A
REF 10	0.84 ± 0.34		0.37	0.764	0.03 ± 0.78	U	0.58	0.000	0.81	N/A
REF 11	0.97 ± 0.42		0.4	0.882	0.11 ± 0.4	U	0.58	0.001	0.90	N/A
REF 12	1.19 ± 0.37		0.35	1.082	0.1 ± 0.44	U	0.59	0.001	1.11	N/A
REF 13	0.69 ± 0.42		0.46	0.627	0.12 ± 0.41	U	0.59	0.001	0.67	N/A
REF 14	0.96 ± 0.84		0.34	0.873	0.002 ± 0.022	U	0.59	0.000	0.91	N/A
REF 15	1.34 ± 0.45		0.37	1.218	0.57 ± 0.38	U	0.58	0.005	1.27	N/A
REF 16	0.55 ± 0.35		0.34	0.500	0.02 ± 0.69	U	0.59	0.000	0.55	N/A
REF 2	0.6			0.545	0.08 ± 0.46	U	0.6	0.001	0.61	N/A
REF 3	1.27 ± 0.37		0.32	1.155	0.01 ± 0.4	U	0.6	0.000	1.19	N/A
REF 4	0.65 ± 0.51		0.6	0.591	0.26 ± 0.4	U	0.59	0.002	0.65	N/A
REF 5	0.6			0.545	0.12 ± 0.37	U	0.58	0.001	0.55	N/A
REF 6	0.98 ± 0.37		0.36	0.891	0.05 ± 0.51	U	0.58	0.000	0.92	N/A
REF 7	0.86 ± 0.43		0.51	0.782	0.2 ± 0.38	U	0.59	0.002	0.80	N/A
REF 8	0.6			0.545	-0.04 ± 0.42	U	0.57	0.000	0.60	N/A
REF 9	0.8 ± 0.44		0.4	0.727	0.23 ± 0.39	U	0.59	0.002	0.78	N/A

[a] Results and MDCs reported at 95% confidence level

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[c] Ratio to DCGLw is the result divided by respective DCGLw

[d] Where a thorium result was not reported by the laboratory, the highest Th-232 MDC result of 0.6 pCi/g was used

[e] Sum of Ratios (SOR) is the sum of all "Ratio to DCGLw" values for each sample location

[f] Net SOR is the sum of sample net ratios to DCGLw, where each net ratio is the net result minus average background divided by the respective DCGLw; net results were set to zero if negative

Fort Belvoir 7304
WRS Test
SU #1 Class 2

Survey Unit #1 - Class 2

DCGL = 1 (same units as measurement results)

Sample ID	SOR	Survey Area	Adjusted Data	Ranks	References Area Ranks
REF 1	0.59	R	1.59	20	20
REF 2	0.61	R	1.61	22	22
REF 3	1.19	R	2.19	32	32
REF 4	0.65	R	1.65	23	23
REF 5	0.55	R	1.55	19	19
REF 6	0.92	R	1.92	30	30
REF 7	0.80	R	1.80	26	26
REF 8	0.60	R	1.60	21	21
REF 9	0.78	R	1.78	25	25
REF 10	0.81	R	1.81	27	27
REF 11	0.90	R	1.90	28	28
REF 12	1.11	R	2.11	31	31
REF 13	0.67	R	1.67	24	24
REF 14	0.91	R	1.91	29	29
REF 15	1.27	R	2.27	33	33
REF 16	0.55	R	1.55	18	18
1016	0.60	S	0.60	10	0
1017	0.47	S	0.47	2	0
1018	0.77	S	0.77	15	0
1019	0.61	S	0.61	11	0
1020	0.64	S	0.64	12	0
1021	0.66	S	0.66	13	0
1022	0.90	S	0.90	17	0
1023	0.58	S	0.58	9	0
1024	0.57	S	0.57	7	0
1025	0.82	S	0.82	16	0
1026	0.57	S	0.57	8	0
1027	0.53	S	0.53	4	0
1028	0.55	S	0.55	6	0
1029	0.67	S	0.67	14	0
1030	0.30	S	0.30	1	0
1031	0.51	S	0.51	3	0
1032	0.54	S	0.54	5	0
			Sum =	561	408
			WRS Test Critical Value =		**317.7**
			SU Pass / Fail =		**PASS**

Notes: S represents samples collected in Survey Unit.
R represents samples collected in Reference Unit.

0.90 sample max

Fort Belvoir 7304
WRS Test
SU #2 Class 1

Survey Unit #2 - Class 1

DCGL = 1 (same units as measurement results)

SampleID	SOR	Survey Area	Adjusted Data	Ranks	References Area Ranks
REF 1	0.59	R	1.59	19	19
REF 2	0.61	R	1.61	21	21
REF 3	1.19	R	2.19	31	31
REF 4	0.65	R	1.65	22	22
REF 5	0.55	R	1.55	18	18
REF 6	0.92	R	1.92	29	29
REF 7	0.80	R	1.80	25	25
REF 8	0.60	R	1.60	20	20
REF 9	0.78	R	1.78	24	24
REF 10	0.81	R	1.81	26	26
REF 11	0.90	R	1.90	27	27
REF 12	1.11	R	2.11	30	30
REF 13	0.67	R	1.67	23	23
REF 14	0.91	R	1.91	28	28
REF 15	1.27	R	2.27	32	32
REF 16	0.55	R	1.55	17	17
2001	0.89	S	0.89	15	0
2002	0.53	S	0.53	5	0
2003	0.66	S	0.66	12	0
2004	0.70	S	0.70	14	0
2005	0.65	S	0.65	11	0
2006	0.56	S	0.56	6	0
2007	0.25	S	0.25	1	0
2008	0.69	S	0.69	13	0
2009	0.46	S	0.46	2	0
2010	0.60	S	0.60	8	0
2011	0.65	S	0.65	10	0
2012	0.51	S	0.51	4	0
2013	0.61	S	0.61	9	0
2014	1.12	S	1.12	16	0
2015	0.50	S	0.50	3	0
2016	0.58	S	0.58	7	0
			Sum =	528	392
			WRS Test Critical Value =		**307.6**
			SU Pass / Fail =		**PASS**

Notes: S represents samples collected in Survey Unit.
R represents samples collected in Reference Unit.

1.12 sample max

Fort Belvoir 7304
WRS Test
SU #3 Class 1

Survey Unit #3 - Class 1

DCGL = 1 (same units as measurement results)

Sample ID	SOR	Survey Area	Adjusted Data	Ranks	References Area Ranks
REF 1	0.59	R	1.59	19	19
REF 2	0.61	R	1.61	21	21
REF 3	1.19	R	2.19	31	31
REF 4	0.65	R	1.65	22	22
REF 5	0.55	R	1.55	18	18
REF 6	0.92	R	1.92	29	29
REF 7	0.80	R	1.80	25	25
REF 8	0.60	R	1.60	20	20
REF 9	0.78	R	1.78	24	24
REF 10	0.81	R	1.81	26	26
REF 11	0.90	R	1.90	27	27
REF 12	1.11	R	2.11	30	30
REF 13	0.67	R	1.67	23	23
REF 14	0.91	R	1.91	28	28
REF 15	1.27	R	2.27	32	32
REF 16	0.55	R	1.55	17	17
2017	0.58	S	0.58	12	0
2018	0.55	S	0.55	8	0
2019	0.51	S	0.51	4	0
2020	0.53	S	0.53	6	0
2021	0.55	S	0.55	7	0
2022	0.32	S	0.32	1	0
2023	0.41	S	0.41	3	0
2024	0.61	S	0.61	14	0
2025	0.58	S	0.58	11	0
2026	0.62	S	0.62	15	0
2027	0.53	S	0.53	5	0
2028	0.63	S	0.63	16	0
2029	0.56	S	0.56	10	0
2030	0.60	S	0.60	13	0
2031	0.56	S	0.56	9	0
2032	0.36	S	0.36	2	0
			Sum =	528	392
			WRS Test Critical Value =		**307.6**
			SU Pass / Fail =		**PASS**

Notes: S represents samples collected in Survey Unit.
R represents samples collected in Reference Unit.

0.63 sample max

INSTRUMENT QA/QC RECORDS

Designer and Manufacturer of Scientific and Industrial Instruments

CERTIFICATE OF CALIBRATION

LUDLUM MEASUREMENTS, INC.
POST OFFICE BOX 810 PH. 325-235-5494
501 OAK STREET FAX NO. 325-235-46
SWEETWATER, TEXAS 79556, U.S.A.

CUSTOMER CABRERA SERVICES ORDER NO. 231852/289674

Mfg. Ludlum Measurements, Inc. Model 2221 Serial No. 176941

Mfg. Ludlum Measurements, Inc. Model 44-20 Serial No. Pr 172518

Cal. Date 7-Mar-05 Cal Due Date 7-Mar-06 Cal. Interval 1 Year Meterface 202-159

Check mark ☑ applies to applicable instr. and/or detector IAW mfg. spec. T. 70 °F RH 40 % Alt 698.8 mm H

☐ New Instrument Instrument Received ☑ Within Toler. +-10% ☐ 10-20% ☐ Out of Tol. ☐ Requiring Repair ☐ Other-See comments

☑ Mechanical ck. ☑ Meter Zeroed ☐ Background Subtract ☑ Input Sens. Linearity
☑ F/S Resp. ck ☑ Reset ck. ☑ Window Operation ☑ Geotropism
☑ Audio ck. ☐ Alarm Setting ck. ☑ Batt. ck. (Min. Volt) 4.4 VDC

☑ Calibrated in accordance with LMI SOP 14.8 rev 12/05/89. ☐ Calibrated in accordance with LMI SOP 14.9 rev 02/07/97.

Instrument Volt Set Comm V Input Sens. Comm mV Det. Oper. Comm V at Comm mV Threshold Dial Ratio Comm = Comm

☑ HV Readout (2 points) Ref./Inst. 500 / 491 V Ref./Inst. 2000 / 1972 V

COMMENTS:

Peak Settings:
Peak Voltage: 713 V.
Thshld = 642
Win = 40
Win. Pos: "IN"
Resolution for Cs 137 is 10%

Gross Settings
HV: 1050 V
Thshld = 100 (10 mV)
Win Pos: "Out"
Firmware No 26 10 27
Cald using 5' C/C Cable.

Gamma Calibration: GM detectors positioned perpendicular to source except for M 44-9 in which the front of probe faces source.

RANGE/MULTIPLIER	REFERENCE CAL. POINT	INSTRUMENT REC'D "AS FOUND READING"	INSTRUMENT METER READING*
x1k	400kcpm	400	400
x1k	100kcpm	100	100
x100	40kcpm	400	400
x100	10kcpm	100	100
x10	4kcpm	400	400
x10	1kcpm	100	100
x1	400cpm	400	400
x1	100cpm	100	100

*Uncertainty within ± 10% C.F. within ± 20%

ALL Range(s) Calibrated Electronically

	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
Digital Readout	400kcpm	400475	400475
	40kcpm	40059	40059
	4kcpm	4001	4001
	400cpm	400	400
	40cpm	40	40

	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING
Log Scale	500kcpm	500 Kcpm	500 Kcpm
	50kcpm	50 "	50 "
	5kcpm	5 "	5 "
	500cpm	500 cpm	500 cpm
	50cpm	50 "	50 "

Ludlum Measurements, Inc. certifies that the above instrument has been calibrated by standards traceable to the National Institute of Standards and Technology, or to the calibration facilities o other International Standards Organization members, or have been derived from accepted values of natural physical constants or have been derived by the ratio type of calibration technique The calibration system conforms to the requirements of ANSI/NCSL Z540-1-1994 and ANSI N323-1978 State of Texas Calibration License No. LO-19

Reference Instruments and/or Sources:

Cs-137 Gamma S/N ☐ 1162 ☐ G112 ☐ M565 ☐ 5105 ☐ T1008 ☐ T879 ☐ E552 ☐ E551 ☐ 720 ☐ 734 ☐ 1616 ☐ Neutron Am-241 Be S/N T-3

☐ Alpha S/N ☐ Beta S/N ☑ Other Am 241 4.0.84 uCi

☑ m 500 S/N 54680 ☐ Oscilloscope S/N ☑ Multimeter S/N 69101832

Calibrated By: Date 7-Mar-05

Reviewed By: Date 8 mar 05

AC Inst. ☐ ☐ Passed Dielectric (Hi-Pot) and Continuity Test

Designer and Manufacturer
of
Scientific and Industrial
Instruments

LUDLUM MEASUREMENTS, INC.
POST OFFICE BOX 810 PH. 325-235-5494
501 OAK STREET FAX NO. 325-235-46
SWEETWATER, TEXAS 79556, U.S.A.

Bench Test Data For Detector

Detector 44-20 Serial No. Ps 172518

Customer CABRERA SERVICES Order #. 231852/289674

Counter 2221 Serial No. 176941 Counter Input Sensitivity 10 mV

Count Time 1 Min. Source + Background Distance Source to Detector Surface

Other

High Voltage	Background	Isotope Am-241 Size ~0.84 uCi	Isotope Size	Isotope Size	Isotope Size
750	10545	16151			
800	11882	170695			
850	12360	185109			
900	15719	215725			
950	13861	225693			
1000	12398	229227			
→ 1050	12558	234850			
1100	12725	234963			
1150	13287	236063			
1200	13151	236890			
1250	13936	236504			
1300	15271	238881			
1350	18815	243532			
1400	21991	249351			

Signature [signature] Date 7-Mar-05

FORM C4A 04/09/2003

Designer and Manufacturer of Scientific and Industrial Instruments

CERTIFICATE OF CALIBRATION

LUDLUM MEASUREMENTS, INC.
POST OFFICE BOX 810 PH. 325-235-5494
501 OAK STREET FAX NO. 325-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

CUSTOMER CABRERA SERVICES ORDER NO. 248314 / 298361

Mfg. Ludlum Measurements, Inc. Model 19 Serial No. 80139

Mfg. _____ Model _____ Serial No. _____

Cal. Date 9-Jan-06 Cal Due Date 9-Jan-07 Cal. Interval 1 Year Meterface 202-016

Check mark ☑ applies to applicable instr. and/or detector IAW mfg. spec. T. 77 °F RH 20 % Alt 707.8 mm Hg

☐ New Instrument Instrument Received ☑ Within Toler. +-10% ☐ 10-20% ☐ Out of Tol. ☐ Requiring Repair ☐ Other-See comments

☑ Mechanical ck.	☑ Meter Zeroed	☐ Background Subtract	☐ Input Sens. Linearity
☑ F/S Resp. ck	☑ Reset ck.	☐ Window Operation	☑ Geotropism
☑ Audio ck.	☐ Alarm Setting ck.	☑ Batt. ck. (Min. Volt) 2.2 VDC	

☐ Calibrated in accordance with LMI SOP 14.8 rev 12/05/89. ☑ Calibrated in accordance with LMI SOP 14.9 rev 02/07/97.

Instrument Volt Set 650 V Input Sens. 40 mV Det. Oper. _____ V at _____ mV Threshold Dial Ratio _____ = _____ mV

☐ HV Readout (2 points) Ref./Inst. _____ / _____ V Ref./Inst. _____ / _____ V

COMMENTS:

Gamma Calibration: GM detectors positioned perpendicular to source except for M 44-9 in which the front of probe faces source.

RANGE/MULTIPLIER	REFERENCE CAL. POINT	INSTRUMENT REC'D "AS FOUND READING"	INSTRUMENT METER READING*
5000	4000 µR/hr	4000	4000
5000	1000 µR/hr	1000	1000
500	400 µR/hr = 74,800 cpm	420	400
500	100 µR/hr	110	100
250	200 µR/hr = 38,000 cpm	220	200
250	100 µR/hr	110	100
50	7480 cpm	42	40
50	1,820 cpm	11	10
25	3,800 cpm	21	20
25	950 cpm	5.5	5

*Uncertainty within ± 10% C.F. within ± 20% 50, 25 Range(s) Calibrated Electronically

	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*		REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
Digital Readout				Log Scale			

Ludlum Measurements, Inc. certifies that the above instrument has been calibrated by standards traceable to the National Institute of Standards and Technology, or to the calibration facilities of other International Standards Organization members, or have been derived from accepted values of natural physical constants or have been derived by the ratio type of calibration techniques. The calibration system conforms to the requirements of ANSI/NCSL Z540-1-1994 and ANSI N323-1978 State of Texas Calibration License No. LO-1963

Reference Instruments and/or Sources:

Cs-137 Gamma S/N ☐ 1162 ☐ G112 ☑ M565 ☐ 5105 ☐ T1008 ☐ T879 ☐ E552 ☐ E551 ☐ 720 ☐ 734 ☐ 1616 ☐ Neutron Am-241 Be S/N T-304

☐ Alpha S/N _____ ☐ Beta S/N _____ ☐ Other _____

☑ m 500 S/N 189491 ☐ Oscilloscope S/N _____ ☑ Multimeter S/N 82250292

Calibrated By: Dennis Miekos Date 9-Jan-06

Reviewed By: [signature] Date 9 Jan 06

FORM C22A 11/26/2003

AC Inst. Only ☐ Passed Dielectric (Hi-Pot) and Continuity Test ☐ Failed: _____

Designer and Manufacturer of Scientific and Industrial Instruments

CERTIFICATE OF CALIBRATION

LUDLUM MEASUREMENTS, INC.
POST OFFICE BOX 810 PH. 325-235-5494
501 OAK STREET FAX NO. 325-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

CUSTOMER CABRERA SERVICES ORDER NO. 241292/294629

Mfg. Ludlum Measurements, Inc. Model 2224-1 Serial No. 162426

Mfg. Ludlum Measurements, Inc. Model 43-93 Serial No. PR193921

Cal. Date 26-Aug-05 Cal Due Date 26-Aug-06 Cal. Interval 1 Year Meterface 202-848

Check mark ☑ applies to applicable instr. and/or detector IAW mfg. spec. T. 74 °F RH 41 % Alt 698.7 mm Hg

☐ New Instrument Instrument Received ☑ Within Toler. +-10% ☐ 10-20% ☐ Out of Tol. ☐ Requiring Repair ☐ Other-See comments

☑ Mechanical ck. ☑ Meter Zeroed ☐ Background Subtract ☐ Input Sens. Linearity
☐ F/S Resp. ck ☑ Reset ck. ☑ Window Operation ☑ Geotropism
☑ Audio ck. ☐ Alarm Setting ck. ☑ Batt. ck. (Min. Volt) 2.2 VDC
☑ Calibrated in accordance with LMI SOP 14.8 rev 12/05/89. ☐ Calibrated in accordance with LMI SOP 14.9 rev 02/07/97.

Instrument Volt Set 825 V Input Sens. Comment mV Det. Oper. 825 V at Comment mV Threshold Dial Ratio ____ = ____ mV

☑ HV Readout (2 points) Ref./Inst. 500 / 501 V Ref./Inst. 1500 / 1500 V

COMMENTS:

ALPHA SENS:120mv
BETA SENS:3.5mv
BETA WIN:30mv
HV SET WITH DETECTOR NOT CONNECTED
OL SET TO SIMULATE LEAK
FIRMWARE:390096
CAL WITH A 5FT. CABLE
EFF FOR:TH-230 18%, TC-99 22%, Ni-63 0.19% Sr90y90 28%
4 Pi Efficiencies (refer to plateau sheet for details.

Gamma Calibration: GM detectors positioned perpendicular to source except for M 44-9 in which the front of probe faces source.

RANGE/MULTIPLIER	REFERENCE CAL. POINT	INSTRUMENT REC'D "AS FOUND READING"	INSTRUMENT METER READING*
X1000	800kcpm	800	800
X1000	200kcpm	200	200
X100	80kcpm	800	800
X100	20kcpm	200	200
X10	8kcpm	800	800
X10	2kcpm	200	200
X1	800cpm	800	800
X1	200cpm	200	200

*Uncertainty within ± 10% C.F. within ± 20%

ALL Range(s) Calibrated Electronically

	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
Digital Readout	800kcpm	802778	802778
	80kcpm	80317	80317
	8kcpm	8032	8032
	800cpm	803	803
	80cpm	80	80

	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
Log Scale			

Ludlum Measurements, Inc. certifies that the above instrument has been calibrated by standards traceable to the National Institute of Standards and Technology, or to the calibration facilities of other International Standards Organization members, or have been derived from accepted values of natural physical constants or have been derived by the ratio type of calibration techniques. The calibration system conforms to the requirements of ANSI/NCSL Z540-1-1994 and ANSI N323-1978 State of Texas Calibration License No. LO-1963

Reference Instruments and/or Sources:

Cs-137 Gamma S/N ☐ 1162 ☐ G112 ☐ M565 ☐ 5105 ☐ T1008 ☐ T879 ☐ E552 ☐ E551 ☐ 720 ☐ 734 ☐ 1616 ☐ Neutron Am-241 Be S/N T-304

☑ Alpha S/N TH-230#5030-02 5730dpm ☑ Beta S/N TC-99#5280 Sr90y90#4016 ☐ Other ____

☑ m 500 S/N 54683 ☐ Oscilloscope S/N ____ ☑ Multimeter S/N 70602489

Calibrated By: Duaine Jackson Date 26aug05

Reviewed By: [signature] Date 28Aug05

FORM C22A 11/26/2003

AC Inst. Only ☐ Passed Dielectric (Hi-Pot) and Continuity Test ☐ Failed: ____

Designer and Manufacturer
of
Scientific and Industrial
Instruments

LUDLUM MEASUREMENTS, INC.
POST OFFICE BOX 810 PH. 325-235-5494
501 OAK STREET FAX NO. 325-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

Bench Test Data For Detector

Detector 43-93 Serial No. PR193921

Customer CABRERA SERVICES

Counter 2224-1 Serial No. 162426

Count Time 1 Minute

Other

Order #. 241292/294629

Alpha Input Sensitivity 120 mV

Beta Input Sensitivity 35 mV

Beta Window 30 mV

Distance Source to Detector Surface

High Voltage	Background		Isotope Tc-99 Size 93,200dpm		Isotope Sr90/Y90 Size 69,200dpm		Isotope Ni-63 Size 293,372dpm	
	Alpha	Beta	Alpha	Beta	Alpha	Beta	Alpha	Beta
800	0	170	39	18053	4	18174	0	269
825	0	223	31	21016	2	19606	4	789
850	1	255	61	24022	7	20182	2	1806
875	1	293	40	26350	20	20389	6	3439

☐ Gas Proportional detector count rate decreased ≤ 10% after 15 hour static test using 39" cable.

☐ Gas proportional detector count rate decreased ≤ 10% after 5 hour static test using 39" cable and alpha/beta counter.

Signature Duane Jackson Date 26-Aug 05

FORM C4B 04/09/2003

Designer and Manufacturer
of
Scientific and Industrial
Instruments

LUDLUM MEASUREMENTS, INC.
POST OFFICE BOX 810 PH. 325-235-5494
501 OAK STREET FAX NO. 325-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

Bench Test Data For Detector

Detector 43-93 Serial No. PR193921

Customer CABRERA SERVICES

Counter 2224-1 Serial No. 162426

Count Time 1Minute

Other

Order #. 241292/294629

Alpha Input Sensitivity 120 mV

Beta Input Sensitivity 3.5 mV

Beta Window 30 mV

Distance Source to Detector Surface

High Voltage	Background		Isotope Th-230 Size 5730dpm		Isotope Size		Isotope Size	
	Alpha	Beta	Alpha	Beta	Alpha	Beta	Alpha	Beta
800	0	170	1005	278				
825	0	223	1016	338				
850	1	255	1040	426				
875	1	293	1067	604				

☐ Gas Proportional detector count rate decreased ≤ 10% after 15 hour static test using 39" cable.

☐ Gas proportional detector count rate decreased ≤ 10% after 5 hour static test using 39" cable and alpha/beta counter.

Signature Daniel Jackson Date 26 Aug 05

Designer and Manufacturer of Scientific and Industrial Instruments

CERTIFICATE OF CALIBRATION

LUDLUM MEASUREMENTS, INC.
POST OFFICE BOX 810 PH. 325-235-5494
501 OAK STREET FAX NO. 325-235-46
SWEETWATER, TEXAS 79556, U.S.A.

CUSTOMER CABRERA SERVICES ORDER NO. 24445/296283

Mfg. Ludlum Measurements, Inc. Model 2929 Serial No. 200051

Mfg. Ludlum Measurements, Inc. Model 43-10-1 Serial No. PR 215948

Cal. Date 25-Oct-05 Cal Due Date 25-Oct-06 Cal. Interval 1 Year Meterface 202-014

Check mark ☑ applies to applicable instr. and/or detector IAW mfg. spec. T. 70 °F RH 28 % Alt 701.8 mm H

☐ New Instrument Instrument Received ☑ Within Toler. +-10% ☐ 10-20% ☐ Out of Tol. ☐ Requiring Repair ☐ Other-See commen

☑ Mechanical ck. ☑ Window Operation

☑ Audio ck.

☑ Meter Zeroed Alpha Sensitivity 175 mV Beta Sensitivity 4 mV Beta Window 50 mV

☑ Calibrated in accordance with LMI SOP 14.8 rev 12/05/89. ☐ Calibrated in accordance with LMI SOP 14.9 rev 02/07/97.

Instrument Volt Set 675 V = 2177 on High Voltage dial. High Voltage set with detector connected.

☑ HV Readout (2 points) Ref./Inst. 500 / 502 V Ref./Inst. 2000 / 2008 V

COMMENTS:

EFF's FOR
TH-230 40% 4Pi. #5020
Ni-63 6% 4Pi. #4017
TC-99 41% 4Pi. #5279
Sr90y90 40% 4Pi. #4016

For 4Pi Efficiences refere to the platue sheet

Gamma Calibration: GM detectors positioned perpendicular to source except for M 44-9 in which the front of probe faces source.

Alpha Channel Digital Readout	REFERENCE CAL POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
	400K cpm	401220	401220
	40K cpm	4003	4003
	4K cpm	400	400
	400 cpm	40	40
	40 cpm	4	4

Beta/Gamma Channel Digital Readout	REFERENCE CAL POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
	400K cpm	400200	400200
	40K cpm	4004	4004
	4K cpm	401	401
	400 cpm	40	40
	40 cpm	1	4

*Uncertainty within ± 10% C.F. within ± 20%

Ludlum Measurements, Inc. certifies that the above instrument has been calibrated by standards traceable to the National Institute of Standards and Technology, or to the calibration facilities o other International Standards Organization members, or have been derived from accepted values of natural physical constants or have been derived by the ratio type of calibration technique The calibration system conforms to the requirements of ANSI/NCSL Z540-1-1994 and ANSI N323-1978. State of Texas Calibration License No. LO-19

Reference Instruments and/or Sources:

Cs-137 Gamma S/N ☐ 1162 ☐ G112 ☐ M565 ☐ 5105 ☐ T1008 ☐ T879 ☐ E552 ☐ E551 ☐ 720 ☐ 734 ☐ 1616 ☐ Neutron Am-241 Be S/N T-3

☑ Alpha S/N TH-239#5020 ☑ Beta S/N TC-99#5279 Sr90y90#4016 ☑ Other Ni-63#4017

☑ m 500 S/N 54683 ☐ Oscilloscope S/N ☑ Multimeter S/N 70602489

Calibrated By: Duane Ackson Date 25-Oct-05

Reviewed By: L A Nabors Date 27 Oct 05

This certificate shall not be reproduced except in full, without the written approval of Ludlum Measurements, Inc.
FORM C25 11/26/2003

AC Inst. Only ☑ Passed Dielectric (Hi-Pot) and Continuity Tes ☐ Failed:

Designer and Manufacturer
of
Scientific and Industrial
Instruments

LUDLUM MEASUREMENTS, INC.
POST OFFICE BOX 810 PH. 325-235-5494
501 OAK STREET FAX NO. 325-235-46
SWEETWATER, TEXAS 79556, U.S.A.

Bench Test Data For Detector

Detector 43-10-1 Serial No. PR215948

Customer CABRERA SERVICES

Counter 2929 Serial No. 200051

Count Time 1Minute

Other

Order #. 24445/296283

Alpha Input Sensitivity 175 mV

Beta Input Sensitivity 4 mV

Beta Window 50 mV

Distance Source to Detector TRAY

High Voltage	Background		Isotope TH-230 Size 5730dpm		Isotope TC-99 Size 28,800dpm		Isotope Sr90Y90 Size 60,045dpm	
	Alpha	Beta	Alpha	Beta	Alpha	Beta	Alpha	Beta
625	1	31	1850	275	10	9732	1	24250
650	0	57	2004	419	15	11126	5	25576
675	0	53	2270	560	19	11940	5	24314
700	0	70	2035	1015	14	11946	26	22560

☐ Gas Proportional detector count rate decreased ≤ 10% after 15 hour static test using 39" cable.

☐ Gas proportional detector count rate decreased ≤ 10% after 5 hour static test using 39" cable and alpha/beta counter.

Signature Dudley Jackson Date 25-Oct-05

FORM C4B 04/09/2003

Designer and Manufacturer
of
Scientific and Industrial
Instruments

LUDLUM MEASUREMENTS, INC.
POST OFFICE BOX 810 PH. 325-235-5494
501 OAK STREET FAX NO. 325-235-46
SWEETWATER, TEXAS 79556, U.S.A.

Bench Test Data For Detector

Detector 43-10-1 Serial No. PR215948

Customer CABRERA SERVICES

Counter 2929 Serial No. 200051

Count Time 1Minute

Other

Order #. 24445/296283

Alpha Input Sensitivity 175 mV

Beta Input Sensitivity 4 mV

Beta Window 50 mV

Distance Source to Detector TOAY

High Voltage	Background		Isotope Ni-63 Size 292,039dpm		Isotope Size		Isotope Size	
	Alpha	Beta	Alpha	Beta	Alpha	Beta	Alpha	Beta
625	181	31	0	4822				
650	0	57	0	10893				
675	0	53	0	18222				
700	1	70	1	25322				

☐ Gas Proportional detector count rate decreased ≤ 10% after 15 hour static test using 39" cable.

☐ Gas proportional detector count rate decreased ≤ 10% after 5 hour static test using 39" cable and alpha/beta counter.

Signature Danny Jackson Date 25OCT05

FORM C48 04/09/2003

CTI
Calibration Technology

A Division of RSCS, Inc.

Calibration Certificate
ID Number: 10252005-1025-8,414

Contact: Eric Barbour

Customer: Cabrera Services, Inc.
473 Silver Lane
East Hartford, CT 06118-

Instrument	Serial Number
Ludlum Model 2221	196087
Probe Model	**Serial Number**
Alpha Spectra Inc G5	051200A

Precision Check

Test 1	Test 2	Test 3	Mean	Results
40.00 kcpm	40.00 kcpm	40.00 kcpm	40.00 kcpm	Satisfactory

Accuracy Check

Range	Target Value	As Found		As Left	
X1000	400 Kcpm	399.8 Kcpm	#	399.8 Kcpm	#
X1000	100 Kcpm	99.5 Kcpm	#	99.5 Kcpm	#
X100	40 Kcpm	40 Kcpm	#	40 Kcpm	#
X100	10 Kcpm	9.96 Kcpm	#	9.96 Kcpm	#
X10	4 Kcpm	4.0 Kcpm	#	4.0 Kcpm	#
X10	1 Kcpm	1.06 Kcpm	#	1.06 Kcpm	#
X1	400 cpm	400 cpm	#	400 cpm	#
X1	100 cpm	102 cpm	#	102 cpm	#

Readings in Blue indicate ranges where readings are >20% of Target value. Items in Red indicate As-Left Readings >10% of Target Value

Probe Model & S/N	Isotope	Efficiency	Nist Source ID	Geometry
G5 051200A	Co-57	0.4338 C/D	Co-57 (5586)	On Contact
G5 051200A	I-129	0.3532 C/D	I-129 (NES-166S)	On Contact

Outer Physical Check	☑	Mechanical Zero	☑
Internal Check	☑	Tap Test	☑
Geotropism Check	☑	Dessicant Check	☐

Electronics Checks	As Found	As left
High Voltage	1082 V	1082 V

Comments: # Indicates scale calibrated with pulser Model 500 SN: 134720

Calibrated by:

QA Review:

Date: 10/25/2005 Expires: 10/25/2006

This calibration was performed using a NIST Traceable radiation source, in conformance to the following standards: ANSI N323A (1997), NCRP 112 (1991). RSCS New Hampshire Radioactive Material License Number: 361R. RSCS calibration services are performed in accordance with the RSCS Radiation Protection Program and SOP 2.4.21, Calibration of Contamination Monitors and Scalers. This calibration certificate shall not be reproduced except in full without the express written consent of RSCS, Inc.

Designer and Manufacturer of Scientific and Industrial Instruments

CERTIFICATE OF CALIBRATION

LUDLUM MEASUREMENTS, INC.
POST OFFICE BOX 810 PH. 325-235-5494
501 OAK STREET FAX NO. 325-235-46
SWEETWATER, TEXAS 79556, U.S.A.

CUSTOMER CABRERA SERVICES ORDER NO. 236989/292374

Mfg. Ludlum Measurements, Inc. Model 2221 Serial No. 176947

Mfg. Ludlum Measurements, Inc. Model 44-110 Serial No. PR178079

Cal. Date 7-Jun-05 Cal Due Date 7-Jun-06 Cal. Interval 1 Year Meterface 202-159

Check mark ☑ applies to applicable instr. and/or detector IAW mfg. spec. T. 72 °F RH 46 % Alt 702.8 mm H

☐ New Instrument Instrument Received ☑ Within Toler. +-10% ☐ 10-20% ☐ Out of Tol. ☐ Requiring Repair ☐ Other-See comments

☑ Mechanical ck. ☑ Meter Zeroed ☐ Background Subtract ☑ Input Sens. Linearity
☑ F/S Resp. ck ☑ Reset ck. ☑ Window Operation ☑ Geotropism
☑ Audio ck. ☐ Alarm Setting ck. ☑ Batt. ck. (Min. Volt) 4.4 VDC
☑ Calibrated in accordance with LMI SOP 14.8 rev 12/05/89. ☐ Calibrated in accordance with LMI SOP 14.9 rev 02/07/97.

Instrument Volt Set 1650 V Input Sens. 5 mV Det. Oper. 1650 V at 5 mV Threshold Dial Ratio 100 = 5 mV

☑ HV Readout (2 points) Ref./Inst. 500 / 501 V Ref./Inst. 2000 / 2002 V

COMMENTS:
Firmware: 261027
Cal'd with window in OUT position.

Gamma Calibration: GM detectors positioned perpendicular to source except for M 44-9 in which the front of probe faces source.

RANGE/MULTIPLIER	REFERENCE CAL. POINT	INSTRUMENT REC'D "AS FOUND READING"	INSTRUMENT METER READING*
x1k	400kcpm	400	400
x1k	100kcpm	100	100
x100	40kcpm	400	400
x100	10kcpm	100	100
x10	4kcpm	400	400
x10	1kcpm	100	100
x1	400cpm	400	400
x1	100cpm	100	100

*Uncertainty within ± 10% C.F. within ± 20%

ALL Range(s) Calibrated Electronically

	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
Digital Readout	400kcpm	40067 (0)	40067 (0)
	40kcpm	4005	4005
	4kcpm	401	401
	400cpm	40	40
	40cpm	4	4

	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING
Log Scale	500kcpm	500k	500K
	50kcpm	50k	50K
	5kcpm	5K	5K
	500cpm	500	500
	50cpm	50	50

Ludlum Measurements, Inc. certifies that the above instrument has been calibrated by standards traceable to the National Institute of Standards and Technology, or to the calibration facilities o other International Standards Organization members, or have been derived from accepted values of natural physical constants or have been derived by the ratio type of calibration technique The calibration system conforms to the requirements of ANSI/NCSL Z540-1-1994 and ANSI N323-1978 State of Texas Calibration License No. LO-19

Reference Instruments and/or Sources:

Cs-137 Gamma S/N ☐ 1162 ☐ G112 ☐ M565 ☐ 5105 ☐ T1008 ☐ T879 ☐ E552 ☐ E551 ☐ 720 ☐ 734 ☐ 1616 ☐ Neutron Am-241 Be S/N T-3

☐ Alpha S/N ☑ Beta S/N H-3 SN LC306 ☐ Other

☑ m 500 S/N 132899 ☐ Oscilloscope S/N ☑ Multimeter S/N 82080087

Calibrated By: Josh Boston Date 7 Jun 05

Reviewed By: [illegible] Date 7 June 05

AC Inst. ☐ ☐ Passed Dielectric (Hi-Pot) and Continuity Test

Designer and Manufacturer
of
Scientific and Industrial
Instruments

LUDLUM MEASUREMENTS, INC.
POST OFFICE BOX 810 PH. 325-235-5494
501 OAK STREET FAX NO. 325-235-46
SWEETWATER, TEXAS 79556, U.S.A.

Bench Test Data For Detector

Detector 44-110 Serial No. PR178079

Customer CABRERA SERVICES Order #. 236989/292374

Counter 2221 Serial No. 176947 Counter Input Sensitivity 5 mV

Count Time 1 minute Distance Source to Detector Surface

Other

High Voltage	Background	Isotope H-3 Size 2920 dpm	Isotope Size	Isotope Size	Isotope Size
1600	217	1241			
→ 1650	376	1474			
1700	454	1802			

Signature Josh Boston Date 7Jun05

EBERLINE SERVICES

CERTIFICATE OF CALIBRATION

Electroplated Beta Standard

S.O.# 3863
P.O.# 02-055

Description of Standard:

Model No. DNS-12 Serial No. 3975-02 Isotope Tc-99

Electroplated on polished SS disc, 0.79 mm thick.

Total diameter of 4.77 cm and an active diameter of 4.45 cm.

The radioactive material is permanently fixed to the disc by heat treatment without any covering over the active surface.

Measurement Method:

The 2pi beta emission rate was measured using an internal gas flow proportional chamber. Absolute counting of beta particles emitted in the hemisphere above the active surface was verified by counting above, below, and at the operative voltage. The calibration is traceable to NIST by reference to an NIST calibrated beta source S/N 2148/90.

Measurement Result:

The observed beta count rate from the surface of the disc per minute (cpm) on the calibration date was:

11,000 ± 441

The total disintegration rate (dpm) assuming 25 % backscatter of beta particles from the surface of the disc, was:

17,700 ± 706 (0.00796 μCi)

The uncertainty of the measurement is 4 %, which is the sum of random counting error at the 99% confidence level, and the estimated upper limit of systematic error in this measurement.

Calibrated by: ART REUST Reviewed by:

Calibration Technician: Q.A. Representati

Calibration Date: 4-25-2002 Reviewed Date: 4-29-02

Analytical Services
7021 Pan American Freeway NE
Albuquerque, New Mexico 87109-4238
(505) 345-3461 Fax (505) 761-5416
Toll Free (866) RAD-LABS (723-5227)
www.eberlineservices.com

EBERLINE SERVICES

CERTIFICATE OF CALIBRATION

Electroplated Alpha Standard

S.O.# 3863
P.O.# 02-055

Description of Standard:

Model No. DNS-11 Serial No. 3973-02 Isotope Th-230

Electroplated on polished SS disc, 0.79 mm thick.

Total diameter of 4.77 cm and an active diameter of 4.45 cm.

The radioactive material is permanently fixed to the disc by heat treatment without any covering over the active surface.

Measurement Method:

The 2pi alpha emission rate was measured using an internal gas flow proportional chamber. Absolute counting of alpha particles emitted in the hemisphere above the active surface was verified by counting above, below, and at the operative voltage. The calibration is traceable to NIST by reference to an NIST calibrated alpha source S/N 2393/91.

Measurement Result:

The observed alpha particles emitted from the surface of the disc per minute (cpm) on the calibration date was:

8,860 ± 265

The total disintegration rate (dpm) assuming 1.5% backscatter of alpha particles from the surface of the disc, was:

17,500 ± 523 (0.00786 μCi)

The uncertainty of the measurement is 3 %, which is the sum of random counting error at the 99% confidence level, and the estimated upper limit of systematic error in this measurement.

Calibrated by: ART REUST Reviewed by:

Calibration Technician: Art Reust Q.A. Representative:

Calibration Date: 4-29-2002 Reviewed Date: 4-29-02

Analytical Services
7021 Pan American Freeway NE
Albuquerque, New Mexico 87109-4238
(505) 345-3461 Fax (505) 761-5416
Toll Free (866) RAD-LABS (723-5227)
www.eberlineservices.com

CERTIFICATE OF CALIBRATION
(AIR SAMPLER)

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

Customer and Contact: Cabrera Services, Inc., Attn: Larry Pawlus (860) 289-1885
Customer Address: 809 Main Street, East Hartford, CT 06108

Inst. Mfr. F&J Specialty Products | Inst. Model LV-1 | Inst. s/n 002773
Reference Inst. F&J Venturi D-812 | Inst. s/n 2541

Cal. Date 01 April 2005 | Due Date 01 April 2006 | Cal. Interval 1 year

Barometric Press: Actual 29.92 in. Hg | Corrected to: 29.59 in. Hg
Temperature: Actual 65°F | Corrected to: 63.8°F
Filters Used: ☒Particulate ☐Charcoal/silver zeolite ☐Other:

Measurement	Air Sampler Flow Rate (LPM)	Ref. Inst. Flow Rate (LPM)	Percent Deviation
1	19.67	20.01	1.70
2	39.33	39.01	-0.82
3	49.17	49.02	-0.30
4	59.00	59.02	0.04
5	78.66	76.03	-3.47
6			
7			
8			
9			
10			
11			
12			

****Average percent deviation across the range = -0.57**

This is to certify that RSA Laboratories, Inc. of Hebron, Connecticut, has on this date certified this air sampler to be within the accuracy specified above. The Reference Flow Device bears Letters of Certification traceable to the National Institute of Science and Technology. RSA Laboratories, Inc. ID# 9649.

Calibrated by: Kurt D. Newton _____ Date: 01 April 2005

Reviewed by: Jay R. Dockendorff _____ Date: 01 April 2005

CERTIFICATE OF CALIBRATION
(AIR SAMPLER)

Facility: RSA Laboratories, Inc. **Customer:** Cabrera Services, Inc.

Air Sampler Model F&J LV-1 — Air Sampler Serial No. 002773
Calibrator Model F&J Venturi D-812 — Calibrator Serial No. 2541

	AIR SAMPLER						CALIBRATOR		
Measurement	Inlet Temp. (°F)	Inlet Press (In-Hg)	Gauge Press (In-Hg)	Indicated Flow (LPM)	Temp/Press Correction Factor	Corrected Flow (LPM)	Indicated Flow (LPM)	Temp/Press Correction Factor	Corrected Flow (LPM)
1	63.8	29.59	1	20	0.983	19.67	20	1.000	20.01
2	63.8	29.59	1	40	0.983	39.33	39	1.000	39.01
3	63.8	29.59	1	50	0.983	49.17	49	1.000	48.02
4	63.8	29.59	1	60	0.983	59.00	59	1.000	57.02
5	63.8	29.59	1	80	0.983	78.66	76	1.000	76.03
6									
7									
8									
9									
10									
11									
12									

$$\text{Air Sampler Temp/Press Corr Factor} = \sqrt{\frac{530°R}{\text{Inlet temp (°F)} + 460°R} \times \frac{(\text{Inlet Press} - \text{Gauge Press})}{29.92 \text{ in. Hg}}}$$

$$\text{Calibrator Temp/Press Corr Factor} = \sqrt{\frac{530°R}{\text{Inlet temp (°F)} + 460°R} \times \frac{\text{Inlet Press}}{29.92 \text{ in. Hg}}}$$

$$\% \text{ Deviation} = \frac{\text{Corrected Flow} - \text{Sampler Flow}}{\text{Corrected Flow}} \times 100$$

Corrected Flow = (Indicated Flow) x (Temp/Press Corr Factor)

Calibrated by: Kurt D. Newton _____ Date: 01 April 2005

Reviewed by: Jay R. Dockendorff _____ Date: 01 April 2005

CERTIFICATE OF CALIBRATION
(AIR SAMPLER)

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

Customer and Contact: Cabrera Services, Inc., Attn: Larry Pawlus (860) 289-1885
Customer Address: 809 Main Street, East Hartford, CT 06108

Inst. Mfr. F&J Specialty Products | Inst. Model LV-1 | Inst. s/n 002591
Reference Inst. F&J Venturi D-812 | | Inst. s/n 2541

Cal. Date 01 April 2005 | Due Date 01 April 2006 | Cal. Interval 1 year

Barometric Press: Actual 29.92 in. Hg | Corrected to: 29.59 in. Hg
Temperature: Actual 65°F | Corrected to: 64.1°F
Filters Used: ☒Particulate ☐Charcoal/silver zeolite ☐Other:

Measurement	Air Sampler Flow Rate (LPM)	Ref. Inst. Flow Rate (LPM)	Percent Deviation
1	19.66	20.00	1.70
2	39.32	39.00	-0.82
3	49.15	48.00	-2.39
4	58.98	57.00	-3.47
5	78.64	76.00	-3.47
6			
7			
8			
9			
10			
11			
12			

****Average percent deviation across the range = -1.69**

This is to certify that RSA Laboratories, Inc. of Hebron, Connecticut, has on this date certified this air sampler to be within the accuracy specified above. The Reference Flow Device bears Letters of Certification traceable to the National Institute of Science and Technology. RSA Laboratories, Inc. ID# 9648.

Calibrated by: Kurt D. Newton _____ Date: 01 April 2005

Reviewed by: Jay R. Dockendorff _____ Date: 01 April 2005

CERTIFICATE OF CALIBRATION
(AIR SAMPLER)

Facility: RSA Laboratories, Inc. **Customer: Cabrera Services, Inc.**

Air Sampler Model F&J LV-1 — Air Sampler Serial No. 002591
Calibrator Model F&J Venturi D-812 — Calibrator Serial No. 2541

	AIR SAMPLER						CALIBRATOR		
Measurement	Inlet Temp. (°F)	Inlet Press (In-Hg)	Gauge Press (In-Hg)	Indicated Flow (LPM)	Temp/Press Correction Factor	Corrected Flow (LPM)	Indicated Flow (LPM)	Temp/Press Correction Factor	Corrected Flow (LPM)
1	64.1	29.59	1	20	0.983	19.66	20	1.000	20.00
2	64.1	29.59	1	40	0.983	39.32	39	1.000	39.00
3	64.1	29.59	1	50	0.983	49.15	48	1.000	48.00
4	64.1	29.59	1	60	0.983	58.98	57	1.000	57.00
5	64.1	29.59	1	80	0.983	78.64	76	1.000	76.00
6									
7									
8									
9									
10									
11									
12									

Air Sampler Temp/Press Corr Factor = $\sqrt{\frac{530°R}{\text{Inlet temp (°F)} + 460°R} \times \frac{(\text{Inlet Press} - \text{Gauge Press})}{29.92 \text{ in. Hg}}}$

Calibrator Temp/Press Corr Factor = $\sqrt{\frac{530°R}{\text{Inlet temp (°F)} + 460°R} \times \frac{\text{Inlet Press}}{29.92 \text{ in. Hg}}}$

% Deviation = $\frac{\text{Corrected Flow} - \text{Sampler Flow}}{\text{Corrected Flow}} \times 100$

Corrected Flow = (Indicated Flow) x (Temp/Press Corr Factor)

Calibrated by: Kurt D. Newton _____ Date: 01 April 2005

Reviewed by: Jay R. Dockendorff _____ Date: 01 April 2005

Designer and Manufacturer of Scientific and Industrial Instruments

CERTIFICATE OF CALIBRATION

LUDLUM MEASUREMENTS, INC.
POST OFFICE BOX 810 PH. 325-235-5494
501 OAK STREET FAX NO. 325-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

CUSTOMER CABRERA SERVICES ORDER NO. 224610

Mfg. Ludlum Measurements, Inc. Model 2929 Serial No. 200051

Mfg. Ludlum Measurements, Inc. Model 43-10-1 Serial No. PR 215998

Cal. Date 19-Oct-04 Cal Due Date 19-Oct-05 Cal. Interval 1 Year Meterface 202-014

Check mark ☑ applies to applicable instr. and/or detector IAW mfg. spec. T. 72 °F RH 36 % Alt 699.8 mm Hg

☑ New Instrument Instrument Received ☐ Within Toler. +-10% ☐ 10-20% ☐ Out of Tol. ☐ Requiring Repair ☐ Other-See comments

☑ Mechanical ck. ☑ Window Operation

☑ Audio ck.

☑ Meter Zeroed Alpha Sensitivity 175 mV Beta Sensitivity 4 mV Beta Window 50 mV

☑ Calibrated in accordance with LMI SOP 14.8 rev 12/05/89. ☐ Calibrated in accordance with LMI SOP 14.9 rev 02/07/97.

Instrument Volt Set 625 V = 2.55 on High Voltage dial. High Voltage set with detector connected.

☑ HV Readout (2 points) Ref./Inst. 500 / 500 V Ref./Inst. 2000 / 2000 V

COMMENTS:

Gamma Calibration: GM detectors positioned perpendicular to source except for M 44-9 in which the front of probe faces source.

	REFERENCE CAL POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
Alpha Channel Digital Readout	400K cpm		39934 (6)
	40K cpm		3994 (6)
	4K cpm		400 (0)
	400 cpm		40 (6)
	40 cpm		4 (0)
Beta/Gamma Channel Digital Readout	400K cpm		39893 (6)
	40K cpm		3990 (0)
	4K cpm		399 (0)
	400 cpm		40 (0)
	40 cpm		4 (0)

*Uncertainty within ± 10% C.F. within ± 20%

Ludlum Measurements, Inc. certifies that the above instrument has been calibrated by standards traceable to the National Institute of Standards and Technology, or to the calibration facilities of other International Standards Organization members, or have been derived from accepted values of natural physical constants or have been derived by the ratio type of calibration techniques. The calibration system conforms to the requirements of ANSI/NCSL Z540-1-1994 and ANSI N323-1978. State of Texas Calibration License No. LO-1963

Reference Instruments and/or Sources:

Cs-137 Gamma S/N ☐ 1162 ☐ G112 ☐ M565 ☐ 5105 ☐ T1008 ☐ T879 ☐ E552 ☐ E551 ☐ 720 ☐ 734 ☐ 1616 ☐ Neutron Am-241 Be S/N T-304

☐ Alpha S/N ☐ Beta S/N ☐ Other

☑ m 500 S/N 38120 ☐ Oscilloscope S/N ☑ Multimeter S/N 78401030

Calibrated By: Leann Ortega Date 19-Oct-04

Reviewed By: Gloria Orozco Date 19 Oct 04

FORM C25 11/26/2003

AC Inst. Only ☑ Passed Dielectric (Hi-Pot) and Continuity Test ☐ Failed:

Designer and Manufacturer
of
Scientific and Industrial
Instruments

LUDLUM MEASUREMENTS, INC.
POST OFFICE BOX 810 PH. 325-235-5494
501 OAK STREET FAX NO. 325-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

Bench Test Data For Detector

Detector 43-10-1 Serial No. PR 215948 Order #. 224610

Customer CABRERA SERVICES Alpha Input Sensitivity 175 mV

Counter 2929 Serial No. 200051 Beta Input Sensitivity 4 mV

Count Time 1 Minute Beta Window 50 mV

Other _____ Distance Source to Detector Tray

High Voltage	Background		Isotope Pu239 Size 30900 dpm		Isotope Tc99 Size 22900		Isotope C-14 Size 311649	
	Alpha	Beta	Alpha	Beta	Alpha	Beta	Alpha	Beta
575	0	39	11892	348	10	7420	0	15483
600	0	55	11991	448	15	8581	1	21755
✓ 625	0	71	12241	663	8	9438	0	27478
650	0	63	12215	1489	8	9590	5	30950
675	0	90	11997	3617	9	9455	0	37348

☐ Gas Proportional detector count rate decreased ≤ 10% after 16 hour static test using 39" cable.

☐ Gas proportional detector count rate decreased ≤ 10% after 5 hour static test using 39" cable and alpha/beta counter.

Signature Juan Ortega Date 19-Oct-04

CABRERA ALPHA-BETA COUNTING INSTRUMENT (Rev 5)

Counting Instrument:	2360	Detector:	43-93	Calibration Date:	6/24/2005
Serial #:	202398	Serial #:	PR 211706	12 month calibration:	OK
Detector Active Area or Area Covered by Smear (cm^2):	100			NRC 6 Mo Cal. Due Date?	OK

	Efficiency (fraction)	Source Nuclide	Source Number	Original Source Activity (DPM)	Source Creation Date	$T_{1/2}$ (yr)	Source Decayed Activity	Required MDA (DPM/100cm^2)	Control Chart & Daily Bkg Count Time	Control Chart & Daily Source-Sample Count Time	Control Chart bkg Average α/β cpm	Control Chart bkg 1 sigma, cpm	Control Chart Source-bkg Average α/β cpm	Control Chart source 1 sigma, cpm
Alpha	0.2000	Th 230	2697-01	22,800	6/11/2001	7.54E+04	22,799	100	2	2	0.75	0.68	4956.5	87.09
Beta		Tc 99	11965	4,686	8/9/1996	2.11E+05	4,686	100	2	2	261.40	7.94	875.8	38.22

Date	Daily Bkg Counts		Daily Check Source Counts		Daily Bkg Rate (cpm)		Net Daily Source Rate (cpm)		Bkg QC Pass/Fail		Source QC Pass/Fail		MDA α (dpm)	MDA β (dpm)	α MDA OK?	β MDA OK?	H.P. Technician	Technician Initials
	Alpha	Beta	Alpha	Beta	Alpha	Beta	Alpha	Beta	Alpha	Beta	Alpha	Beta						
9/7/2005	4	541	9765		2.0	270.5	4880.5		PASS	PASS	PASS		30.76		Yes		Jon A Cote	JAC
9/8/2005	4	501	9888	2318	2.0	250.5	4942.0	908.5	PASS	PASS	PASS	PASS	30.76	#DIV/0!	Yes	#DIV/0!	Jon A Cote	JAC
9/12/2005	2	496	9901	2365	1.0	248.0	4949.5	934.6	PASS	PASS	PASS	PASS	23.95	#DIV/0!	Yes	#DIV/0!	Jon A Cote	JAC
9/13/2005	0	485	9987	2322	0.0	242.5	4993.5	918.5	PASS	QUESTION	PASS	PASS	7.50	#DIV/0!	Yes	#DIV/0!	Jon A Cote	JAC

CABRERA ALPHA-BETA COUNTING INSTRUMENT (Rev 5)

Initial Background and Source Counts for Control Chart								
	Initial bkg counts				Initial source plus bkg counts			
#	Alpha	cpm	Beta	cpm	Alpha	cpm	Beta	cpm
1	1	0.5	546	273	9938	4969	2337	1168.5
2	0	0	526	263	10029	5014.5	2334	1167
3	2	1	541	270.5	10119	5059.5	2231	1115.5
4	3	1.5	535	267.5	9728	4864	2178	1089
5	1	0.5	503	251.5	9727	4863.5	2391	1195.5
6	0	0	530	265	9746	4873	2302	1151
7	2	1	525	262.5	9749	4874.5	2304	1152
8	4	2	502	251	10003	5001.5	2284	1142
9	2	1	514	257	9903	4951.5	2225	1112.5
10	0	0	506	253	10203	5101.5	2158	1079
Mean		0.75		261.4		4957.3		1137.2
$S_{(n-1)}$		0.68		7.94		86.99		37.25
-3 sigma		-1.28		237.58		4696.29		1025.44
+3 sigma		2.78		285.22		5218.21		1248.96
-2 sigma		-0.60		245.52		4783.28		1062.69
+2 sigma		2.10		277.28		5131.22		1211.71
					Mean bkg	4956.5		875.8
					$S_{(n-1)}$	87.09		36.22
				Mean bkg	-3 sigma	4695.23		761.14
				Mean bkg	+3 sigma	5217.77		990.46
				Mean bkg	-2 sigma	4782.32		799.36
				Mean bkg	+2 sigma	5130.68		952.24
						4968.5		895.5
						5014.5		904
						5058.5		845
						4862.5		821.5
						4863		944
						4873		886
						4873.5		889.5
						4999.5		891
						4950.5		855.5
						5101.5		826

CABRERA ALPHA-BETA COUNTING INSTRUMENT (Rev 5)

Counting Instrument:	2360	Detector:	43-93	Calibration Date:	6/24/2005
Serial #:	202398	Serial #:	PR 211706	12 month calibration:	OK
Detector Active Area or Area Covered by Smear (cm^2):	100			NRC 6 Mo Cal. Due Date?	OK

	Efficiency (fraction)	Source Nuclide	Source Number	Original Source Activity (DPM)	Source Creation Date	$T_{1/2}$ (yr)	Source Decayed Activity	Required MDA (DPM/100cm^2)	Control Chart & Daily Bkg Count Time	Control Chart & Daily Source-Sample Count Time	Control Chart bkg Average α/β cpm	Control Chart bkg 1 sigma, cpm	Control Chart Source-bkg Average α/β cpm	Control Chart source 1 sigma, cpm
Alpha	0.2000	Th 230	2897-01	22,800	6/11/2001	7.54E+04	22,799	100	2	2	0.75	0.68	4956.5	87.09
Beta	0.3100	Tc 99	11965	4,686	8/9/1996	2.11E+05	4,686	1000	2	2	261.40	7.94	875.8	38.22

Date	Daily Bkg Counts		Daily Check Source Counts		Daily Bkg Rate (cpm)		Net Daily Source Rate (cpm)		Bkg QC Pass/Fail		Source QC Pass/Fail		MDA α (dpm)	MDA β (dpm)	α MDA OK?	β MDA OK?	H.P. Technician	Technician Initials
	Alpha	Beta	Alpha	Beta	Alpha	Beta	Alpha	Beta	Alpha	Beta	Alpha	Beta						
9/20/2005	0	550	10090	2223	0.0	275.0	5045.0	836.5	PASS	PASS	PASS	PASS	7.50	181	Yes	Yes	Jon A Cote	JAC
9/21/2005	1	553	10105	2320	0.5	276.5	5052.0	883.5	PASS	PASS	PASS	PASS	19.13	181	Yes	Yes	Jon A Cote	JAC

CABRERA ALPHA-BETA COUNTING INSTRUMENT (Rev 5)

Initial Background and Source Counts for Control Chart

#	Initial bkg counts				Initial source plus bkg counts			
	Alpha	cpm	Beta	cpm	Alpha	cpm	Beta	cpm
1	1	0.5	546	273	9938	4969	2337	1168.5
2	0	0	526	263	10029	5014.5	2334	1167
3	2	1	541	270.5	10119	5059.5	2231	1115.5
4	3	1.5	535	267.5	9728	4864	2178	1089
5	1	0.5	503	251.5	9727	4863.5	2391	1195.5
6	0	0	530	265	9746	4873	2302	1151
7	2	1	525	262.5	9749	4874.5	2304	1152
8	4	2	502	251	10003	5001.5	2284	1142
9	2	1	514	257	9903	4951.5	2225	1112.5
10	0	0	506	253	10203	5101.5	2158	1079
Mean		0.75		261.4		4957.3		1137.2
$S_{(n-1)}$		0.68		7.94		86.99		37.25
-3 sigma		-1.28		237.58		4696.29		1025.44
+3 sigma		2.78		285.22		5218.21		1248.96
-2 sigma		-0.60		246.52		4783.28		1062.69
+2 sigma		2.10		277.28		5131.22		1211.71
					Mean-bkg	4956.5		875.8
					$S_{(n-1)}$	87.09		38.22
				Mean-bkg	-3 sigma	4695.23		761.14
				Mean-bkg	+3 sigma	5217.77		990.46
				Mean-bkg	-2 sigma	4782.32		799.36
				Mean-bkg	+2 sigma	5130.68		952.24
						4968.5		895.5
						5014.5		904
						5058.5		845
						4862.5		821.5
						4863		944
						4873		886
						4873.5		889.5
						4999.5		891
						4950.5		855.5
						5101.5		826

CABRERA ALPHA-BETA COUNTING INSTRUMENT (Rev 5)

Counting Instrument:	2360	Detector:	43-93	Calibration Date:	6/24/2005
Serial #:	202396	Serial #:	PR 211706	12 month calibration:	OK
Detector Active Area or Area Covered by Smear (cm^2):	100			NRC 6 Mo Cal. Due Date?	OK

	Efficiency (fraction)	Source Nuclide	Source Number	Original Source Activity (DPM)	Source Creation Date	$T_{1/2}$ (yr)	Source Decayed Activity	Required MDA (DPM/100cm^2)	Control Chart & Daily Bkg Count Time	Control Chart & Daily Source-Sample Count Time	Control Chart bkg Average α/β cpm	Control Chart bkg 1 sigma, cpm	Control Chart Source-bkg Average α/β cpm	Control Chart source 1 sigma, cpm
Alpha	0.2000	Th 230	2897-01	22,800	6/11/2001	7.54E+04	22,799	200	2	2	1.45	0.72	4955.8	87.18
Beta	0.1000	Tc 99	11965	4,686	8/9/1996	2.11E+05	4,686	1000	2	2	269.65	9.33	667.4	35.15

Date	Daily Bkg Counts		Daily Check Source Counts		Daily Bkg Rate (cpm)		Net Daily Source Rate (cpm)		Bkg QC Pass/Fail		Source QC Pass/Fail		MDA α (dpm)	MDA β (dpm)	α MDA OK?	β MDA OK?	H.P. Technician	Technician Initials
	Alpha	Beta	Alpha	Beta	Alpha	Beta	Alpha	Beta	Alpha	Beta	Alpha	Beta						
9/26/2005	1	528	10079	2333	0.5	264.0	5039.0	902.5	PASS	PASS	PASS	PASS	19.13	550	Yes	Yes	Jon A Cote	JAC
9/27/2005	3	552	10073	2338	1.5	276.0	5035.0	893.0	PASS	PASS	PASS	PASS	27.65	562	Yes	Yes	Jon A Cote	JAC
9/28/2005	1	508	10126	2414	0.5	254.0	5062.6	953.0	PASS	PASS	PASS	QUESTION	19.13	539	Yes	Yes	Jon A Cote	JAC
9/29/2005	1	529	10150	2297	0.5	264.5	5074.5	884.0	PASS	PASS	PASS	PASS	19.13	550	Yes	Yes	Jon A Cote	JAC
10/3/2005	2	492	9991	2244	1.0	246.0	4994.5	876.0	PASS	QUESTION	PASS	PASS	23.95	531	Yes	Yes	Jon A Cote	JAC
10/4/2005	0	514	10222	2370	0.0	257.0	5111.0	928.0	QUESTION	PASS	PASS	PASS	7.50	542	Yes	Yes	Jon A Cote	JAC
10/5/2005	1	499	10126	2240	0.5	249.5	5062.5	870.5	PASS	QUESTION	PASS	PASS	19.13	535	Yes	Yes	Jon A Cote	JAC
10/6/2005	4	512	10143	2274	2.0	256.0	5069.5	881.0	PASS	PASS	PASS	PASS	30.76	541	Yes	Yes	Jon A Cote	JAC

CABRERA ALPHA-BETA COUNTING INSTRUMENT (Rev 5)

Initial Background and Source Counts for Control Chart								
	Initial bkg counts				Initial source plus bkg counts			
#	Alpha	cpm	Beta	cpm	Alpha	cpm	Beta	cpm
1	2	1	550	275	9938	4969	2337	1168.5
2	2	1	541	270.5	10029	5014.5	2334	1167
3	4	2	561	280.5	10119	5059.5	2231	1115.5
4	6	3	518	259	9728	4864	2178	1089
5	2	1	521	260.5	9727	4863.5	2391	1195.5
6	4	2	564	282	9746	4873	2302	1151
7	3	1.5	553	276.5	9749	4874.5	2304	1152
8	2	1	551	275.5	10003	5001.5	2284	1142
9	1	0.5	519	259.5	9903	4951.5	2225	1112.5
10	3	1.5	519	259.5	10203	5101.5	2158	1079
Mean		1.45		269.9		4957.3		1137.2
$S_{(n-1)}$		0.72		9.33		86.99		37.25
-3 sigma		-0.72		241.86		4696.29		1025.44
+3 sigma		3.62		297.84		5218.21		1248.96
-2 sigma		0.00		251.19		4783.28		1062.69
+2 sigma		2.90		288.51		5131.22		1211.71
					Mean-bkg	4955.8		867.4
					$S_{(n-1)}$	87.16		35.15
				Mean-bkg	-3 sigma	4694.31		761.91
				Mean-bkg	+3 sigma	5217.29		972.79
				Mean-bkg	-2 sigma	4781.48		797.06
				Mean-bkg	+2 sigma	5130.12		937.64
						4968		893.5
						5013.5		896.5
						5057.5		835
						4861		830
						4862.5		935
						4871		869
						4873		875.5
						5000.5		868.5
						4951		853
						5100		819.5

Inst.#196062		
QC Daily Source		
Date	Result (cpm)	P/F
9/7/2005	53891	Pass
9/8/2005	51100	Pass
9/12/2005	52314	Pass
9/12/2005	50481	Pass
9/14/2005	53274	Pass
9/15/2005	50443	Pass
9/16/2005	50539	Pass
9/19/2005	50918	Pass
9/20/2005	50684	Pass
9/21/2005	53158	Pass
9/22/2005	53356	Pass
9/26/2005	51336	Pass
9/27/2005	48769	Pass
9/28/2005	51772	Pass
9/29/2005	50449	Pass
10/3/2005	51161	Pass
10/4/2005	50386	Pass
10/5/2005	50888	Pass

Inst.#196062	
Initial Source Readings	
Date	Result (cpm)
9/7/2005	53959
9/7/2005	48509
9/7/2005	50066
9/7/2005	52253
9/7/2005	47494
9/7/2005	51449
9/7/2005	50491
9/7/2005	49223
9/7/2005	50433
9/7/2005	53841
	Average
	50772

Inst.#194299		
QC Daily Source		
Date	Result (cpm)	P/F
9/8/2005	650	Pass
9/12/2005	700	Pass
9/13/2005	750	Pass
9/14/2005	650	Pass
9/15/2005	700	Pass
9/16/2005	750	Pass
9/19/2005	700	Pass
9/20/2005	650	Pass
9/21/2005	650	Pass
9/22/2005	700	Pass
9/26/2005	650	Pass
9/27/2005	650	Pass
9/28/2005	700	Pass
9/29/2005	700	Pass
10/3/2005	700	Pass
10/4/2005	650	Pass
10/5/2005	650	Pass

Inst.#194299	
Initial Source Readings	
Date	Result (cpm)
9/8/2005	600
9/8/2005	650
9/8/2005	600
9/8/2005	700
9/8/2005	650
9/8/2005	700
9/8/2005	600
9/8/2005	650
9/8/2005	700
9/8/2005	650
	Average
	650

Inst.#196087		
QC Daily Source		
Date	Result (cpm)	P/F
11/16/2005	47721	Pass
11/17/2005	47392	Pass
11/18/2005	48640	Pass

Inst.#196087	
Initial Source Readings	
Date	Result (cpm)
11/16/2005	47587
11/16/2005	49515
11/16/2005	48166
11/16/2005	48435
11/16/2005	49144
11/16/2005	49276
11/16/2005	47737
11/16/2005	47183
11/16/2005	49063
11/16/2005	48810
	Average
	48492

Inst.#79517		
QC Daily Source		
Date	Result (cpm)	P/F
11/16/2005	3300	Pass
11/17/2005	3200	Pass
11/18/2005	3350	Pass

Inst.#79517	
Initial Source Readings	
Date	Result (cpm)
11/16/2005	3200
11/16/2005	3250
11/16/2005	3300
11/16/2005	3200
11/16/2005	3300
11/16/2005	3350
11/16/2005	3250
11/16/2005	3300
11/16/2005	3400
11/16/2005	3300
	Average
	3285

Inst.#89973		
QC Daily Source		
Date	Result (cpm)	P/F
11/16/2005	2700	Pass
11/17/2005	2700	Pass
11/18/2005	2800	Pass

Inst.#89973	
Initial Source Readings	
Date	Result (cpm)
11/16/2005	2600
11/16/2005	2700
11/16/2005	2800
11/16/2005	2700
11/16/2005	2600
11/16/2005	2700
11/16/2005	2600
11/16/2005	2800
11/16/2005	2700
11/16/2005	2800
	Average
	2700

Inst.#C853F (Bicron)		
QC Daily Source		
Date	Result (µrem/hr)	P/F
9/7/2005	700	Pass
9/8/2005	700	Pass
9/12/2005	700	Pass
9/13/2005	700	Pass
9/14/2005	650	Pass
9/15/2005	700	Pass
9/16/2005	750	Pass
9/19/2005	700	Pass
9/20/2005	650	Pass
9/21/2005	650	Pass
9/22/2005	650	Pass
9/26/2005	650	Pass
9/27/2005	650	Pass
9/28/2005	650	Pass
9/29/2005	700	Pass
10/3/2005	700	Pass
10/4/2005	650	Pass
10/5/2005	650	Pass

Inst.#C853F (Bicron)	
Initial Source Readings	
Date	Result (µrem/hr)
9/7/2005	650
9/7/2005	650
9/7/2005	700
9/7/2005	600
9/7/2005	650
9/7/2005	600
9/7/2005	700
9/7/2005	650
9/7/2005	600
9/7/2005	700
	Average
	650

BENCHMARK TEST DATA

1. Ensure that the selected template is in the proper project coordinate type (meters, feet, or survey feet)
2. Insert the "blue" highlighted data into the GPS worksheet; "yellow" highlight and "PASS" and "FAIL" flags should appear automatically; Contact PM should Benchmark data not appear as shown below

Add QC Tab

Trimble #0220164772, Antenna # 0220161434, Handset # 0220159474

QC Daily GPS (Meters)

Date	AM/PM	Northing (meters)	Easting (meters)	Offset (meters)	P/F
8/19/2002	AM	80406.3	76931.4	0.23	PASS
8/20/2002	PM	80406.4	76931.7	0.12	PASS
8/21/2002	AM	80406.6	76931.6	0.29	PASS
12/22/2002	PM	80406.6	76932.6	1.01	FAIL

Trimble #0220164772, Antenna # 0220161434, Handset # 0220159474

Initial GPS Readings (meter)

Date	Northing	Easting
8/19/2002	80406.2	76931.5
8/19/2002	80406.4	76931.8
8/19/2002	80406.3	76931.7
8/19/2002	80406.2	76931.6
8/19/2002	80406.3	76931.5
8/19/2002	80406.3	76931.5
8/19/2002	80406.2	76931.6
8/19/2002	80406.6	76931.6
8/19/2002	80406.5	76931.7
8/19/2002	80406.2	76931.9
	Average	
	80406.308	76931.630

max	80406.6	76931.9	
Min	80406.2	76931.5	
Delta	0.37795	0.36576	
Stdev	0.122752	0.134933784	
Max offset (m)	0.525954458		PASS

GPS QC Daily Worksheet

METERS (Rev3)

Trimble #0224025354, Antenna # 0220286517, Handset # 0220175080					
QC Daily GPS (meters)					
Date	AM/PM	Northing (meters)	Easting (meters)	Offset (m)	P/F
9/27/2005	pm	2113662.6	3618793.0	0.28	PASS
9/29/2005	AM	2113662.2	3618792.6	0.78	PASS
10/3/2005	AM	2113663.3	3618793.1	0.44	PASS
10/4/2005	AM	2113663.1	3618792.8	0.28	PASS
10/5/2005	AM	2113662.700	3618792.600	0.42	PASS

Trimble #0224025354, Antenna # 0220286517, Handset # 0220175080		
Initial GPS Readings (meters)		
Date	Northing	Easting
9/27/2005	2113662.7	3618792.8
9/27/2005	2113662.8	3618792.8
9/27/2005	2113662.9	3618793.0
9/27/2005	2113663.1	3618793.0
9/27/2005	2113663.1	3618792.9
9/27/2005	2113663.1	3618793.0
9/27/2005	2113662.9	3618793.0
9/27/2005	2113662.7	3618793.1
9/27/2005	2113662.7	3618793.1
9/27/2005	2113662.8	3618793.1
	Average	
	2113662.880	3618792.980

max	2113663.1	3618793.1
Min	2113662.7	3618792.8
Delta	0.40000	0.30000
Stdev	0.164041831	0.093169499
Max offset (m)	0.5	AS

CABRERA ALPHA-BETA COUNTING INSTRUMENT (Rev 5)

Counting Instrument:	2929	Detector:	43-10-1	Calibration Date:	3/8/2005
Serial #:	163827	Serial #:	PR 171322	12 month calibration:	OK
Detector Active Area or Area Covered by Smear (cm^2):	100			NRC 6 Mo Cal. Due Date?	WARNING

	Efficiency (fraction)	Source Nuclide	Source Number	Original Source Activity (DPM)	Source Creation Date	$T_{1/2}$ (yr)	Source Decayed Activity	Required MDA (DPM/100cm^2)	Control Chart & Daily Bkg Count Time	Control Chart & Daily Source-Sample Count Time	Control Chart bkg Average α/β cpm	Control Chart bkg 1 sigma, cpm	Control Chart Source-bkg Average α/β cpm	Control Chart source 1 sigma, cpm
Alpha	0.3770	Th 230	3975-02	17,500	4/29/2002	7.54E+04	17,499	20	20	2	0.16	0.06	6216.3	72.75
Beta	0.1200	Tc 99	3975-02	17,700	4/29/2002	2.11E+05	17,700	1000	20	2	42.26	1.56	3892.2	70.70

Date	Daily Bkg Counts		Daily Check Source Counts		Daily Bkg Rate (cpm)		Net Daily Source Rate (cpm)		Bkg QC Pass/Fail		Source QC Pass/Fail				α MDA OK?	β MDA OK?	H.P. Technician	Technician Initials
	Alpha	Beta	Alpha	Beta	Alpha	Beta	Alpha	Beta	Alpha	Beta	Alpha	Beta	MDA α (dpm)	MDA β (dpm)				
11/16/2005	2	860	12274	7980	0.1	43.0	6136.9	3947.0	PASS	PASS	PASS	PASS	6.03	146	Yes	Yes	Jon Cote	JAC
11/17/2005	5	893	12368	7756	0.3	44.7	6183.8	3823.4	PASS	PASS	PASS	PASS	7.21	148	Yes	Yes	Jon Cote	JAC
11/18/2005	3	843	12447	7861	0.2	42.2	6223.4	3888.4	PASS	PASS	PASS	PASS	6.49	145	Yes	Yes	Jon Cote	JAC

CABRERA ALPHA-BETA COUNTING INSTRUMENT (Rev 5)

Initial Background and Source Counts for Control Chart								
	Initial Counts				Initial Source plus Counts			
#	Alpha	cpm	Beta	cpm	Alpha	cpm	Beta	cpm
1	6	0.3	868	43.4	12361	6180.5	7871	3935.5
2	1	0.05	878	43.9	12372	6186	7862	3931
3	4	0.2	809	40.45	12353	6176.5	8043	4021.5
4	3	0.15	841	42.05	12426	6213	7683	3841.5
5	2	0.1	804	40.2	12370	6185	7841	3920.5
6	3	0.15	845	42.25	12371	6185.5	8055	4027.5
7	5	0.25	833	41.65	12784	6392	7948	3974
8	4	0.2	831	41.55	12585	6292.5	7608	3804
9	2	0.1	906	45.3	12419	6209.5	7847	3923.5
10	2	0.1	837	41.85	12288	6144	7932	3966
Mean		0.16		42.3		6216.5		3934.5
$S_{(n-1)}$		0.08		1.56		72.78		70.54
-3 sigma		-0.07		37.69		5998.11		3722.89
+3 sigma		0.39		46.93		6434.79		4146.11
-2 sigma		0.01		39.14		6070.89		3793.42
+2 sigma		0.31		45.38		6362.01		4075.58
					Mean bkg	6216.3		3892.2
					$S_{(n-1)}$	72.75		70.70
				Mean bkg	-3 sigma	5998.05		3680.14
				Mean bkg	+3 sigma	6434.53		4104.34
				Mean bkg	-2 sigma	6070.80		3750.84
				Mean bkg	+2 sigma	6361.78		4033.64
						6160.2		3892.1
						6185.95		3887.1
						6176.3		3981.05
						6212.85		3799.45
						6184.9		3880.3
						6185.35		3985.25
						6391.75		3932.35
						6292.3		3762.45
						6209.4		3878.2
						6143.9		3924.15

APPENDIX E

RESRAD V. 5.0 RUN FOR FT BELVOIR VAULT BLDG 7304

ummary : Ft Belvoir Farmer 641m2 Ave
ile : RESRAD Ft Belvoir 641m2 Farmer Ave ROC.RAD

Table of Contents

Part I: Mixture Sums and Single Radionuclide Guidelines

Dose Conversion Factor (and Related) Parameter Summary
File: HEAST 2001 MORBIDITY

enu	Parameter	Current Value	Base Case*	Parameter Name
-1	Dose conversion factors for inhalation, mrem/pCi:			
-1	Am-241	4.440E-01	4.440E-01	DCF2(1)
-1	C-14	2.090E-06	2.090E-06	DCF2(2)
-1	Cs-137+D	3.190E-05	3.190E-05	DCF2(3)
-1	H-3	6.400E-08	6.400E-08	DCF2(4)
-1	Np-237+D	5.400E-01	5.400E-01	DCF2(5)
-1	Pm-147	3.920E-05	3.920E-05	DCF2(6)
-1	Ra-228+D	5.078E-03	4.770E-03	DCF2(7)
-1	Sm-147	7.470E-02	7.470E-02	DCF2(8)
-1	Th-228+D	3.454E-01	3.420E-01	DCF2(9)
-1	Th-229+D	2.169E+00	2.150E+00	DCF2(10)
-1	Th-232	1.640E+00	1.640E+00	DCF2(11)
-1	U-233	1.350E-01	1.350E-01	DCF2(12)
-1	Dose conversion factors for ingestion, mrem/pCi:			
-1	Am-241	3.640E-03	3.640E-03	DCF3(1)
-1	C-14	2.090E-06	2.090E-06	DCF3(2)
-1	Cs-137+D	5.000E-05	5.000E-05	DCF3(3)
-1	H-3	6.400E-08	6.400E-08	DCF3(4)
-1	Np-237+D	4.444E-03	4.440E-03	DCF3(5)
-1	Pm-147	1.050E-06	1.050E-06	DCF3(6)
-1	Ra-228+D	1.442E-03	1.440E-03	DCF3(7)
-1	Sm-147	1.850E-04	1.850E-04	DCF3(8)
-1	Th-228+D	8.086E-04	3.960E-04	DCF3(9)
-1	Th-229+D	4.027E-03	3.530E-03	DCF3(10)
-1	Th-232	2.730E-03	2.730E-03	DCF3(11)
-1	U-233	2.890E-04	2.890E-04	DCF3(12)
-34	Food transfer factors:			
-34	Am-241 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(1,1)
-34	Am-241 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	5.000E-05	5.000E-05	RTF(1,2)
-34	Am-241 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-06	2.000E-06	RTF(1,3)
-34				
-34	C-14 , plant/soil concentration ratio, dimensionless	5.500E+00	5.500E+00	RTF(2,1)
-34	C-14 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.100E-02	3.100E-02	RTF(2,2)
-34	C-14 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.200E-02	1.200E-02	RTF(2,3)
-34				
-34	Cs-137+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(3,1)
-34	Cs-137+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.000E-02	3.000E-02	RTF(3,2)
-34	Cs-137+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	8.000E-03	8.000E-03	RTF(3,3)
-34				
-34	H-3 , plant/soil concentration ratio, dimensionless	4.800E+00	4.800E+00	RTF(4,1)
-34	H-3 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.200E-02	1.200E-02	RTF(4,2)
-34	H-3 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-02	1.000E-02	RTF(4,3)
-34				
-34	Np-237+D , plant/soil concentration ratio, dimensionless	2.000E-02	2.000E-02	RTF(5,1)
-34	Np-237+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(5,2)
-34	Np-237+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(5,3)
-34				

Dose Conversion Factor (and Related) Parameter Summary (continued)
File: HEAST 2001 MORBIDITY

Menu	Parameter	Current Value	Base Case*	Parameter Name
D-34	Pm-147 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(6,1)
D-34	Pm-147 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-03	2.000E-03	RTF(6,2)
D-34	Pm-147 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-05	2.000E-05	RTF(6,3)
D-34				
D-34	Ra-228+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(7,1)
D-34	Ra-228+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(7,2)
D-34	Ra-228+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-03	1.000E-03	RTF(7,3)
D-34				
D-34	Sm-147 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(8,1)
D-34	Sm-147 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-03	2.000E-03	RTF(8,2)
D-34	Sm-147 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-05	2.000E-05	RTF(8,3)
D-34				
D-34	Th-228+D , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(9,1)
D-34	Th-228+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(9,2)
D-34	Th-228+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(9,3)
D-34				
D-34	Th-229+D , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(10,1)
D-34	Th-229+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(10,2)
D-34	Th-229+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(10,3)
D-34				
D-34	Th-232 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(11,1)
D-34	Th-232 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(11,2)
D-34	Th-232 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(11,3)
D-34				
D-34	U-233 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(12,1)
D-34	U-233 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(12,2)
D-34	U-233 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(12,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	Am-241 , fish	3.000E+01	3.000E+01	BIOFAC(1,1)
D-5	Am-241 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(1,2)
D-5				
D-5	C-14 , fish	5.000E+04	5.000E+04	BIOFAC(2,1)
D-5	C-14 , crustacea and mollusks	9.100E+03	9.100E+03	BIOFAC(2,2)
D-5				
D-5	Cs-137+D , fish	2.000E+03	2.000E+03	BIOFAC(3,1)
D-5	Cs-137+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(3,2)
D-5				
D-5	H-3 , fish	1.000E+00	1.000E+00	BIOFAC(4,1)
D-5	H-3 , crustacea and mollusks	1.000E+00	1.000E+00	BIOFAC(4,2)
D-5				
D-5	Np-237+D , fish	3.000E+01	3.000E+01	BIOFAC(5,1)
D-5	Np-237+D , crustacea and mollusks	4.000E+02	4.000E+02	BIOFAC(5,2)
D-5				
D-5	Pm-147 , fish	3.000E+01	3.000E+01	BIOFAC(6,1)
D-5	Pm-147 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(6,2)
D-5				
D-5	Ra-228+D , fish	5.000E+01	5.000E+01	BIOFAC(7,1)
D-5	Ra-228+D , crustacea and mollusks	2.500E+02	2.500E+02	BIOFAC(7,2)
D-5				

Dose Conversion Factor (and Related) Parameter Summary (continued)
File: HEAST 2001 MORBIDITY

anu	Parameter	Current Value	Base Case*	Parameter Name
-5	Sm-147 , fish	2.500E+01	2.500E+01	BIOFAC(8,1)
-5	Sm-147 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(8,2)
-5				
-5	Th-228+D , fish	1.000E+02	1.000E+02	BIOFAC(9,1)
-5	Th-228+D , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(9,2)
-5				
-5	Th-229+D , fish	1.000E+02	1.000E+02	BIOFAC(10,1)
-5	Th-229+D , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(10,2)
-5				
-5	Th-232 , fish	1.000E+02	1.000E+02	BIOFAC(11,1)
-5	Th-232 , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(11,2)
-5				
-5	U-233 , fish	1.000E+01	1.000E+01	BIOFAC(12,1)
-5	U-233 , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(12,2)

Base Case means Default.Lib w/o Associate Nuclide contributions.

Site-Specific Parameter Summary

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R011	Area of contaminated zone (m**2)	6.410E+02	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	4.573E+00	2.000E+00	---	THICK0
R011	Length parallel to aquifer flow (m)	2.532E+01	1.000E+02	---	LCZPAQ
R011	Basic radiation dose limit (mrem/yr)	1.500E+01	3.000E+01	---	BRDL
R011	Time since placement of material (yr)	0.000E+00	0.000E+00	---	TI
R011	Times for calculations (yr)	1.000E+00	1.000E+00	---	T(2)
R011	Times for calculations (yr)	3.000E+00	3.000E+00	---	T(3)
R011	Times for calculations (yr)	1.000E+01	1.000E+01	---	T(4)
R011	Times for calculations (yr)	3.000E+01	3.000E+01	---	T(5)
R011	Times for calculations (yr)	1.000E+02	1.000E+02	---	T(6)
R011	Times for calculations (yr)	3.000E+02	3.000E+02	---	T(7)
R011	Times for calculations (yr)	1.000E+03	1.000E+03	---	T(8)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(9)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(10)
R012	Initial principal radionuclide (pCi/g): Am-241	8.000E-03	0.000E+00	---	S1(1)
R012	Initial principal radionuclide (pCi/g): C-14	4.100E-02	0.000E+00	---	S1(2)
R012	Initial principal radionuclide (pCi/g): Cs-137	2.500E-02	0.000E+00	---	S1(3)
R012	Initial principal radionuclide (pCi/g): H-3	6.078E+00	0.000E+00	---	S1(4)
R012	Initial principal radionuclide (pCi/g): Pm-147	6.851E+00	0.000E+00	---	S1(6)
R012	Initial principal radionuclide (pCi/g): Th-232	5.730E-01	0.000E+00	---	S1(11)
R012	Concentration in groundwater (pCi/L): Am-241	not used	0.000E+00	---	W1(1)
R012	Concentration in groundwater (pCi/L): C-14	not used	0.000E+00	---	W1(2)
R012	Concentration in groundwater (pCi/L): Cs-137	not used	0.000E+00	---	W1(3)
R012	Concentration in groundwater (pCi/L): H-3	not used	0.000E+00	---	W1(4)
R012	Concentration in groundwater (pCi/L): Pm-147	not used	0.000E+00	---	W1(6)
R012	Concentration in groundwater (pCi/L): Th-232	not used	0.000E+00	---	W1(11)
R013	Cover depth (m)	0.000E+00	0.000E+00	---	COVER0
R013	Density of cover material (g/cm**3)	not used	1.500E+00	---	DENSCV
R013	Cover depth erosion rate (m/yr)	not used	1.000E-03	---	VCV
R013	Density of contaminated zone (g/cm**3)	1.431E+00	1.500E+00	---	DENSCZ
R013	Contaminated zone erosion rate (m/yr)	1.000E-03	1.000E-03	---	VCZ
R013	Contaminated zone total porosity	4.000E-01	4.000E-01	---	TPCZ
R013	Contaminated zone field capacity	2.000E-01	2.000E-01	---	FCCZ
R013	Contaminated zone hydraulic conductivity (m/yr)	1.000E+01	1.000E+01	---	HCCZ
R013	Contaminated zone b parameter	5.300E+00	5.300E+00	---	BCZ
R013	Average annual wind speed (m/sec)	2.000E+00	2.000E+00	---	WIND
R013	Humidity in air (g/m**3)	8.000E+00	8.000E+00	---	HUMID
R013	Evapotranspiration coefficient	5.000E-01	5.000E-01	---	EVAPTR
R013	Precipitation (m/yr)	9.812E-01	1.000E+00	---	PRECIP
R013	Irrigation (m/yr)	2.000E-01	2.000E-01	---	RI
R013	Irrigation mode	overhead	overhead	---	IDITCH
R013	Runoff coefficient	2.000E-01	2.000E-01	---	RUNOFF
R013	Watershed area for nearby stream or pond (m**2)	1.000E+06	1.000E+06	---	WAREA
R013	Accuracy for water/soil computations	1.000E-03	1.000E-03	---	EPS
R014	Density of saturated zone (g/cm**3)	1.431E+00	1.500E+00	---	DENSAQ
R014	Saturated zone total porosity	4.000E-01	4.000E-01	---	TPSZ
R014	Saturated zone effective porosity	2.000E-01	2.000E-01	---	EPSZ

Site-Specific Parameter Summary (continued)

Anu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
)14	Saturated zone field capacity	2.000E-01	2.000E-01	---	FCSZ
)14	Saturated zone hydraulic conductivity (m/yr)	1.000E+02	1.000E+02	---	HCSZ
)14	Saturated zone hydraulic gradient	2.000E-02	2.000E-02	---	HGWT
)14	Saturated zone b parameter	5.300E+00	5.300E+00	---	BSZ
)14	Water table drop rate (m/yr)	1.000E-03	1.000E-03	---	VWT
)14	Well pump intake depth (m below water table)	1.000E+01	1.000E+01	---	DWIBWT
)14	Model: Nondispersion (ND) or Mass-Balance (MB)	MB	ND	---	MODEL
)14	Well pumping rate (m**3/yr)	2.500E+02	2.500E+02	---	UW
)15	Number of unsaturated zone strata	0	1	---	NS
)16	Distribution coefficients for Am-241				
)16	Contaminated zone (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCC(1)
016	Saturated zone (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCS(1)
016	Leach rate (/yr)	0.000E+00	0.000E+00	3.721E-03	ALEACH(1)
016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
016	Distribution coefficients for C-14				
016	Contaminated zone (cm**3/g)	0.000E+00	0.000E+00	---	DCNUCC(2)
016	Saturated zone (cm**3/g)	0.000E+00	0.000E+00	---	DCNUCS(2)
016	Leach rate (/yr)	0.000E+00	0.000E+00	3.360E-01	ALEACH(2)
016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(2)
016	Distribution coefficients for Cs-137				
016	Contaminated zone (cm**3/g)	4.600E+03	4.600E+03	---	DCNUCC(3)
016	Saturated zone (cm**3/g)	4.600E+03	4.600E+03	---	DCNUCS(3)
016	Leach rate (/yr)	0.000E+00	0.000E+00	1.636E-05	ALEACH(3)
016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(3)
016	Distribution coefficients for H-3				
016	Contaminated zone (cm**3/g)	0.000E+00	0.000E+00	---	DCNUCC(4)
016	Saturated zone (cm**3/g)	0.000E+00	0.000E+00	---	DCNUCS(4)
016	Leach rate (/yr)	0.000E+00	0.000E+00	3.360E-01	ALEACH(4)
016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(4)
016	Distribution coefficients for Pm-147				
016	Contaminated zone (cm**3/g)	-1.000E+00	-1.000E+00	8.249E+02	DCNUCC(6)
016	Saturated zone (cm**3/g)	-1.000E+00	-1.000E+00	8.249E+02	DCNUCS(6)
016	Leach rate (/yr)	0.000E+00	0.000E+00	9.120E-05	ALEACH(6)
016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(6)
016	Distribution coefficients for Th-232				
016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCC(11)
016	Saturated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCS(11)
016	Leach rate (/yr)	0.000E+00	0.000E+00	1.254E-06	ALEACH(11)
016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(11)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R016	Distribution coefficients for daughter Np-237				
R016	Contaminated zone (cm**3/g)	-1.000E+00	-1.000E+00	2.574E+02	DCNUCC(5)
R016	Saturated zone (cm**3/g)	-1.000E+00	-1.000E+00	2.574E+02	DCNUCS(5)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.921E-04	ALEACH(5)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(5)
R016	Distribution coefficients for daughter Ra-228				
R016	Contaminated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCC(7)
R016	Saturated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCS(7)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.072E-03	ALEACH(7)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(7)
R016	Distribution coefficients for daughter Sm-147				
R016	Contaminated zone (cm**3/g)	-1.000E+00	-1.000E+00	8.249E+02	DCNUCC(8)
R016	Saturated zone (cm**3/g)	-1.000E+00	-1.000E+00	8.249E+02	DCNUCS(8)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	9.120E-05	ALEACH(8)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(8)
R016	Distribution coefficients for daughter Th-228				
R016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCC(9)
R016	Saturated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCS(9)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.254E-06	ALEACH(9)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(9)
R016	Distribution coefficients for daughter Th-229				
R016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCC(10)
R016	Saturated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCS(10)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.254E-06	ALEACH(10)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(10)
R016	Distribution coefficients for daughter U-233				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(12)
R016	Saturated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCS(12)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.498E-03	ALEACH(12)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(12)
R017	Inhalation rate (m**3/yr)	8.513E+03	8.400E+03	---	INHALR
R017	Mass loading for inhalation (g/m**3)	4.000E-04	1.000E-04	---	MLINH
R017	Exposure duration	3.000E+01	3.000E+01	---	ED
R017	Shielding factor, inhalation	2.500E-01	4.000E-01	---	SHF3
R017	Shielding factor, external gamma	5.512E-01	7.000E-01	---	SHF1
R017	Fraction of time spent indoors	6.571E-01	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	1.101E-01	2.500E-01	---	FOTD
R017	Shape factor flag, external gamma	1.000E+00	1.000E+00	>0 shows circular AREA.	FS

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
017	Radii of shape factor array (used if FS = -1):				
017	Outer annular radius (m), ring 1:	not used	5.000E+01	---	RAD_SHAPE(1)
017	Outer annular radius (m), ring 2:	not used	7.071E+01	---	RAD_SHAPE(2)
017	Outer annular radius (m), ring 3:	not used	0.000E+00	---	RAD_SHAPE(3)
017	Outer annular radius (m), ring 4:	not used	0.000E+00	---	RAD_SHAPE(4)
017	Outer annular radius (m), ring 5:	not used	0.000E+00	---	RAD_SHAPE(5)
017	Outer annular radius (m), ring 6:	not used	0.000E+00	---	RAD_SHAPE(6)
017	Outer annular radius (m), ring 7:	not used	0.000E+00	---	RAD_SHAPE(7)
017	Outer annular radius (m), ring 8:	not used	0.000E+00	---	RAD_SHAPE(8)
017	Outer annular radius (m), ring 9:	not used	0.000E+00	---	RAD_SHAPE(9)
017	Outer annular radius (m), ring 10:	not used	0.000E+00	---	RAD_SHAPE(10)
017	Outer annular radius (m), ring 11:	not used	0.000E+00	---	RAD_SHAPE(11)
017	Outer annular radius (m), ring 12:	not used	0.000E+00	---	RAD_SHAPE(12)
017	Fractions of annular areas within AREA:				
017	Ring 1	not used	1.000E+00	---	FRACA(1)
017	Ring 2	not used	2.732E-01	---	FRACA(2)
017	Ring 3	not used	0.000E+00	---	FRACA(3)
017	Ring 4	not used	0.000E+00	---	FRACA(4)
017	Ring 5	not used	0.000E+00	---	FRACA(5)
017	Ring 6	not used	0.000E+00	---	FRACA(6)
017	Ring 7	not used	0.000E+00	---	FRACA(7)
017	Ring 8	not used	0.000E+00	---	FRACA(8)
017	Ring 9	not used	0.000E+00	---	FRACA(9)
017	Ring 10	not used	0.000E+00	---	FRACA(10)
017	Ring 11	not used	0.000E+00	---	FRACA(11)
017	Ring 12	not used	0.000E+00	---	FRACA(12)
018	Fruits, vegetables and grain consumption (kg/yr)	1.118E+02	1.600E+02	---	DIET(1)
018	Leafy vegetable consumption (kg/yr)	2.140E+01	1.400E+01	---	DIET(2)
018	Milk consumption (L/yr)	2.330E+02	9.200E+01	---	DIET(3)
018	Meat and poultry consumption (kg/yr)	6.510E+01	6.300E+01	---	DIET(4)
018	Fish consumption (kg/yr)	2.060E+01	5.400E+00	---	DIET(5)
018	Other seafood consumption (kg/yr)	0.000E+00	9.000E-01	---	DIET(6)
018	Soil ingestion rate (g/yr)	1.826E+01	3.650E+01	---	SOIL
018	Drinking water intake (L/yr)	4.785E+02	5.100E+02	---	DWI
018	Contamination fraction of drinking water	1.000E+00	1.000E+00	---	FDW
018	Contamination fraction of household water	not used	1.000E+00	---	FHHW
018	Contamination fraction of livestock water	1.000E+00	1.000E+00	---	FLW
018	Contamination fraction of irrigation water	1.000E+00	1.000E+00	---	FIRW
018	Contamination fraction of aquatic food	1.000E+00	5.000E-01	---	FR9
018	Contamination fraction of plant food	1.000E+00	-1	---	FPLANT
018	Contamination fraction of meat	1.000E+00	-1	---	FMEAT
018	Contamination fraction of milk	1.000E+00	-1	---	FMILK
019	Livestock fodder intake for meat (kg/day)	2.685E+01	6.800E+01	---	LFI5
019	Livestock fodder intake for milk (kg/day)	6.325E+01	5.500E+01	---	LFI6
019	Livestock water intake for meat (L/day)	5.000E+01	5.000E+01	---	LWI5
019	Livestock water intake for milk (L/day)	6.000E+01	1.600E+02	---	LWI6
019	Livestock soil intake (kg/day)	2.000E-02	5.000E-01	---	LSI

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R019	Mass loading for foliar deposition (g/m**3)	1.000E-04	1.000E-04	---	MLFD
R019	Depth of soil mixing layer (m)	1.500E-01	1.500E-01	---	DM
019	Depth of roots (m)	9.000E-01	9.000E-01	---	DROOT
019	Drinking water fraction from ground water	1.000E+00	1.000E+00	---	FGWDW
R019	Household water fraction from ground water	not used	1.000E+00	---	FGWHH
019	Livestock water fraction from ground water	1.000E+00	1.000E+00	---	FGWLW
019	Irrigation fraction from ground water	1.000E+00	1.000E+00	---	FGWIR
R19B	Wet weight crop yield for Non-Leafy (kg/m**2)	4.000E+00	7.000E-01	---	YV(1)
19B	Wet weight crop yield for Leafy (kg/m**2)	2.000E+00	1.500E+00	---	YV(2)
19B	Wet weight crop yield for Fodder (kg/m**2)	1.500E+00	1.100E+00	---	YV(3)
R19B	Growing Season for Non-Leafy (years)	2.500E-01	1.700E-01	---	TE(1)
19B	Growing Season for Leafy (years)	2.500E-01	2.500E-01	---	TE(2)
19B	Growing Season for Fodder (years)	8.000E-02	8.000E-02	---	TE(3)
R19B	Translocation Factor for Non-Leafy	1.000E-01	1.000E-01	---	TIV(1)
19B	Translocation Factor for Leafy	1.000E+00	1.000E+00	---	TIV(2)
19B	Translocation Factor for Fodder	1.000E+00	1.000E+00	---	TIV(3)
R19B	Dry Foliar Interception Fraction for Non-Leafy	2.500E-01	2.500E-01	---	RDRY(1)
R19B	Dry Foliar Interception Fraction for Leafy	2.500E-01	2.500E-01	---	RDRY(2)
19B	Dry Foliar Interception Fraction for Fodder	2.500E-01	2.500E-01	---	RDRY(3)
19B	Wet Foliar Interception Fraction for Non-Leafy	2.500E-01	2.500E-01	---	RWET(1)
R19B	Wet Foliar Interception Fraction for Leafy	2.500E-01	2.500E-01	---	RWET(2)
19B	Wet Foliar Interception Fraction for Fodder	2.500E-01	2.500E-01	---	RWET(3)
19B	Weathering Removal Constant for Vegetation	2.000E+01	2.000E+01	---	WLAM
C14	C-12 concentration in water (g/cm**3)	2.000E-05	2.000E-05	---	C12WTR
14	C-12 concentration in contaminated soil (g/g)	3.000E-02	3.000E-02	---	C12CZ
C14	Fraction of vegetation carbon from soil	2.000E-02	2.000E-02	---	CSOIL
C14	Fraction of vegetation carbon from air	9.800E-01	9.800E-01	---	CAIR
14	C-14 evasion layer thickness in soil (m)	3.000E-01	3.000E-01	---	DMC
14	C-14 evasion flux rate from soil (1/sec)	7.000E-07	7.000E-07	---	EVSN
C14	C-12 evasion flux rate from soil (1/sec)	1.000E-10	1.000E-10	---	REVSN
14	Fraction of grain in beef cattle feed	8.000E-01	8.000E-01	---	AVFG4
14	Fraction of grain in milk cow feed	2.000E-01	2.000E-01	---	AVFG5
C14	DCF correction factor for gaseous forms of C14	8.894E+01	0.000E+00	---	CO2F
TOR	Storage times of contaminated foodstuffs (days):				
STOR	Fruits, non-leafy vegetables, and grain	1.400E+01	1.400E+01	---	STOR_T(1)
STOR	Leafy vegetables	1.000E+00	1.000E+00	---	STOR_T(2)
TOR	Milk	1.000E+00	1.000E+00	---	STOR_T(3)
TOR	Meat and poultry	2.000E+01	2.000E+01	---	STOR_T(4)
STOR	Fish	7.000E+00	7.000E+00	---	STOR_T(5)
TOR	Crustacea and mollusks	7.000E+00	7.000E+00	---	STOR_T(6)
TOR	Well water	0.000E+00	1.000E+00	---	STOR_T(7)
STOR	Surface water	0.000E+00	1.000E+00	---	STOR_T(8)
STOR	Livestock fodder	0.000E+00	4.500E+01	---	STOR_T(9)
R021	Thickness of building foundation (m)	not used	1.500E-01	---	FLOOR1
R021	Bulk density of building foundation (g/cm**3)	not used	2.400E+00	---	DENSFL
021	Total porosity of the cover material	not used	4.000E-01	---	TPCV

Site-Specific Parameter Summary (continued)

enu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
021	Total porosity of the building foundation	not used	1.000E-01	---	TPFL
021	Volumetric water content of the cover material	not used	5.000E-02	---	PH2OCV
021	Volumetric water content of the foundation	not used	3.000E-02	---	PH2OFL
021	Diffusion coefficient for radon gas (m/sec):				
021	in cover material	not used	2.000E-06	---	DIFCV
021	in foundation material	not used	3.000E-07	---	DIFFL
021	in contaminated zone soil	not used	2.000E-06	---	DIFCZ
021	Radon vertical dimension of mixing (m)	not used	2.000E+00	---	HMIX
021	Average building air exchange rate (1/hr)	not used	5.000E-01	---	REXG
021	Height of the building (room) (m)	not used	2.500E+00	---	HRM
021	Building interior area factor	not used	0.000E+00	---	FAI
021	Building depth below ground surface (m)	not used	-1.000E+00	---	DMFL
021	Emanating power of Rn-222 gas	not used	2.500E-01	---	EMANA(1)
021	Emanating power of Rn-220 gas	not used	1.500E-01	---	EMANA(2)
ITL	Number of graphical time points	1024	---	---	NPTS
ITL	Maximum number of integration points for dose	17	---	---	LYMAX
ITL	Maximum number of integration points for risk	257	---	---	KYMAX

Summary of Pathway Selections

Pathway	User Selection
1 -- external gamma	active
2 -- inhalation (w/o radon)	active
3 -- plant ingestion	active
4 -- meat ingestion	active
5 -- milk ingestion	active
6 -- aquatic foods	active
7 -- drinking water	active
8 -- soil ingestion	active
9 -- radon	suppressed
Find peak pathway doses	active

Summary : Ft Belvoir Farmer 641m2 Ave
File : RESRAD Ft Belvoir 641m2 Farmer Ave ROC.RAD

Contaminated Zone Dimensions		Initial Soil Concentrations, pCi/g	
Area:	641.00 square meters	Am-241	8.000E-03
Thickness:	4.57 meters	C-14	4.100E-02
Cover Depth:	0.00 meters	Cs-137	2.500E-02
		H-3	6.078E+00
		Pm-147	6.851E+00
		Th-232	5.730E-01

Total Dose TDOSE(t), mrem/yr
Basic Radiation Dose Limit = 1.500E+01 mrem/yr
Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

t (years):	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
TDOSE(t):	3.198E+00	3.827E+00	5.760E+00	1.097E+01	1.384E+01	1.148E+01	9.493E+00	9.187E+00
M(t):	2.132E-01	2.551E-01	3.840E-01	7.311E-01	9.227E-01	7.653E-01	6.328E-01	6.124E-01

Maximum TDOSE(t): 1.385E+01 mrem/yr at t = 28.48 ± 0.06 years

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 2.848E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio-nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	1.289E-04	0.0000	3.619E-04	0.0000	0.000E+00	0.0000	3.327E-03	0.0002	3.823E-06	0.0000	9.706E-07	0.0000	2.241E-04	0.0000
C-14	6.644E-30	0.0000	1.676E-28	0.0000	0.000E+00	0.0000	1.317E-24	0.0000	4.554E-25	0.0000	4.328E-25	0.0000	2.151E-29	0.0000
Cs-137	1.806E-02	0.0013	4.851E-08	0.0000	0.000E+00	0.0000	3.408E-03	0.0002	1.367E-03	0.0001	3.040E-03	0.0002	5.743E-06	0.0000
H-3	0.000E+00	0.0000	5.454E-13	0.0000	0.000E+00	0.0000	1.226E-10	0.0000	1.371E-11	0.0000	1.058E-10	0.0000	2.266E-15	0.0000
Pm-147	6.977E-08	0.0000	1.509E-08	0.0000	0.000E+00	0.0000	1.132E-06	0.0000	3.860E-08	0.0000	2.825E-09	0.0000	3.053E-08	0.0000
Th-232	3.693E+00	0.2667	1.343E-01	0.0097	0.000E+00	0.0000	4.513E+00	0.3259	5.747E-02	0.0041	4.726E-01	0.0341	2.513E-02	0.0018
Total	3.711E+00	0.2680	1.347E-01	0.0097	0.000E+00	0.0000	4.519E+00	0.3264	5.884E-02	0.0042	4.757E-01	0.0343	2.536E-02	0.0018

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 2.848E+01 years

Water Dependent Pathways

adio-nuclide nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
m-241	5.888E-01	0.0425	4.875E-04	0.0000	0.000E+00	0.0000	4.126E-02	0.0030	3.434E-04	0.0000	8.265E-05	0.0000	6.350E-01	0.0459
-14	5.658E-24	0.0000	8.081E-24	0.0000	0.000E+00	0.0000	1.385E-24	0.0000	1.281E-24	0.0000	1.359E-24	0.0000	1.997E-23	0.0000
s-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.588E-02	0.0019
-3	5.574E-10	0.0000	1.558E-14	0.0000	0.000E+00	0.0000	1.206E-10	0.0000	3.746E-11	0.0000	1.641E-10	0.0000	1.122E-09	0.0000
m-147	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.289E-06	0.0000
h-232	3.715E+00	0.2682	5.136E-03	0.0004	0.000E+00	0.0000	2.673E-01	0.0193	4.350E-02	0.0031	2.609E-01	0.0188	1.319E+01	0.9523
otal	4.303E+00	0.3108	5.623E-03	0.0004	0.000E+00	0.0000	3.085E-01	0.0223	4.385E-02	0.0032	2.609E-01	0.0188	1.385E+01	1.0000

Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-uclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	1.500E-04	0.0000	4.212E-04	0.0001	0.000E+00	0.0000	3.871E-03	0.0012	4.437E-06	0.0000	1.129E-06	0.0000	2.608E-04	0.0001
-14	1.107E-07	0.0000	2.793E-06	0.0000	0.000E+00	0.0000	2.186E-02	0.0068	7.551E-03	0.0024	7.211E-03	0.0023	3.584E-07	0.0000
s-137	3.488E-02	0.0109	9.373E-08	0.0000	0.000E+00	0.0000	6.584E-03	0.0021	2.640E-03	0.0008	5.874E-03	0.0018	1.110E-05	0.0000
H-3	0.000E+00	0.0000	5.970E-04	0.0002	0.000E+00	0.0000	1.341E-01	0.0419	1.499E-02	0.0047	1.158E-01	0.0362	2.481E-06	0.0000
Pm-147	1.297E-04	0.0000	2.806E-05	0.0000	0.000E+00	0.0000	2.105E-03	0.0007	7.177E-05	0.0000	5.252E-06	0.0000	5.676E-05	0.0000
h-232	9.872E-02	0.0309	1.119E-01	0.0350	0.000E+00	0.0000	4.488E-01	0.1403	3.543E-03	0.0011	2.844E-02	0.0089	1.450E-02	0.0045
Total	1.339E-01	0.0419	1.129E-01	0.0353	0.000E+00	0.0000	6.174E-01	0.1930	2.880E-02	0.0090	1.573E-01	0.0492	1.484E-02	0.0046

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

Water Dependent Pathways

adio-Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
m-241	6.503E-01	0.2033	5.293E-04	0.0002	0.000E+00	0.0000	4.511E-02	0.0141	3.553E-04	0.0001	9.109E-05	0.0000	7.011E-01	0.2192
-14	8.329E-02	0.0260	1.148E-01	0.0359	0.000E+00	0.0000	1.882E-02	0.0059	1.656E-02	0.0052	1.991E-02	0.0062	2.900E-01	0.0907
s-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.999E-02	0.0156
-3	5.663E-01	0.1771	1.546E-05	0.0000	0.000E+00	0.0000	1.169E-01	0.0366	3.489E-02	0.0109	1.662E-01	0.0520	1.150E+00	0.3595
m-147	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.397E-03	0.0007
Th-232	2.596E-01	0.0812	3.430E-04	0.0001	0.000E+00	0.0000	1.822E-02	0.0057	2.668E-03	0.0008	1.812E-02	0.0057	1.005E+00	0.3142
otal	1.559E+00	0.4876	1.157E-01	0.0362	0.000E+00	0.0000	1.991E-01	0.0622	5.448E-02	0.0170	2.043E-01	0.0639	3.198E+00	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

adio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
uclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
a-241	1.492E-04	0.0000	4.189E-04	0.0001	0.000E+00	0.0000	3.850E-03	0.0010	4.414E-06	0.0000	1.123E-06	0.0000	2.594E-04	0.0001
-14	1.853E-08	0.0000	4.673E-07	0.0000	0.000E+00	0.0000	3.669E-03	0.0010	1.269E-03	0.0003	1.207E-03	0.0003	5.998E-08	0.0000
s-137	3.409E-02	0.0089	9.159E-08	0.0000	0.000E+00	0.0000	6.433E-03	0.0017	2.580E-03	0.0007	5.739E-03	0.0015	1.084E-05	0.0000
-3	0.000E+00	0.0000	2.880E-04	0.0001	0.000E+00	0.0000	6.476E-02	0.0169	7.241E-03	0.0019	5.587E-02	0.0146	1.197E-06	0.0000
a-147	9.958E-05	0.0000	2.154E-05	0.0000	0.000E+00	0.0000	1.616E-03	0.0004	5.510E-05	0.0000	4.032E-06	0.0000	4.358E-05	0.0000
a-232	3.327E-01	0.0869	1.127E-01	0.0295	0.000E+00	0.0000	9.241E-01	0.2415	9.899E-03	0.0026	8.094E-02	0.0212	1.543E-02	0.0040
otal	3.670E-01	0.0959	1.134E-01	0.0296	0.000E+00	0.0000	1.004E+00	0.2625	2.105E-02	0.0055	1.438E-01	0.0376	1.575E-02	0.0041

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

Water Dependent Pathways

adio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
uclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
m-241	6.835E-01	0.1786	5.659E-04	0.0001	0.000E+00	0.0000	4.790E-02	0.0125	3.986E-04	0.0001	9.595E-05	0.0000	7.372E-01	0.1926
-14	1.563E-02	0.0041	2.232E-02	0.0058	0.000E+00	0.0000	3.825E-03	0.0010	3.536E-03	0.0009	3.755E-03	0.0010	5.521E-02	0.0144
s-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.885E-02	0.0128
-3	2.945E-01	0.0770	8.233E-06	0.0000	0.000E+00	0.0000	6.374E-02	0.0167	1.979E-02	0.0052	8.670E-02	0.0227	5.929E-01	0.1549
m-147	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.840E-03	0.0005
h-232	7.929E-01	0.2072	1.081E-03	0.0003	0.000E+00	0.0000	5.661E-02	0.0148	8.927E-03	0.0023	5.559E-02	0.0145	2.391E+00	0.6248
otal	1.787E+00	0.4668	2.398E-02	0.0063	0.000E+00	0.0000	1.721E-01	0.0450	3.266E-02	0.0085	1.461E-01	0.0382	3.827E+00	1.0000

Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	1.476E-04	0.0000	4.145E-04	0.0001	0.000E+00	0.0000	3.810E-03	0.0007	4.368E-06	0.0000	1.111E-06	0.0000	2.567E-04	0.0000
C-14	5.179E-10	0.0000	1.306E-08	0.0000	0.000E+00	0.0000	1.025E-04	0.0000	3.546E-05	0.0000	3.373E-05	0.0000	1.676E-09	0.0000
Cs-137	3.255E-02	0.0057	8.745E-08	0.0000	0.000E+00	0.0000	6.142E-03	0.0011	2.463E-03	0.0004	5.480E-03	0.0010	1.035E-05	0.0000
H-3	0.000E+00	0.0000	6.703E-05	0.0000	0.000E+00	0.0000	1.507E-02	0.0026	1.685E-03	0.0003	1.300E-02	0.0023	2.785E-07	0.0000
Pm-147	5.869E-05	0.0000	1.270E-05	0.0000	0.000E+00	0.0000	9.528E-04	0.0002	3.248E-05	0.0000	2.377E-06	0.0000	2.569E-05	0.0000
Th-232	8.762E-01	0.1521	1.155E-01	0.0201	0.000E+00	0.0000	1.722E+00	0.2990	2.053E-02	0.0036	1.686E-01	0.0293	1.725E-02	0.0030
Total	9.089E-01	0.1578	1.160E-01	0.0201	0.000E+00	0.0000	1.748E+00	0.3035	2.475E-02	0.0043	1.871E-01	0.0325	1.754E-02	0.0030

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+00 years

Water Dependent Pathways

Radio-Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	6.761E-01	0.1174	5.598E-04	0.0001	0.000E+00	0.0000	4.739E-02	0.0082	3.943E-04	0.0001	9.491E-05	0.0000	7.292E-01	0.1266
C-14	4.372E-04	0.0001	6.242E-04	0.0001	0.000E+00	0.0000	1.070E-04	0.0000	9.890E-05	0.0000	1.050E-04	0.0000	1.544E-03	0.0003
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.664E-02	0.0081
H-3	6.854E-02	0.0119	1.916E-06	0.0000	0.000E+00	0.0000	1.483E-02	0.0026	4.606E-03	0.0008	2.017E-02	0.0035	1.380E-01	0.0240
Pm-147	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.085E-03	0.0002
Th-232	1.666E+00	0.2892	2.291E-03	0.0004	0.000E+00	0.0000	1.195E-01	0.0207	1.923E-02	0.0033	1.169E-01	0.0203	4.844E+00	0.8409
Total	2.411E+00	0.4185	3.477E-03	0.0006	0.000E+00	0.0000	1.818E-01	0.0316	2.433E-02	0.0042	1.373E-01	0.0238	5.760E+00	1.0000

* Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

adio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
uclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
m-241	1.422E-04	0.0000	3.993E-04	0.0000	0.000E+00	0.0000	3.671E-03	0.0003	4.211E-06	0.0000	1.071E-06	0.0000	2.473E-04	0.0000
-14	1.853E-15	0.0000	4.672E-14	0.0000	0.000E+00	0.0000	3.669E-10	0.0000	1.269E-10	0.0000	1.207E-10	0.0000	5.997E-15	0.0000
s-137	2.768E-02	0.0025	7.438E-08	0.0000	0.000E+00	0.0000	5.225E-03	0.0005	2.095E-03	0.0002	4.661E-03	0.0004	8.805E-06	0.0000
-3	0.000E+00	0.0000	4.057E-07	0.0000	0.000E+00	0.0000	9.121E-05	0.0000	1.020E-05	0.0000	7.869E-05	0.0000	1.686E-09	0.0000
m-147	9.228E-06	0.0000	1.996E-06	0.0000	0.000E+00	0.0000	1.498E-04	0.0000	5.106E-06	0.0000	3.736E-07	0.0000	4.038E-06	0.0000
h-232	2.456E+00	0.2239	1.258E-01	0.0115	0.000E+00	0.0000	3.394E+00	0.3095	4.269E-02	0.0039	3.511E-01	0.0320	2.179E-02	0.0020
otal	2.484E+00	0.2265	1.262E-01	0.0115	0.000E+00	0.0000	3.403E+00	0.3103	4.481E-02	0.0041	3.558E-01	0.0324	2.205E-02	0.0020

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

Water Dependent Pathways

adio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
uclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
m-241	6.509E-01	0.0594	5.389E-04	0.0000	0.000E+00	0.0000	4.562E-02	0.0042	3.796E-04	0.0000	9.137E-05	0.0000	7.020E-01	0.0640
-14	1.568E-09	0.0000	2.238E-09	0.0000	0.000E+00	0.0000	3.836E-10	0.0000	3.547E-10	0.0000	3.766E-10	0.0000	5.535E-09	0.0000
s-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.967E-02	0.0036
-3	4.147E-04	0.0000	1.159E-08	0.0000	0.000E+00	0.0000	8.976E-05	0.0000	2.787E-05	0.0000	1.221E-04	0.0000	8.350E-04	0.0001
m-147	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.705E-04	0.0000
h-232	3.318E+00	0.3025	4.583E-03	0.0004	0.000E+00	0.0000	2.386E-01	0.0218	3.875E-02	0.0035	2.330E-01	0.0212	1.022E+01	0.9323
otal	3.969E+00	0.3619	5.121E-03	0.0005	0.000E+00	0.0000	2.843E-01	0.0259	3.916E-02	0.0036	2.332E-01	0.0213	1.097E+01	1.0000

Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio-nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	1.279E-04	0.0000	3.590E-04	0.0000	0.000E+00	0.0000	3.300E-03	0.0002	3.793E-06	0.0000	9.628E-07	0.0000	2.223E-04	0.0000
C-14	4.279E-31	0.0000	1.079E-29	0.0000	0.000E+00	0.0000	8.478E-26	0.0000	2.933E-26	0.0000	2.787E-26	0.0000	1.385E-30	0.0000
Cs-137	1.743E-02	0.0013	4.684E-08	0.0000	0.000E+00	0.0000	3.290E-03	0.0002	1.319E-03	0.0001	2.935E-03	0.0002	5.545E-06	0.0000
H-3	0.000E+00	0.0000	1.792E-13	0.0000	0.000E+00	0.0000	4.029E-11	0.0000	4.505E-12	0.0000	3.476E-11	0.0000	7.445E-16	0.0000
Pm-147	4.670E-08	0.0000	1.010E-08	0.0000	0.000E+00	0.0000	7.581E-07	0.0000	2.584E-08	0.0000	1.891E-09	0.0000	2.044E-08	0.0000
Th-232	3.718E+00	0.2687	1.345E-01	0.0097	0.000E+00	0.0000	4.535E+00	0.3277	5.776E-02	0.0042	4.750E-01	0.0343	2.519E-02	0.0018
Total	3.736E+00	0.2699	1.349E-01	0.0097	0.000E+00	0.0000	4.542E+00	0.3281	5.908E-02	0.0043	4.780E-01	0.0345	2.542E-02	0.0018

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years

Water Dependent Pathways

Radio-Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	5.840E-01	0.0422	4.835E-04	0.0000	0.000E+00	0.0000	4.093E-02	0.0030	3.406E-04	0.0000	8.197E-05	0.0000	6.298E-01	0.0455
C-14	3.646E-25	0.0000	5.207E-25	0.0000	0.000E+00	0.0000	8.924E-26	0.0000	8.251E-26	0.0000	8.758E-26	0.0000	1.287E-24	0.0000
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.498E-02	0.0018
H-3	1.831E-10	0.0000	5.119E-15	0.0000	0.000E+00	0.0000	3.963E-11	0.0000	1.231E-11	0.0000	5.390E-11	0.0000	3.687E-10	0.0000
Pm-147	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.631E-07	0.0000
Th-232	3.670E+00	0.2652	5.074E-03	0.0004	0.000E+00	0.0000	2.641E-01	0.0191	4.299E-02	0.0031	2.577E-01	0.0186	1.319E+01	0.9527
Total	4.254E+00	0.3074	5.558E-03	0.0004	0.000E+00	0.0000	3.050E-01	0.0220	4.333E-02	0.0031	2.578E-01	0.0186	1.384E+01	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

adio-uclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
m-241	8.817E-05	0.0000	2.473E-04	0.0000	0.000E+00	0.0000	2.275E-03	0.0002	2.637E-06	0.0000	6.642E-07	0.0000	1.531E-04	0.0000
-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
s-137	3.455E-03	0.0003	9.284E-09	0.0000	0.000E+00	0.0000	6.521E-04	0.0001	2.615E-04	0.0000	5.818E-04	0.0001	1.099E-06	0.0000
-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
m-147	4.307E-16	0.0000	1.492E-12	0.0000	0.000E+00	0.0000	1.036E-11	0.0000	3.531E-13	0.0000	2.584E-14	0.0000	2.793E-13	0.0000
h-232	3.842E+00	0.3347	1.354E-01	0.0118	0.000E+00	0.0000	4.644E+00	0.4046	5.920E-02	0.0052	4.869E-01	0.0424	2.552E-02	0.0022
otal	3.846E+00	0.3350	1.356E-01	0.0118	0.000E+00	0.0000	4.647E+00	0.4048	5.947E-02	0.0052	4.875E-01	0.0425	2.568E-02	0.0022

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

Water Dependent Pathways

adio-uclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
m-241	3.993E-01	0.0348	3.306E-04	0.0000	0.000E+00	0.0000	2.798E-02	0.0024	2.329E-04	0.0000	5.605E-05	0.0000	4.307E-01	0.0375
-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
s-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.952E-03	0.0004
-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
m-147	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.251E-11	0.0000
h-232	1.602E+00	0.1395	2.215E-03	0.0002	0.000E+00	0.0000	1.152E-01	0.0100	1.876E-02	0.0016	1.125E-01	0.0098	1.104E+01	0.9621
otal	2.001E+00	0.1743	2.545E-03	0.0002	0.000E+00	0.0000	1.432E-01	0.0125	1.900E-02	0.0017	1.125E-01	0.0098	1.148E+01	1.0000

Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
uclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	3.054E-05	0.0000	8.529E-05	0.0000	0.000E+00	0.0000	7.880E-04	0.0001	9.574E-07	0.0000	2.310E-07	0.0000	5.281E-05	0.0000
-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
s-137	3.390E-05	0.0000	9.108E-11	0.0000	0.000E+00	0.0000	6.398E-06	0.0000	2.566E-06	0.0000	5.708E-06	0.0000	1.078E-08	0.0000
H-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
m-147	0.000E+00	0.0000	1.465E-12	0.0000	0.000E+00	0.0000	1.017E-11	0.0000	3.465E-13	0.0000	2.536E-14	0.0000	2.741E-13	0.0000
h-232	3.841E+00	0.4047	1.353E-01	0.0143	0.000E+00	0.0000	4.643E+00	0.4891	5.919E-02	0.0062	4.868E-01	0.0513	2.552E-02	0.0027
Total	3.841E+00	0.4047	1.354E-01	0.0143	0.000E+00	0.0000	4.644E+00	0.4892	5.919E-02	0.0062	4.868E-01	0.0513	2.557E-02	0.0027

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
m-241	1.346E-01	0.0142	1.115E-04	0.0000	0.000E+00	0.0000	9.434E-03	0.0010	7.854E-05	0.0000	1.890E-05	0.0000	1.452E-01	0.0153
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
s-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.858E-05	0.0000
-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pm-147	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.228E-11	0.0000
Th-232	1.350E-01	0.0142	1.866E-04	0.0000	0.000E+00	0.0000	9.711E-03	0.0010	1.581E-03	0.0002	9.479E-03	0.0010	9.347E+00	0.9847
Total	2.696E-01	0.0284	2.981E-04	0.0000	0.000E+00	0.0000	1.915E-02	0.0020	1.660E-03	0.0002	9.498E-03	0.0010	9.493E+00	1.0000

Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years

Water Independent Pathways (Inhalation excludes radon)

adio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
uclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
m-241	9.082E-07	0.0000	2.076E-06	0.0000	0.000E+00	0.0000	2.338E-05	0.0000	8.315E-08	0.0000	8.046E-09	0.0000	1.286E-06	0.0000
-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
s-137	3.171E-12	0.0000	8.520E-18	0.0000	0.000E+00	0.0000	5.985E-13	0.0000	2.400E-13	0.0000	5.339E-13	0.0000	1.009E-15	0.0000
-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
m-147	0.000E+00	0.0000	1.375E-12	0.0000	0.000E+00	0.0000	9.537E-12	0.0000	3.251E-13	0.0000	2.379E-14	0.0000	2.571E-13	0.0000
h-232	3.838E+00	0.4178	1.352E-01	0.0147	0.000E+00	0.0000	4.639E+00	0.5050	5.914E-02	0.0064	4.864E-01	0.0529	2.549E-02	0.0028
otal	3.838E+00	0.4178	1.352E-01	0.0147	0.000E+00	0.0000	4.639E+00	0.5050	5.914E-02	0.0064	4.864E-01	0.0529	2.550E-02	0.0028

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years

Water Dependent Pathways

adio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
uclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
m-241	2.944E-03	0.0003	2.437E-06	0.0000	0.000E+00	0.0000	2.063E-04	0.0000	1.750E-06	0.0000	4.139E-07	0.0000	3.182E-03	0.0003
-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
s-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.544E-12	0.0000
-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
m-147	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.152E-11	0.0000
h-232	2.333E-05	0.0000	3.226E-08	0.0000	0.000E+00	0.0000	1.679E-06	0.0000	2.733E-07	0.0000	1.639E-06	0.0000	9.183E+00	0.9997
otal	2.967E-03	0.0003	2.470E-06	0.0000	0.000E+00	0.0000	2.080E-04	0.0000	2.024E-06	0.0000	2.052E-06	0.0000	9.187E+00	1.0000

Sum of all water independent and dependent pathways.

Summary : Ft Belvoir Farmer 641m2 Ave
File : RESRAD Ft Belvoir 641m2 Farmer Ave ROC.RAD

Dose/Source Ratios Summed Over All Pathways
Parent and Progeny Principal Radionuclide Contributions Indicated

Parent (i)	Product (j)	Thread Fraction	DSR(j,t) At Time in Years (mrem/yr)/(pCi/g) 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
m-241	Am-241	1.000E+00	8.764E+01	9.215E+01	9.115E+01	8.775E+01	7.873E+01	5.383E+01	1.815E+01	3.968E-01
m-241	Np-237+D	1.000E+00	4.925E-06	1.199E-05	2.571E-05	7.246E-05	1.960E-04	5.325E-04	9.817E-04	1.010E-03
Am-241	U-233	1.000E+00	2.373E-11	5.608E-11	1.116E-10	2.991E-10	2.310E-09	2.076E-08	1.030E-07	3.007E-07
Am-241	Th-229+D	1.000E+00	1.450E-12	1.170E-12	1.581E-12	7.092E-13	7.446E-12	6.248E-11	5.924E-10	8.036E-09
m-241	∑DSR(j)		8.764E+01	9.215E+01	9.115E+01	8.775E+01	7.873E+01	5.383E+01	1.815E+01	3.978E-01
C-14	C-14	1.000E+00	7.074E+00	1.347E+00	3.766E-02	1.350E-07	3.138E-23	0.000E+00	0.000E+00	0.000E+00
s-137+D	Cs-137+D	1.000E+00	2.000E+00	1.954E+00	1.866E+00	1.587E+00	9.994E-01	1.981E-01	1.943E-03	1.818E-10
H-3	H-3	1.000E+00	1.892E-01	9.755E-02	2.270E-02	1.374E-04	6.066E-11	2.151E-33	0.000E+00	0.000E+00
Pm-147	Pm-147	1.000E+00	3.499E-04	2.686E-04	1.583E-04	2.489E-05	1.260E-07	1.162E-15	1.281E-38	0.000E+00
Pm-147	Sm-147	1.000E+00	2.232E-13	5.989E-13	1.109E-12	1.725E-12	1.836E-12	1.825E-12	1.792E-12	1.681E-12
m-147	∑DSR(j)		3.499E-04	2.686E-04	1.583E-04	2.489E-05	1.260E-07	1.826E-12	1.792E-12	1.681E-12
Th-232	Th-232	1.000E+00	5.846E-01	5.846E-01	5.846E-01	5.846E-01	5.846E-01	5.846E-01	5.844E-01	5.839E-01
h-232	Ra-228+D	1.000E+00	1.138E+00	3.404E+00	7.152E+00	1.462E+01	1.815E+01	1.425E+01	1.129E+01	1.101E+01
h-232	Th-228+D	1.000E+00	3.155E-02	1.845E-01	7.166E-01	2.636E+00	4.281E+00	4.441E+00	4.437E+00	4.433E+00
Th-232	∑DSR(j)		1.754E+00	4.173E+00	8.453E+00	1.784E+01	2.301E+01	1.927E+01	1.631E+01	1.603E+01

he DSR includes contributions from associated (half-life ≤ 30 days) daughters.

Single Radionuclide Soil Guidelines G(i,t) in pCi/g
Basic Radiation Dose Limit = 1.500E+01 mrem/yr

uclide (i)	t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Am-241	1.712E-01	1.628E-01	1.646E-01	1.709E-01	1.905E-01	2.786E-01	8.264E-01	3.771E+01
-14	2.120E+00	1.114E+01	3.983E+02	1.111E+08	*4.455E+12	*4.455E+12	*4.455E+12	*4.455E+12
s-137	7.501E+00	7.677E+00	8.040E+00	9.452E+00	1.501E+01	7.573E+01	7.719E+03	8.252E+10
H-3	7.929E+01	1.538E+02	6.607E+02	1.092E+05	2.473E+11	*9.597E+15	*9.597E+15	*9.597E+15
m-147	4.287E+04	5.584E+04	9.474E+04	6.026E+05	1.191E+08	8.215E+12	8.371E+12	8.923E+12
h-232	8.553E+00	3.595E+00	1.774E+00	8.406E-01	6.518E-01	7.782E-01	9.195E-01	9.359E-01

*At specific activity limit

ummary : Ft Belvoir Farmer 641m2 Ave
ile : RESRAD Ft Belvoir 641m2 Farmer Ave ROC.RAD

Summed Dose/Source Ratios DSR(i,t) in (mrem/yr)/(pCi/g)
and Single Radionuclide Soil Guidelines G(i,t) in pCi/g
at tmin = time of minimum single radionuclide soil guideline
and at tmax = time of maximum total dose = 28.48 ± 0.06 years

uclide (i)	Initial (pCi/g)	tmin (years)	DSR(i,tmin)	G(i,tmin) (pCi/g)	DSR(i,tmax)	G(i,tmax) (pCi/g)
m-241	8.000E-03	0.1031 ± 0.0002	9.258E+01	1.620E-01	7.938E+01	1.890E-01
-14	4.100E-02	0.000E+00	7.074E+00	2.120E+00	4.871E-22	*4.455E+12
s-137	2.500E-02	0.000E+00	2.000E+00	7.501E+00	1.035E+00	1.449E+01
-3	6.078E+00	0.000E+00	1.892E-01	7.929E+01	1.846E-10	8.124E+10
m-147	6.851E+00	0.000E+00	3.499E-04	4.287E+04	1.882E-07	7.971E+07
h-232	5.730E-01	29.08 ± 0.06	2.302E+01	6.517E-01	2.301E+01	6.518E-01

At specific activity limit

Individual Nuclide Dose Summed Over All Pathways
Parent Nuclide and Branch Fraction Indicated

Nuclide (j)	Parent (i)	THF(i)	DOSE(j,t), mrem/yr							
		t=	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Am-241	Am-241	1.000E+00	7.011E-01	7.372E-01	7.292E-01	7.020E-01	6.298E-01	4.307E-01	1.452E-01	3.174E-03
Np-237	Am-241	1.000E+00	3.940E-08	9.596E-08	2.057E-07	5.797E-07	1.568E-06	4.260E-06	7.854E-06	8.081E-06
U-233	Am-241	1.000E+00	1.898E-13	4.486E-13	8.926E-13	2.393E-12	1.848E-11	1.661E-10	8.237E-10	2.405E-09
Th-229	Am-241	1.000E+00	1.160E-14	9.358E-15	1.265E-14	5.673E-15	5.957E-14	4.998E-13	4.740E-12	6.429E-11
C-14	C-14	1.000E+00	2.900E-01	5.521E-02	1.544E-03	5.535E-09	1.287E-24	0.000E+00	0.000E+00	0.000E+00
Cs-137	Cs-137	1.000E+00	4.999E-02	4.885E-02	4.664E-02	3.967E-02	2.498E-02	4.952E-03	4.858E-05	4.544E-12
H-3	H-3	1.000E+00	1.150E+00	5.929E-01	1.380E-01	8.350E-04	3.687E-10	0.000E+00	0.000E+00	0.000E+00
Pm-147	Pm-147	1.000E+00	2.397E-03	1.840E-03	1.085E-03	1.705E-04	8.631E-07	7.960E-15	0.000E+00	0.000E+00
Sm-147	Pm-147	1.000E+00	1.529E-12	4.103E-12	7.596E-12	1.182E-11	1.258E-11	1.250E-11	1.228E-11	1.152E-11
Th-232	Th-232	1.000E+00	3.350E-01	3.350E-01	3.350E-01	3.350E-01	3.350E-01	3.350E-01	3.349E-01	3.346E-01
Ra-228	Th-232	1.000E+00	6.518E-01	1.950E+00	4.098E+00	8.379E+00	1.040E+01	8.165E+00	6.470E+00	6.309E+00
Th-228	Th-232	1.000E+00	1.808E-02	1.057E-01	4.106E-01	1.510E+00	2.453E+00	2.544E+00	2.543E+00	2.540E+00

THF(i) is the thread fraction of the parent nuclide.

Individual Nuclide Soil Concentration
Parent Nuclide and Branch Fraction Indicated

ıclide (j)	Parent (i)	THF(i)	S(j,t), pCi/g							
		t=	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
ı-241	Am-241	1.000E+00	8.000E-03	7.958E-03	7.873E-03	7.585E-03	6.819E-03	4.697E-03	1.619E-03	3.897E-05
ɔ-237	Am-241	1.000E+00	0.000E+00	2.584E-09	7.708E-09	2.520E-08	7.152E-08	1.977E-07	3.675E-07	3.819E-07
-233	Am-241	1.000E+00	0.000E+00	5.652E-15	5.063E-14	5.533E-13	4.751E-12	4.494E-11	2.628E-10	8.467E-10
h-229	Am-241	1.000E+00	0.000E+00	1.780E-19	4.790E-18	1.752E-16	4.564E-15	1.496E-13	2.909E-12	4.174E-11
-14	C-14	1.000E+00	4.100E-02	6.862E-03	1.919E-04	6.875E-10	1.595E-25	0.000E+00	0.000E+00	0.000E+00
s-137	Cs-137	1.000E+00	2.500E-02	2.443E-02	2.332E-02	1.984E-02	1.249E-02	2.476E-03	2.429E-05	2.272E-12
-3	H-3	1.000E+00	6.078E+00	2.933E+00	6.826E-01	4.133E-03	1.828E-09	6.518E-32	0.000E+00	0.000E+00
m-147	Pm-147	1.000E+00	6.851E+00	5.260E+00	3.100E+00	4.874E-01	2.467E-03	2.275E-11	2.509E-34	0.000E+00
m-147	Pm-147	1.000E+00	0.000E+00	3.937E-11	9.278E-11	1.573E-10	1.690E-10	1.680E-10	1.650E-10	1.548E-10
h-232	Th-232	1.000E+00	5.730E-01	5.730E-01	5.730E-01	5.730E-01	5.730E-01	5.729E-01	5.728E-01	5.723E-01
a-228	Th-232	1.000E+00	0.000E+00	6.504E-02	1.736E-01	3.996E-01	5.532E-01	5.679E-01	5.677E-01	5.672E-01
h-228	Th-232	1.000E+00	0.000E+00	1.068E-02	7.116E-02	3.222E-01	5.457E-01	5.679E-01	5.677E-01	5.672E-01

HF(i) is the thread fraction of the parent nuclide.

ESCALC.EXE execution time = 2075.12 seconds

Summary : Ft Belvoir Industrial 15 mrem/yr 641m2
File : RESRAD Ft Belvoir 641m2 Industrial Ave ROC.RAD

Table of Contents

Part I: Mixture Sums and Single Radionuclide Guidelines

Dose Conversion Factor (and Related) Parameter Summary
File: HEAST 2001 MORBIDITY

enu	Parameter	Current Value	Base Case*	Parameter Name
-1	Dose conversion factors for inhalation, mrem/pCi:			
-1	Am-241	4.440E-01	4.440E-01	DCF2(1)
-1	C-14	2.090E-06	2.090E-06	DCF2(2)
-1	Cs-137+D	3.190E-05	3.190E-05	DCF2(3)
-1	H-3	6.400E-08	6.400E-08	DCF2(4)
-1	Np-237+D	5.400E-01	5.400E-01	DCF2(5)
-1	Pm-147	3.920E-05	3.920E-05	DCF2(6)
-1	Ra-228+D	5.078E-03	4.770E-03	DCF2(7)
-1	Sm-147	7.470E-02	7.470E-02	DCF2(8)
-1	Th-228+D	3.454E-01	3.420E-01	DCF2(9)
-1	Th-229+D	2.169E+00	2.150E+00	DCF2(10)
-1	Th-232	1.640E+00	1.640E+00	DCF2(11)
-1	U-233	1.350E-01	1.350E-01	DCF2(12)
-1	Dose conversion factors for ingestion, mrem/pCi:			
-1	Am-241	3.640E-03	3.640E-03	DCF3(1)
-1	C-14	2.090E-06	2.090E-06	DCF3(2)
-1	Cs-137+D	5.000E-05	5.000E-05	DCF3(3)
-1	H-3	6.400E-08	6.400E-08	DCF3(4)
-1	Np-237+D	4.444E-03	4.440E-03	DCF3(5)
-1	Pm-147	1.050E-06	1.050E-06	DCF3(6)
-1	Ra-228+D	1.442E-03	1.440E-03	DCF3(7)
-1	Sm-147	1.850E-04	1.850E-04	DCF3(8)
-1	Th-228+D	8.086E-04	3.960E-04	DCF3(9)
-1	Th-229+D	4.027E-03	3.530E-03	DCF3(10)
-1	Th-232	2.730E-03	2.730E-03	DCF3(11)
-1	U-233	2.890E-04	2.890E-04	DCF3(12)
-34	Food transfer factors:			
-34	Am-241 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(1,1)
-34	Am-241 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	5.000E-05	5.000E-05	RTF(1,2)
-34	Am-241 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-06	2.000E-06	RTF(1,3)
-34				
-34	C-14 , plant/soil concentration ratio, dimensionless	5.500E+00	5.500E+00	RTF(2,1)
-34	C-14 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.100E-02	3.100E-02	RTF(2,2)
-34	C-14 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.200E-02	1.200E-02	RTF(2,3)
-34				
-34	Cs-137+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(3,1)
-34	Cs-137+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.000E-02	3.000E-02	RTF(3,2)
-34	Cs-137+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	8.000E-03	8.000E-03	RTF(3,3)
-34				
-34	H-3 , plant/soil concentration ratio, dimensionless	4.800E+00	4.800E+00	RTF(4,1)
-34	H-3 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.200E-02	1.200E-02	RTF(4,2)
-34	H-3 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-02	1.000E-02	RTF(4,3)
-34				
-34	Np-237+D , plant/soil concentration ratio, dimensionless	2.000E-02	2.000E-02	RTF(5,1)
-34	Np-237+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(5,2)
-34	Np-237+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(5,3)
-34				

Dose Conversion Factor (and Related) Parameter Summary (continued)
File: HEAST 2001 MORBIDITY

Menu	Parameter	Current Value	Base Case*	Parameter Name
D-34	Pm-147 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(6,1)
-34	Pm-147 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-03	2.000E-03	RTF(6,2)
-34	Pm-147 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-05	2.000E-05	RTF(6,3)
D-34				
-34	Ra-228+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(7,1)
-34	Ra-228+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(7,2)
D-34	Ra-228+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-03	1.000E-03	RTF(7,3)
n-34				
-34	Sm-147 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(8,1)
-34	Sm-147 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-03	2.000E-03	RTF(8,2)
D-34	Sm-147 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-05	2.000E-05	RTF(8,3)
-34				
-34	Th-228+D , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(9,1)
D-34	Th-228+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(9,2)
-34	Th-228+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(9,3)
-34				
D-34	Th-229+D , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(10,1)
D-34	Th-229+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(10,2)
-34	Th-229+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(10,3)
-34				
D-34	Th-232 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(11,1)
-34	Th-232 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(11,2)
-34	Th-232 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(11,3)
D-34				
n-34	U-233 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(12,1)
-34	U-233 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(12,2)
D-34	U-233 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(12,3)
-5	Bioaccumulation factors, fresh water, L/kg:			
-5	Am-241 , fish	3.000E+01	3.000E+01	BIOFAC(1,1)
D-5	Am-241 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(1,2)
-5				
-5	C-14 , fish	5.000E+04	5.000E+04	BIOFAC(2,1)
D-5	C-14 , crustacea and mollusks	9.100E+03	9.100E+03	BIOFAC(2,2)
n-5				
-5	Cs-137+D , fish	2.000E+03	2.000E+03	BIOFAC(3,1)
D-5	Cs-137+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(3,2)
D-5				
-5	H-3 , fish	1.000E+00	1.000E+00	BIOFAC(4,1)
-5	H-3 , crustacea and mollusks	1.000E+00	1.000E+00	BIOFAC(4,2)
D-5				
-5	Np-237+D , fish	3.000E+01	3.000E+01	BIOFAC(5,1)
-5	Np-237+D , crustacea and mollusks	4.000E+02	4.000E+02	BIOFAC(5,2)
D-5				
D-5	Pm-147 , fish	3.000E+01	3.000E+01	BIOFAC(6,1)
-5	Pm-147 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(6,2)
-5				
D-5	Ra-228+D , fish	5.000E+01	5.000E+01	BIOFAC(7,1)
-5	Ra-228+D , crustacea and mollusks	2.500E+02	2.500E+02	BIOFAC(7,2)
-5				

Dose Conversion Factor (and Related) Parameter Summary (continued)
File: HEAST 2001 MORBIDITY

anu	Parameter	Current Value	Base Case*	Parameter Name
-5	Sm-147 , fish	2.500E+01	2.500E+01	BIOFAC(8,1)
-5	Sm-147 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(8,2)
-5				
-5	Th-228+D , fish	1.000E+02	1.000E+02	BIOFAC(9,1)
-5	Th-228+D , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(9,2)
-5				
-5	Th-229+D , fish	1.000E+02	1.000E+02	BIOFAC(10,1)
-5	Th-229+D , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(10,2)
-5				
-5	Th-232 , fish	1.000E+02	1.000E+02	BIOFAC(11,1)
-5	Th-232 , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(11,2)
-5				
-5	U-233 , fish	1.000E+01	1.000E+01	BIOFAC(12,1)
-5	U-233 , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(12,2)

Base Case means Default.Lib w/o Associate Nuclide contributions.

Site-Specific Parameter Summary

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R011	Area of contaminated zone (m**2)	6.410E+02	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	4.573E+00	2.000E+00	---	THICK0
011	Length parallel to aquifer flow (m)	not used	1.000E+02	---	LCZPAQ
R011	Basic radiation dose limit (mrem/yr)	1.500E+01	3.000E+01	---	BRDL
R011	Time since placement of material (yr)	0.000E+00	0.000E+00	---	TI
011	Times for calculations (yr)	1.000E+00	1.000E+00	---	T(2)
011	Times for calculations (yr)	3.000E+00	3.000E+00	---	T(3)
R011	Times for calculations (yr)	1.000E+01	1.000E+01	---	T(4)
011	Times for calculations (yr)	3.000E+01	3.000E+01	---	T(5)
011	Times for calculations (yr)	1.000E+02	1.000E+02	---	T(6)
R011	Times for calculations (yr)	3.000E+02	3.000E+02	---	T(7)
R011	Times for calculations (yr)	1.000E+03	1.000E+03	---	T(8)
011	Times for calculations (yr)	not used	0.000E+00	---	T(9)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(10)
012	Initial principal radionuclide (pCi/g): Am-241	8.000E-03	0.000E+00	---	S1(1)
012	Initial principal radionuclide (pCi/g): C-14	4.100E-02	0.000E+00	---	S1(2)
R012	Initial principal radionuclide (pCi/g): Cs-137	2.500E-02	0.000E+00	---	S1(3)
R012	Initial principal radionuclide (pCi/g): H-3	6.078E+00	0.000E+00	---	S1(4)
012	Initial principal radionuclide (pCi/g): Pm-147	6.851E+00	0.000E+00	---	S1(6)
R012	Initial principal radionuclide (pCi/g): Th-232	5.730E-01	0.000E+00	---	S1(11)
R012	Concentration in groundwater (pCi/L): Am-241	not used	0.000E+00	---	W1(1)
012	Concentration in groundwater (pCi/L): C-14	not used	0.000E+00	---	W1(2)
012	Concentration in groundwater (pCi/L): Cs-137	not used	0.000E+00	---	W1(3)
R012	Concentration in groundwater (pCi/L): H-3	not used	0.000E+00	---	W1(4)
012	Concentration in groundwater (pCi/L): Pm-147	not used	0.000E+00	---	W1(6)
012	Concentration in groundwater (pCi/L): Th-232	not used	0.000E+00	---	W1(11)
R013	Cover depth (m)	0.000E+00	0.000E+00	---	COVER0
013	Density of cover material (g/cm**3)	not used	1.500E+00	---	DENSCV
R013	Cover depth erosion rate (m/yr)	not used	1.000E-03	---	VCV
R013	Density of contaminated zone (g/cm**3)	1.431E+00	1.500E+00	---	DENSCZ
013	Contaminated zone erosion rate (m/yr)	1.000E-03	1.000E-03	---	VCZ
013	Contaminated zone total porosity	4.000E-01	4.000E-01	---	TPCZ
R013	Contaminated zone field capacity	2.000E-01	2.000E-01	---	FCCZ
013	Contaminated zone hydraulic conductivity (m/yr)	1.000E+01	1.000E+01	---	HCCZ
013	Contaminated zone b parameter	5.300E+00	5.300E+00	---	BCZ
R013	Average annual wind speed (m/sec)	2.000E+00	2.000E+00	---	WIND
R013	Humidity in air (g/m**3)	8.000E+00	8.000E+00	---	HUMID
013	Evapotranspiration coefficient	5.000E-01	5.000E-01	---	EVAPTR
R013	Precipitation (m/yr)	9.812E-01	1.000E+00	---	PRECIP
R013	Irrigation (m/yr)	2.000E-01	2.000E-01	---	RI
013	Irrigation mode	overhead	overhead	---	IDITCH
013	Runoff coefficient	2.000E-01	2.000E-01	---	RUNOFF
R013	Watershed area for nearby stream or pond (m**2)	not used	1.000E+06	---	WAREA
R013	Accuracy for water/soil computations	not used	1.000E-03	---	EPS
R014	Density of saturated zone (g/cm**3)	not used	1.500E+00	---	DENSAQ
R014	Saturated zone total porosity	not used	4.000E-01	---	TPSZ
014	Saturated zone effective porosity	not used	2.000E-01	---	EPSZ

Site-Specific Parameter Summary (continued)

anu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
014	Saturated zone field capacity	not used	2.000E-01	---	FCSZ
014	Saturated zone hydraulic conductivity (m/yr)	not used	1.000E+02	---	HCSZ
014	Saturated zone hydraulic gradient	not used	2.000E-02	---	HGWT
014	Saturated zone b parameter	not used	5.300E+00	---	BSZ
014	Water table drop rate (m/yr)	not used	1.000E-03	---	VWT
014	Well pump intake depth (m below water table)	not used	1.000E+01	---	DWIBWT
014	Model: Nondispersion (ND) or Mass-Balance (MB)	not used	ND	---	MODEL
014	Well pumping rate (m**3/yr)	not used	2.500E+02	---	UW
015	Number of unsaturated zone strata	not used	1	---	NS
016	Distribution coefficients for Am-241				
016	Contaminated zone (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCC(1)
016	Saturated zone (cm**3/g)	not used	2.000E+01	---	DCNUCS(1)
016	Leach rate (/yr)	0.000E+00	0.000E+00	3.721E-03	ALEACH(1)
016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
016	Distribution coefficients for C-14				
016	Contaminated zone (cm**3/g)	0.000E+00	0.000E+00	---	DCNUCC(2)
016	Saturated zone (cm**3/g)	not used	0.000E+00	---	DCNUCS(2)
016	Leach rate (/yr)	0.000E+00	0.000E+00	3.360E-01	ALEACH(2)
016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(2)
016	Distribution coefficients for Cs-137				
016	Contaminated zone (cm**3/g)	4.600E+03	4.600E+03	---	DCNUCC(3)
016	Saturated zone (cm**3/g)	not used	4.600E+03	---	DCNUCS(3)
016	Leach rate (/yr)	0.000E+00	0.000E+00	1.636E-05	ALEACH(3)
016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(3)
016	Distribution coefficients for H-3				
016	Contaminated zone (cm**3/g)	0.000E+00	0.000E+00	---	DCNUCC(4)
016	Saturated zone (cm**3/g)	not used	0.000E+00	---	DCNUCS(4)
016	Leach rate (/yr)	0.000E+00	0.000E+00	3.360E-01	ALEACH(4)
016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(4)
016	Distribution coefficients for Pm-147				
016	Contaminated zone (cm**3/g)	-1.000E+00	-1.000E+00	8.249E+02	DCNUCC(6)
016	Saturated zone (cm**3/g)	not used	-1.000E+00	---	DCNUCS(6)
016	Leach rate (/yr)	0.000E+00	0.000E+00	9.120E-05	ALEACH(6)
016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(6)
016	Distribution coefficients for Th-232				
016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCC(11)
016	Saturated zone (cm**3/g)	not used	6.000E+04	---	DCNUCS(11)
016	Leach rate (/yr)	0.000E+00	0.000E+00	1.254E-06	ALEACH(11)
016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(11)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R016	Distribution coefficients for daughter Np-237				
R016	Contaminated zone (cm**3/g)	-1.000E+00	-1.000E+00	2.574E+02	DCNUCC(5)
R016	Saturated zone (cm**3/g)	not used	-1.000E+00	---	DCNUCS(5)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.921E-04	ALEACH(5)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(5)
R016	Distribution coefficients for daughter Ra-228				
R016	Contaminated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCC(7)
R016	Saturated zone (cm**3/g)	not used	7.000E+01	---	DCNUCS(7)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.072E-03	ALEACH(7)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(7)
R016	Distribution coefficients for daughter Sm-147				
R016	Contaminated zone (cm**3/g)	-1.000E+00	-1.000E+00	8.249E+02	DCNUCC(8)
R016	Saturated zone (cm**3/g)	not used	-1.000E+00	---	DCNUCS(8)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	9.120E-05	ALEACH(8)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(8)
R016	Distribution coefficients for daughter Th-228				
R016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCC(9)
R016	Saturated zone (cm**3/g)	not used	6.000E+04	---	DCNUCS(9)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.254E-06	ALEACH(9)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(9)
R016	Distribution coefficients for daughter Th-229				
R016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCC(10)
R016	Saturated zone (cm**3/g)	not used	6.000E+04	---	DCNUCS(10)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.254E-06	ALEACH(10)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(10)
R016	Distribution coefficients for daughter U-233				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(12)
R016	Saturated zone (cm**3/g)	not used	5.000E+01	---	DCNUCS(12)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.498E-03	ALEACH(12)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(12)
R017	Inhalation rate (m**3/yr)	8.513E+03	8.400E+03	---	INHALR
R017	Mass loading for inhalation (g/m**3)	4.000E-04	1.000E-04	---	MLINH
R017	Exposure duration	3.000E+01	3.000E+01	---	ED
R017	Shielding factor, inhalation	2.500E-01	4.000E-01	---	SHF3
R017	Shielding factor, external gamma	5.512E-01	7.000E-01	---	SHF1
R017	Fraction of time spent indoors	1.712E-01	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	5.710E-02	2.500E-01	---	FOTD
R017	Shape factor flag, external gamma	1.000E+00	1.000E+00	>0 shows circular AREA.	FS

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
017	Radii of shape factor array (used if FS = -1):				
017	Outer annular radius (m), ring 1:	not used	5.000E+01	---	RAD_SHAPE(1)
017	Outer annular radius (m), ring 2:	not used	7.071E+01	---	RAD_SHAPE(2)
017	Outer annular radius (m), ring 3:	not used	0.000E+00	---	RAD_SHAPE(3)
017	Outer annular radius (m), ring 4:	not used	0.000E+00	---	RAD_SHAPE(4)
017	Outer annular radius (m), ring 5:	not used	0.000E+00	---	RAD_SHAPE(5)
017	Outer annular radius (m), ring 6:	not used	0.000E+00	---	RAD_SHAPE(6)
017	Outer annular radius (m), ring 7:	not used	0.000E+00	---	RAD_SHAPE(7)
017	Outer annular radius (m), ring 8:	not used	0.000E+00	---	RAD_SHAPE(8)
017	Outer annular radius (m), ring 9:	not used	0.000E+00	---	RAD_SHAPE(9)
017	Outer annular radius (m), ring 10:	not used	0.000E+00	---	RAD_SHAPE(10)
017	Outer annular radius (m), ring 11:	not used	0.000E+00	---	RAD_SHAPE(11)
017	Outer annular radius (m), ring 12:	not used	0.000E+00	---	RAD_SHAPE(12)
017	Fractions of annular areas within AREA:				
017	Ring 1	not used	1.000E+00	---	FRACA(1)
017	Ring 2	not used	2.732E-01	---	FRACA(2)
017	Ring 3	not used	0.000E+00	---	FRACA(3)
017	Ring 4	not used	0.000E+00	---	FRACA(4)
017	Ring 5	not used	0.000E+00	---	FRACA(5)
017	Ring 6	not used	0.000E+00	---	FRACA(6)
017	Ring 7	not used	0.000E+00	---	FRACA(7)
017	Ring 8	not used	0.000E+00	---	FRACA(8)
017	Ring 9	not used	0.000E+00	---	FRACA(9)
017	Ring 10	not used	0.000E+00	---	FRACA(10)
017	Ring 11	not used	0.000E+00	---	FRACA(11)
017	Ring 12	not used	0.000E+00	---	FRACA(12)
018	Fruits, vegetables and grain consumption (kg/yr)	not used	1.600E+02	---	DIET(1)
018	Leafy vegetable consumption (kg/yr)	not used	1.400E+01	---	DIET(2)
018	Milk consumption (L/yr)	not used	9.200E+01	---	DIET(3)
018	Meat and poultry consumption (kg/yr)	not used	6.300E+01	---	DIET(4)
018	Fish consumption (kg/yr)	not used	5.400E+00	---	DIET(5)
018	Other seafood consumption (kg/yr)	not used	9.000E-01	---	DIET(6)
018	Soil ingestion rate (g/yr)	1.826E+01	3.650E+01	---	SOIL
018	Drinking water intake (L/yr)	not used	5.100E+02	---	DWI
018	Contamination fraction of drinking water	not used	1.000E+00	---	FDW
018	Contamination fraction of household water	not used	1.000E+00	---	FHHW
018	Contamination fraction of livestock water	not used	1.000E+00	---	FLW
018	Contamination fraction of irrigation water	not used	1.000E+00	---	FIRW
018	Contamination fraction of aquatic food	not used	5.000E-01	---	FR9
018	Contamination fraction of plant food	not used	-1	---	FPLANT
018	Contamination fraction of meat	not used	-1	---	FMEAT
018	Contamination fraction of milk	not used	-1	---	FMILK
019	Livestock fodder intake for meat (kg/day)	not used	6.800E+01	---	LFI5
019	Livestock fodder intake for milk (kg/day)	not used	5.500E+01	---	LFI6
019	Livestock water intake for meat (L/day)	not used	5.000E+01	---	LWI5
019	Livestock water intake for milk (L/day)	not used	1.600E+02	---	LWI6
019	Livestock soil intake (kg/day)	not used	5.000E-01	---	LSI

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R019	Mass loading for foliar deposition (g/m**3)	not used	1.000E-04	---	MLFD
R019	Depth of soil mixing layer (m)	1.500E-01	1.500E-01	---	DM
R019	Depth of roots (m)	not used	9.000E-01	---	DROOT
R019	Drinking water fraction from ground water	not used	1.000E+00	---	FGWDW
R019	Household water fraction from ground water	not used	1.000E+00	---	FGWHH
R019	Livestock water fraction from ground water	not used	1.000E+00	---	FGWLW
R019	Irrigation fraction from ground water	not used	1.000E+00	---	FGWIR
R19B	Wet weight crop yield for Non-Leafy (kg/m**2)	not used	7.000E-01	---	YV(1)
R19B	Wet weight crop yield for Leafy (kg/m**2)	not used	1.500E+00	---	YV(2)
R19B	Wet weight crop yield for Fodder (kg/m**2)	not used	1.100E+00	---	YV(3)
R19B	Growing Season for Non-Leafy (years)	not used	1.700E-01	---	TE(1)
R19B	Growing Season for Leafy (years)	not used	2.500E-01	---	TE(2)
R19B	Growing Season for Fodder (years)	not used	8.000E-02	---	TE(3)
R19B	Translocation Factor for Non-Leafy	not used	1.000E-01	---	TIV(1)
R19B	Translocation Factor for Leafy	not used	1.000E+00	---	TIV(2)
R19B	Translocation Factor for Fodder	not used	1.000E+00	---	TIV(3)
R19B	Dry Foliar Interception Fraction for Non-Leafy	not used	2.500E-01	---	RDRY(1)
R19B	Dry Foliar Interception Fraction for Leafy	not used	2.500E-01	---	RDRY(2)
R19B	Dry Foliar Interception Fraction for Fodder	not used	2.500E-01	---	RDRY(3)
R19B	Wet Foliar Interception Fraction for Non-Leafy	not used	2.500E-01	---	RWET(1)
R19B	Wet Foliar Interception Fraction for Leafy	not used	2.500E-01	---	RWET(2)
R19B	Wet Foliar Interception Fraction for Fodder	not used	2.500E-01	---	RWET(3)
R19B	Weathering Removal Constant for Vegetation	not used	2.000E+01	---	WLAM
C14	C-12 concentration in water (g/cm**3)	2.000E-05	2.000E-05	---	C12WTR
C14	C-12 concentration in contaminated soil (g/g)	3.000E-02	3.000E-02	---	C12CZ
C14	Fraction of vegetation carbon from soil	2.000E-02	2.000E-02	---	CSOIL
C14	Fraction of vegetation carbon from air	9.800E-01	9.800E-01	---	CAIR
C14	C-14 evasion layer thickness in soil (m)	3.000E-01	3.000E-01	---	DMC
C14	C-14 evasion flux rate from soil (1/sec)	7.000E-07	7.000E-07	---	EVSN
C14	C-12 evasion flux rate from soil (1/sec)	1.000E-10	1.000E-10	---	REVSN
C14	Fraction of grain in beef cattle feed	8.000E-01	8.000E-01	---	AVFG4
C14	Fraction of grain in milk cow feed	2.000E-01	2.000E-01	---	AVFG5
C14	DCF correction factor for gaseous forms of C14	8.894E+01	0.000E+00	---	CO2F
STOR	Storage times of contaminated foodstuffs (days):				
STOR	Fruits, non-leafy vegetables, and grain	1.400E+01	1.400E+01	---	STOR_T(1)
STOR	Leafy vegetables	1.000E+00	1.000E+00	---	STOR_T(2)
STOR	Milk	1.000E+00	1.000E+00	---	STOR_T(3)
STOR	Meat and poultry	2.000E+01	2.000E+01	---	STOR_T(4)
STOR	Fish	7.000E+00	7.000E+00	---	STOR_T(5)
STOR	Crustacea and mollusks	7.000E+00	7.000E+00	---	STOR_T(6)
STOR	Well water	0.000E+00	1.000E+00	---	STOR_T(7)
STOR	Surface water	0.000E+00	1.000E+00	---	STOR_T(8)
STOR	Livestock fodder	0.000E+00	4.500E+01	---	STOR_T(9)
R021	Thickness of building foundation (m)	not used	1.500E-01	---	FLOOR1
R021	Bulk density of building foundation (g/cm**3)	not used	2.400E+00	---	DENSFL
R021	Total porosity of the cover material	not used	4.000E-01	---	TPCV

Site-Specific Parameter Summary (continued)

nu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
)21	Total porosity of the building foundation	not used	1.000E-01	---	TPFL
)21	Volumetric water content of the cover material	not used	5.000E-02	---	PH2OCV
)21	Volumetric water content of the foundation	not used	3.000E-02	---	PH2OFL
)21	Diffusion coefficient for radon gas (m/sec):				
)21	in cover material	not used	2.000E-06	---	DIFCV
)21	in foundation material	not used	3.000E-07	---	DIFFL
)21	in contaminated zone soil	not used	2.000E-06	---	DIFCZ
)21	Radon vertical dimension of mixing (m)	not used	2.000E+00	---	HMIX
)21	Average building air exchange rate (1/hr)	not used	5.000E-01	---	REXG
)21	Height of the building (room) (m)	not used	2.500E+00	---	HRM
)21	Building interior area factor	not used	0.000E+00	---	FAI
)21	Building depth below ground surface (m)	not used	-1.000E+00	---	DMFL
)21	Emanating power of Rn-222 gas	not used	2.500E-01	---	EMANA(1)
)21	Emanating power of Rn-220 gas	not used	1.500E-01	---	EMANA(2)
ITL	Number of graphical time points	1024	---	---	NPTS
ITL	Maximum number of integration points for dose	17	---	---	LYMAX
ITL	Maximum number of integration points for risk	257	---	---	KYMAX

Summary of Pathway Selections

Pathway	User Selection
1 -- external gamma	active
2 -- inhalation (w/o radon)	active
3 -- plant ingestion	suppressed
4 -- meat ingestion	suppressed
5 -- milk ingestion	suppressed
6 -- aquatic foods	suppressed
7 -- drinking water	suppressed
8 -- soil ingestion	active
9 -- radon	suppressed
Find peak pathway doses	active

Summary : Ft Belvoir Industrial 15 mrem/yr 641m2
File : RESRAD Ft Belvoir 641m2 Industrial Ave ROC.RAD

Contaminated Zone Dimensions		Initial Soil Concentrations, pCi/g	
Area:	641.00 square meters	Am-241	8.000E-03
Thickness:	4.57 meters	C-14	4.100E-02
Cover Depth:	0.00 meters	Cs-137	2.500E-02
		H-3	6.078E+00
		Pm-147	6.851E+00
		Th-232	5.730E-01

Total Dose TDOSE(t), mrem/yr
Basic Radiation Dose Limit = 1.500E+01 mrem/yr
Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

t (years):	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
TDOSE(t):	8.844E-02	1.637E-01	3.390E-01	8.490E-01	1.255E+00	1.290E+00	1.289E+00	1.288E+00
M(t):	5.896E-03	1.091E-02	2.260E-02	5.660E-02	8.365E-02	8.602E-02	8.592E-02	8.584E-02

Maximum TDOSE(t): 1.291E+00 mrem/yr at t = 66.5 ± 0.1 years

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 6.650E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio-nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	3.378E-05	0.0000	1.076E-04	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.447E-05	0.0000
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Cs-137	2.404E-03	0.0019	7.334E-09	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.096E-07	0.0000
H-3	0.000E+00	0.0000	1.151E-25	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.782E-28	0.0000
Pm-147	9.670E-13	0.0000	7.824E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.760E-13	0.0000
Th-232	1.232E+00	0.9539	4.929E-02	0.0382	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.594E-03	0.0059
Total	1.234E+00	0.9558	4.939E-02	0.0383	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.649E-03	0.0059

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 6.650E+01 years

Water Dependent Pathways

Radio-nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
n-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.959E-04	0.0002
-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
s-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.405E-03	0.0019
-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.156E-25	0.0000
n-147	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.225E-12	0.0000
n-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.289E+00	0.9980
otal	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.291E+00	1.0000

Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	4.811E-05	0.0005	1.534E-04	0.0017	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.761E-05	0.0009
C-14	3.552E-08	0.0000	8.316E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.067E-07	0.0000
Cs-137	1.119E-02	0.1265	3.413E-08	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.302E-06	0.0000
H-3	0.000E+00	0.0000	1.776E-04	0.0020	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.382E-07	0.0000
Pm-147	4.160E-05	0.0005	1.022E-05	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.689E-05	0.0002
Th-232	3.166E-02	0.3580	4.074E-02	0.4607	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.316E-03	0.0488
Total	4.294E-02	0.4855	4.108E-02	0.4646	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.415E-03	0.0499

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

Water Dependent Pathways

Radio-Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.791E-04	0.0032
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.738E-07	0.0000
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.119E-02	0.1265
H-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.784E-04	0.0020
Pm-147	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.870E-05	0.0008
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.672E-02	0.8675
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.844E-02	1.0000

* Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

adio-uclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
m-241	4.785E-05	0.0003	1.525E-04	0.0009	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.719E-05	0.0005
-14	5.944E-09	0.0000	1.392E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.785E-08	0.0000
s-137	1.093E-02	0.0668	3.335E-08	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.226E-06	0.0000
-3	0.000E+00	0.0000	8.571E-05	0.0005	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.562E-07	0.0000
m-147	3.194E-05	0.0002	7.843E-06	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.297E-05	0.0001
h-232	1.067E-01	0.6519	4.104E-02	0.2507	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.593E-03	0.0281
otal	1.177E-01	0.7191	4.129E-02	0.2522	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.687E-03	0.0286

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

Water Dependent Pathways

adio-uclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
m-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.776E-04	0.0017
-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.629E-07	0.0000
s-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.093E-02	0.0668
-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.607E-05	0.0005
m-147	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.275E-05	0.0003
h-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.523E-01	0.9307
otal	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.637E-01	1.0000

Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
uclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	4.735E-05	0.0001	1.509E-04	0.0004	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.638E-05	0.0002
-14	1.661E-10	0.0000	3.889E-09	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.990E-10	0.0000
s-137	1.044E-02	0.0308	3.184E-08	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.081E-06	0.0000
-3	0.000E+00	0.0000	1.995E-05	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.289E-08	0.0000
Pm-147	1.882E-05	0.0001	4.623E-06	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.644E-06	0.0000
h-232	2.810E-01	0.8290	4.207E-02	0.1241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.133E-03	0.0151
Total	2.915E-01	0.8600	4.225E-02	0.1246	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.220E-03	0.0154

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+00 years

Water Dependent Pathways

adio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
m-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.746E-04	0.0008
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.554E-09	0.0000
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.044E-02	0.0308
-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.003E-05	0.0001
m-147	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.109E-05	0.0001
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.282E-01	0.9682
otal	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.390E-01	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

adio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
uclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
m-241	4.562E-05	0.0001	1.454E-04	0.0002	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.358E-05	0.0001
-14	5.942E-16	0.0000	1.391E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.785E-15	0.0000
s-137	8.878E-03	0.0105	2.708E-08	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.620E-06	0.0000
-3	0.000E+00	0.0000	1.207E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.016E-10	0.0000
m-147	2.959E-06	0.0000	7.268E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.202E-06	0.0000
h-232	7.876E-01	0.9277	4.579E-02	0.0539	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.484E-03	0.0076
otal	7.965E-01	0.9382	4.594E-02	0.0541	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.561E-03	0.0077

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

Water Dependent Pathways

adio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
uclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
m-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.646E-04	0.0003
-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.629E-14	0.0000
s-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.881E-03	0.0105
-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.212E-07	0.0000
m-147	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.888E-06	0.0000
h-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.399E-01	0.9892
otal	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.490E-01	1.0000

Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio-nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	4.102E-05	0.0000	1.307E-04	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.615E-05	0.0001
C-14	1.373E-31	0.0000	3.213E-30	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.123E-31	0.0000
Cs-137	5.591E-03	0.0045	1.705E-08	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.650E-06	0.0000
H-3	0.000E+00	0.0000	5.332E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.216E-16	0.0000
Pm-147	1.498E-08	0.0000	3.679E-09	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.082E-09	0.0000
Th-232	1.193E+00	0.9503	4.898E-02	0.0390	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.497E-03	0.0060
Total	1.198E+00	0.9548	4.911E-02	0.0391	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.565E-03	0.0060

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years

Water Dependent Pathways

Radio-Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.379E-04	0.0002
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.763E-30	0.0000
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.593E-03	0.0045
H-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.354E-14	0.0000
Pm-147	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.474E-08	0.0000
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.249E+00	0.9954
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.255E+00	1.0000

* Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

adio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
uclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
m-241	2.828E-05	0.0000	9.005E-05	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.557E-05	0.0000
-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
s-137	1.108E-03	0.0009	3.380E-09	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.271E-07	0.0000
-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
m-147	1.381E-16	0.0000	5.433E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.311E-14	0.0000
h-232	1.232E+00	0.9549	4.929E-02	0.0382	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.595E-03	0.0059
otal	1.233E+00	0.9558	4.938E-02	0.0383	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.641E-03	0.0059

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

Water Dependent Pathways

adio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
uclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
m-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.639E-04	0.0001
-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
s-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.108E-03	0.0009
-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
m-147	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.266E-13	0.0000
h-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.289E+00	0.9990
otal	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.290E+00	1.0000

Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

Radio-nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	9.793E-06	0.0000	3.105E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.571E-05	0.0000
-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
s-137	1.087E-05	0.0000	3.316E-11	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.209E-09	0.0000
H-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pm-147	0.000E+00	0.0000	5.335E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.155E-14	0.0000
h-232	1.232E+00	0.9558	4.928E-02	0.0382	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.593E-03	0.0059
Total	1.232E+00	0.9558	4.931E-02	0.0383	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.609E-03	0.0059

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years

Water Dependent Pathways

Radio-Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
m-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.656E-05	0.0000
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.087E-05	0.0000
-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pm-147	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.150E-13	0.0000
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.289E+00	0.9999
otal	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.289E+00	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years

Water Independent Pathways (Inhalation excludes radon)

adio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
uclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
m-241	2.913E-07	0.0000	7.559E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.826E-07	0.000C
-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.000C
s-137	1.017E-12	0.0000	3.102E-18	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.001E-16	0.000C
-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.000C
m-147	0.000E+00	0.0000	5.005E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.651E-14	0.000C
h-232	1.231E+00	0.9559	4.923E-02	0.0382	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.586E-03	0.0059
otal	1.231E+00	0.9559	4.923E-02	0.0382	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.587E-03	0.0059

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years

Water Dependent Pathways

adio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
uclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
m-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.430E-06	0.000C
-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.000C
s-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.017E-12	0.000C
-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.000C
m-147	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.770E-13	0.000C
h-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.288E+00	1.000C
otal	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.288E+00	1.000C

Sum of all water independent and dependent pathways.

Dose/Source Ratios Summed Over All Pathways
Parent and Progeny Principal Radionuclide Contributions Indicated

Parent (i)	Product (j)	Thread Fraction	DSR(j,t) At Time in Years (mrem/yr)/(pCi/g) 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Am-241	Am-241	1.000E+00	3.488E-02	3.470E-02	3.433E-02	3.307E-02	2.973E-02	2.048E-02	7.062E-03	1.699E-04
Am-241	Np-237+D	1.000E+00	2.980E-08	8.916E-08	2.069E-07	6.087E-07	1.673E-06	4.573E-06	8.471E-06	8.798E-06
Am-241	U-233	1.000E+00	1.604E-15	1.121E-14	5.897E-14	5.190E-13	4.175E-12	3.859E-11	2.242E-10	7.207E-10
Am-241	Th-229+D	1.000E+00	1.785E-18	2.673E-17	3.108E-16	8.140E-15	1.921E-13	6.081E-12	1.171E-10	1.675E-09
Am-241	∑DSR(j)		3.488E-02	3.470E-02	3.433E-02	3.308E-02	2.974E-02	2.049E-02	7.070E-03	1.787E-04
C-14	C-14	1.000E+00	2.375E-05	3.974E-06	1.111E-07	3.974E-13	9.178E-29	0.000E+00	0.000E+00	0.000E+00
Cs-137+D	Cs-137+D	1.000E+00	4.476E-01	4.374E-01	4.176E-01	3.552E-01	2.237E-01	4.434E-02	4.350E-04	4.069E-11
H-3	H-3	1.000E+00	2.935E-05	1.416E-05	3.295E-06	1.994E-08	8.809E-15	3.127E-37	0.000E+00	0.000E+00
Pm-147	Pm-147	1.000E+00	1.003E-05	7.699E-06	4.538E-06	7.134E-07	3.611E-09	3.330E-17	3.672E-40	0.000E+00
Pm-147	Sm-147	1.000E+00	1.118E-14	3.001E-14	5.555E-14	8.641E-14	9.198E-14	9.142E-14	8.977E-14	8.422E-14
Pm-147	∑DSR(j)		1.003E-05	7.699E-06	4.538E-06	7.134E-07	3.611E-09	9.146E-14	8.977E-14	8.422E-14
Th-232	Th-232	1.000E+00	7.836E-02	7.836E-02	7.836E-02	7.836E-02	7.836E-02	7.835E-02	7.833E-02	7.826E-02
Th-232	Ra-228+D	1.000E+00	4.656E-02	1.325E-01	2.760E-01	5.747E-01	7.775E-01	7.970E-01	7.968E-01	7.961E-01
Th-232	Th-228+D	1.000E+00	8.964E-03	5.498E-02	2.184E-01	8.127E-01	1.324E+00	1.374E+00	1.374E+00	1.373E+00
Th-232	∑DSR(j)		1.339E-01	2.659E-01	5.728E-01	1.466E+00	2.180E+00	2.250E+00	2.249E+00	2.247E+00

The DSR includes contributions from associated (half-life ≤ 30 days) daughters.

Single Radionuclide Soil Guidelines G(i,t) in pCi/g
Basic Radiation Dose Limit = 1.500E+01 mrem/yr

Nuclide (i)	t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Am-241	4.300E+02	4.323E+02	4.369E+02	4.535E+02	5.045E+02	7.322E+02	2.122E+03	8.393E+04
C-14	6.316E+05	3.774E+06	1.350E+08	*4.455E+12	*4.455E+12	*4.455E+12	*4.455E+12	*4.455E+12
Cs-137	3.351E+01	3.429E+01	3.592E+01	4.223E+01	6.705E+01	3.383E+02	3.448E+04	3.686E+11
H-3	5.111E+05	1.059E+06	4.552E+06	7.521E+08	1.703E+15	*9.597E+15	*9.597E+15	*9.597E+15
Pm-147	1.496E+06	1.948E+06	3.305E+06	2.102E+07	4.154E+09	1.640E+14	1.671E+14	1.781E+14
Th-232	1.120E+02	5.642E+01	2.619E+01	1.023E+01	6.882E+00	6.667E+00	6.669E+00	6.675E+00

*At specific activity limit

Summed Dose/Source Ratios DSR(i,t) in (mrem/yr)/(pCi/g)
and Single Radionuclide Soil Guidelines G(i,t) in pCi/g
at tmin = time of minimum single radionuclide soil guideline
and at tmax = time of maximum total dose = 66.5 ± 0.1 years

uclide (i)	Initial (pCi/g)	tmin (years)	DSR(i,tmin)	G(i,tmin) (pCi/g)	DSR(i,tmax)	G(i,tmax) (pCi/g)
m-241	8.000E-03	0.000E+00	3.488E-02	4.300E+02	2.448E-02	6.126E+02
-14	4.100E-02	0.000E+00	2.375E-05	6.316E+05	0.000E+00	*4.455E+12
s-137	2.500E-02	0.000E+00	4.476E-01	3.351E+01	9.619E-02	1.559E+02
-3	6.078E+00	0.000E+00	2.935E-05	5.111E+05	1.901E-26	*9.597E+15
m-147	6.851E+00	0.000E+00	1.003E-05	1.496E+06	3.248E-13	4.618E+13
h-232	5.730E-01	95.7 ± 0.2	2.250E+00	6.667E+00	2.249E+00	6.670E+00

At specific activity limit

ummary : Ft Belvoir Industrial 15 mrem/yr 641m2
ile : RESRAD Ft Belvoir 641m2 Industrial Ave ROC.RAD

Individual Nuclide Dose Summed Over All Pathways
Parent Nuclide and Branch Fraction Indicated

Nuclide (j)	Parent (i)	THF(i)	DOSE(j,t), mrem/yr							
		t=	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Am-241	Am-241	1.000E+00	2.791E-04	2.776E-04	2.746E-04	2.646E-04	2.379E-04	1.639E-04	5.649E-05	1.359E-06
p-237	Am-241	1.000E+00	2.384E-10	7.133E-10	1.655E-09	4.870E-09	1.338E-08	3.658E-08	6.777E-08	7.038E-08
-233	Am-241	1.000E+00	1.284E-17	8.967E-17	4.718E-16	4.152E-15	3.340E-14	3.087E-13	1.794E-12	5.766E-12
Th-229	Am-241	1.000E+00	1.428E-20	2.139E-19	2.486E-18	6.512E-17	1.537E-15	4.865E-14	9.369E-13	1.340E-11
-14	C-14	1.000E+00	9.738E-07	1.629E-07	4.554E-09	1.629E-14	3.763E-30	0.000E+00	0.000E+00	0.000E+00
Cs-137	Cs-137	1.000E+00	1.119E-02	1.093E-02	1.044E-02	8.881E-03	5.593E-03	1.108E-03	1.087E-05	1.017E-12
-3	H-3	1.000E+00	1.784E-04	8.607E-05	2.003E-05	1.212E-07	5.354E-14	0.000E+00	0.000E+00	0.000E+00
Pm-147	Pm-147	1.000E+00	6.870E-05	5.275E-05	3.109E-05	4.888E-06	2.474E-08	2.282E-16	0.000E+00	0.000E+00
Sm-147	Pm-147	1.000E+00	7.661E-14	2.056E-13	3.805E-13	5.920E-13	6.301E-13	6.263E-13	6.150E-13	5.770E-13
h-232	Th-232	1.000E+00	4.490E-02	4.490E-02	4.490E-02	4.490E-02	4.490E-02	4.489E-02	4.488E-02	4.484E-02
Ra-228	Th-232	1.000E+00	2.668E-02	7.593E-02	1.581E-01	3.293E-01	4.455E-01	4.567E-01	4.566E-01	4.562E-01
h-228	Th-232	1.000E+00	5.136E-03	3.150E-02	1.251E-01	4.657E-01	7.586E-01	7.875E-01	7.873E-01	7.866E-01

THF(i) is the thread fraction of the parent nuclide.

Individual Nuclide Soil Concentration
Parent Nuclide and Branch Fraction Indicated

uclide (j)	Parent (i)	THF(i)	S(j,t), pCi/g t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
u-241	Am-241	1.000E+00	8.000E-03	7.958E-03	7.873E-03	7.585E-03	6.819E-03	4.697E-03	1.619E-03	3.897E-05
p-237	Am-241	1.000E+00	0.000E+00	2.584E-09	7.708E-09	2.520E-08	7.152E-08	1.977E-07	3.675E-07	3.819E-07
-233	Am-241	1.000E+00	0.000E+00	5.652E-15	5.063E-14	5.533E-13	4.751E-12	4.494E-11	2.628E-10	8.467E-10
h-229	Am-241	1.000E+00	0.000E+00	1.780E-19	4.790E-18	1.752E-16	4.564E-15	1.496E-13	2.909E-12	4.174E-11
-14	C-14	1.000E+00	4.100E-02	6.862E-03	1.919E-04	6.875E-10	1.595E-25	0.000E+00	0.000E+00	0.000E+00
s-137	Cs-137	1.000E+00	2.500E-02	2.443E-02	2.332E-02	1.984E-02	1.249E-02	2.476E-03	2.429E-05	2.272E-12
-3	H-3	1.000E+00	6.078E+00	2.933E+00	6.826E-01	4.133E-03	1.828E-09	6.518E-32	0.000E+00	0.000E+00
m-147	Pm-147	1.000E+00	6.851E+00	5.260E+00	3.100E+00	4.874E-01	2.467E-03	2.275E-11	2.509E-34	0.000E+00
m-147	Pm-147	1.000E+00	0.000E+00	3.937E-11	9.278E-11	1.573E-10	1.690E-10	1.680E-10	1.650E-10	1.548E-10
h-232	Th-232	1.000E+00	5.730E-01	5.730E-01	5.730E-01	5.730E-01	5.730E-01	5.729E-01	5.728E-01	5.723E-01
a-228	Th-232	1.000E+00	0.000E+00	6.504E-02	1.736E-01	3.996E-01	5.532E-01	5.679E-01	5.677E-01	5.672E-01
h-228	Th-232	1.000E+00	0.000E+00	1.068E-02	7.116E-02	3.222E-01	5.457E-01	5.679E-01	5.677E-01	5.672E-01

HF(i) is the thread fraction of the parent nuclide.

ESCALC.EXE execution time = 941.65 seconds

ummary : Ft Belvoir Farmer 641m2 Farmer Max
File : RESRAD Ft Belvoir 641m2 Farmer Max ROC.RAD

Table of Contents

Part I: Mixture Sums and Single Radionuclide Guidelines

Dose Conversion Factor (and Related) Parameter Summary
File: HEAST 2001 MORBIDITY

enu	Parameter	Current Value	Base Case*	Parameter Name
-1	Dose conversion factors for inhalation, mrem/pCi:			
-1	Am-241	4.440E-01	4.440E-01	DCF2(1)
-1	C-14	2.090E-06	2.090E-06	DCF2(2)
-1	Cs-137+D	3.190E-05	3.190E-05	DCF2(3)
-1	H-3	6.400E-08	6.400E-08	DCF2(4)
-1	Np-237+D	5.400E-01	5.400E-01	DCF2(5)
-1	Pm-147	3.920E-05	3.920E-05	DCF2(6)
-1	Ra-228+D	5.078E-03	4.770E-03	DCF2(7)
-1	Sm-147	7.470E-02	7.470E-02	DCF2(8)
-1	Th-228+D	3.454E-01	3.420E-01	DCF2(9)
-1	Th-229+D	2.169E+00	2.150E+00	DCF2(10)
-1	Th-232	1.640E+00	1.640E+00	DCF2(11)
-1	U-233	1.350E-01	1.350E-01	DCF2(12)
-1	Dose conversion factors for ingestion, mrem/pCi:			
-1	Am-241	3.640E-03	3.640E-03	DCF3(1)
-1	C-14	2.090E-06	2.090E-06	DCF3(2)
-1	Cs-137+D	5.000E-05	5.000E-05	DCF3(3)
-1	H-3	6.400E-08	6.400E-08	DCF3(4)
-1	Np-237+D	4.444E-03	4.440E-03	DCF3(5)
-1	Pm-147	1.050E-06	1.050E-06	DCF3(6)
-1	Ra-228+D	1.442E-03	1.440E-03	DCF3(7)
-1	Sm-147	1.850E-04	1.850E-04	DCF3(8)
-1	Th-228+D	8.086E-04	3.960E-04	DCF3(9)
-1	Th-229+D	4.027E-03	3.530E-03	DCF3(10)
-1	Th-232	2.730E-03	2.730E-03	DCF3(11)
-1	U-233	2.890E-04	2.890E-04	DCF3(12)
-34	Food transfer factors:			
-34	Am-241 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(1,1)
-34	Am-241 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	5.000E-05	5.000E-05	RTF(1,2)
-34	Am-241 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-06	2.000E-06	RTF(1,3)
-34				
-34	C-14 , plant/soil concentration ratio, dimensionless	5.500E+00	5.500E+00	RTF(2,1)
-34	C-14 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.100E-02	3.100E-02	RTF(2,2)
-34	C-14 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.200E-02	1.200E-02	RTF(2,3)
-34				
-34	Cs-137+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(3,1)
-34	Cs-137+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.000E-02	3.000E-02	RTF(3,2)
-34	Cs-137+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	8.000E-03	8.000E-03	RTF(3,3)
-34				
-34	H-3 , plant/soil concentration ratio, dimensionless	4.800E+00	4.800E+00	RTF(4,1)
-34	H-3 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.200E-02	1.200E-02	RTF(4,2)
-34	H-3 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-02	1.000E-02	RTF(4,3)
-34				
-34	Np-237+D , plant/soil concentration ratio, dimensionless	2.000E-02	2.000E-02	RTF(5,1)
-34	Np-237+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(5,2)
-34	Np-237+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(5,3)
-34				

Dose Conversion Factor (and Related) Parameter Summary (continued)
File: HEAST 2001 MORBIDITY

enu	Parameter	Current Value	Base Case*	Parameter Name
-34	Pm-147 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(6,1)
-34	Pm-147 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-03	2.000E-03	RTF(6,2)
D-34	Pm-147 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-05	2.000E-05	RTF(6,3)
D-34				
-34	Ra-228+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(7,1)
-34	Ra-228+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(7,2)
D-34	Ra-228+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-03	1.000E-03	RTF(7,3)
-34				
-34	Sm-147 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(8,1)
D-34	Sm-147 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-03	2.000E-03	RTF(8,2)
D-34	Sm-147 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-05	2.000E-05	RTF(8,3)
-34				
D-34	Th-228+D , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(9,1)
D-34	Th-228+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(9,2)
-34	Th-228+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(9,3)
-34				
D-34	Th-229+D , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(10,1)
-34	Th-229+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(10,2)
-34	Th-229+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(10,3)
D-34				
D-34	Th-232 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(11,1)
-34	Th-232 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(11,2)
-34	Th-232 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(11,3)
D-34				
-34	U-233 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(12,1)
-34	U-233 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(12,2)
D-34	U-233 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(12,3)
-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	Am-241 , fish	3.000E+01	3.000E+01	BIOFAC(1,1)
D-5	Am-241 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(1,2)
-5				
-5	C-14 , fish	5.000E+04	5.000E+04	BIOFAC(2,1)
D-5	C-14 , crustacea and mollusks	9.100E+03	9.100E+03	BIOFAC(2,2)
-5				
-5	Cs-137+D , fish	2.000E+03	2.000E+03	BIOFAC(3,1)
D-5	Cs-137+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(3,2)
D-5				
-5	H-3 , fish	1.000E+00	1.000E+00	BIOFAC(4,1)
-5	H-3 , crustacea and mollusks	1.000E+00	1.000E+00	BIOFAC(4,2)
D-5				
-5	Np-237+D , fish	3.000E+01	3.000E+01	BIOFAC(5,1)
-5	Np-237+D , crustacea and mollusks	4.000E+02	4.000E+02	BIOFAC(5,2)
D-5				
-5	Pm-147 , fish	3.000E+01	3.000E+01	BIOFAC(6,1)
-5	Pm-147 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(6,2)
D-5				
D-5	Ra-228+D , fish	5.000E+01	5.000E+01	BIOFAC(7,1)
-5	Ra-228+D , crustacea and mollusks	2.500E+02	2.500E+02	BIOFAC(7,2)
-5				

Dose Conversion Factor (and Related) Parameter Summary (continued)
File: HEAST 2001 MORBIDITY

enu	Parameter	Current Value	Base Case*	Parameter Name
-5	Sm-147 , fish	2.500E+01	2.500E+01	BIOFAC(8,1)
-5	Sm-147 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(8,2)
-5				
-5	Th-228+D , fish	1.000E+02	1.000E+02	BIOFAC(9,1)
-5	Th-228+D , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(9,2)
-5				
-5	Th-229+D , fish	1.000E+02	1.000E+02	BIOFAC(10,1)
-5	Th-229+D , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(10,2)
-5				
-5	Th-232 , fish	1.000E+02	1.000E+02	BIOFAC(11,1)
-5	Th-232 , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(11,2)
-5				
-5	U-233 , fish	1.000E+01	1.000E+01	BIOFAC(12,1)
-5	U-233 , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(12,2)

Base Case means Default.Lib w/o Associate Nuclide contributions.

Site-Specific Parameter Summary

anu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R011	Area of contaminated zone (m**2)	6.410E+02	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	4.573E+00	2.000E+00	---	THICK0
011	Length parallel to aquifer flow (m)	2.532E+01	1.000E+02	---	LCZPAQ
R011	Basic radiation dose limit (mrem/yr)	2.500E+01	3.000E+01	---	BRDL
R011	Time since placement of material (yr)	0.000E+00	0.000E+00	---	TI
011	Times for calculations (yr)	1.000E+00	1.000E+00	---	T(2)
011	Times for calculations (yr)	3.000E+00	3.000E+00	---	T(3)
R011	Times for calculations (yr)	1.000E+01	1.000E+01	---	T(4)
011	Times for calculations (yr)	3.000E+01	3.000E+01	---	T(5)
011	Times for calculations (yr)	1.000E+02	1.000E+02	---	T(6)
R011	Times for calculations (yr)	3.000E+02	3.000E+02	---	T(7)
R011	Times for calculations (yr)	1.000E+03	1.000E+03	---	T(8)
011	Times for calculations (yr)	not used	0.000E+00	---	T(9)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(10)
012	Initial principal radionuclide (pCi/g): Am-241	8.500E-02	0.000E+00	---	S1(1)
012	Initial principal radionuclide (pCi/g): C-14	1.240E+00	0.000E+00	---	S1(2)
R012	Initial principal radionuclide (pCi/g): Cs-137	2.690E-01	0.000E+00	---	S1(3)
012	Initial principal radionuclide (pCi/g): H-3	4.360E+01	0.000E+00	---	S1(4)
012	Initial principal radionuclide (pCi/g): Pm-147	4.700E+01	0.000E+00	---	S1(6)
R012	Initial principal radionuclide (pCi/g): Th-232	1.160E+00	0.000E+00	---	S1(11)
R012	Concentration in groundwater (pCi/L): Am-241	not used	0.000E+00	---	W1(1)
012	Concentration in groundwater (pCi/L): C-14	not used	0.000E+00	---	W1(2)
012	Concentration in groundwater (pCi/L): Cs-137	not used	0.000E+00	---	W1(3)
R012	Concentration in groundwater (pCi/L): H-3	not used	0.000E+00	---	W1(4)
012	Concentration in groundwater (pCi/L): Pm-147	not used	0.000E+00	---	W1(6)
012	Concentration in groundwater (pCi/L): Th-232	not used	0.000E+00	---	W1(11)
R013	Cover depth (m)	0.000E+00	0.000E+00	---	COVER0
013	Density of cover material (g/cm**3)	not used	1.500E+00	---	DENSCV
R013	Cover depth erosion rate (m/yr)	not used	1.000E-03	---	VCV
R013	Density of contaminated zone (g/cm**3)	1.431E+00	1.500E+00	---	DENSCZ
013	Contaminated zone erosion rate (m/yr)	1.000E-03	1.000E-03	---	VCZ
013	Contaminated zone total porosity	4.000E-01	4.000E-01	---	TPCZ
R013	Contaminated zone field capacity	2.000E-01	2.000E-01	---	FCCZ
013	Contaminated zone hydraulic conductivity (m/yr)	1.000E+01	1.000E+01	---	HCCZ
013	Contaminated zone b parameter	5.300E+00	5.300E+00	---	BCZ
R013	Average annual wind speed (m/sec)	2.000E+00	2.000E+00	---	WIND
R013	Humidity in air (g/m**3)	8.000E+00	8.000E+00	---	HUMID
013	Evapotranspiration coefficient	5.000E-01	5.000E-01	---	EVAPTR
R013	Precipitation (m/yr)	9.812E-01	1.000E+00	---	PRECIP
R013	Irrigation (m/yr)	2.000E-01	2.000E-01	---	RI
013	Irrigation mode	overhead	overhead	---	IDITCH
013	Runoff coefficient	2.000E-01	2.000E-01	---	RUNOFF
R013	Watershed area for nearby stream or pond (m**2)	1.000E+06	1.000E+06	---	WAREA
013	Accuracy for water/soil computations	1.000E-03	1.000E-03	---	EPS
R014	Density of saturated zone (g/cm**3)	1.431E+00	1.500E+00	---	DENSAQ
R014	Saturated zone total porosity	4.000E-01	4.000E-01	---	TPSZ
014	Saturated zone effective porosity	2.000E-01	2.000E-01	---	EPSZ

Site-Specific Parameter Summary (continued)

enu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
014	Saturated zone field capacity	2.000E-01	2.000E-01	---	FCSZ
014	Saturated zone hydraulic conductivity (m/yr)	1.000E+02	1.000E+02	---	HCSZ
014	Saturated zone hydraulic gradient	2.000E-02	2.000E-02	---	HGWT
014	Saturated zone b parameter	5.300E+00	5.300E+00	---	BSZ
014	Water table drop rate (m/yr)	1.000E-03	1.000E-03	---	VWT
014	Well pump intake depth (m below water table)	1.000E+01	1.000E+01	---	DWIBWT
014	Model: Nondispersion (ND) or Mass-Balance (MB)	MB	ND	---	MODEL
014	Well pumping rate (m**3/yr)	2.500E+02	2.500E+02	---	UW
015	Number of unsaturated zone strata	0	1	---	NS
016	Distribution coefficients for Am-241				
016	Contaminated zone (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCC(1)
016	Saturated zone (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCS(1)
016	Leach rate (/yr)	0.000E+00	0.000E+00	3.721E-03	ALEACH(1)
016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
016	Distribution coefficients for C-14				
016	Contaminated zone (cm**3/g)	0.000E+00	0.000E+00	---	DCNUCC(2)
016	Saturated zone (cm**3/g)	0.000E+00	0.000E+00	---	DCNUCS(2)
016	Leach rate (/yr)	0.000E+00	0.000E+00	3.360E-01	ALEACH(2)
016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(2)
016	Distribution coefficients for Cs-137				
016	Contaminated zone (cm**3/g)	4.600E+03	4.600E+03	---	DCNUCC(3)
016	Saturated zone (cm**3/g)	4.600E+03	4.600E+03	---	DCNUCS(3)
016	Leach rate (/yr)	0.000E+00	0.000E+00	1.636E-05	ALEACH(3)
016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(3)
016	Distribution coefficients for H-3				
016	Contaminated zone (cm**3/g)	0.000E+00	0.000E+00	---	DCNUCC(4)
016	Saturated zone (cm**3/g)	0.000E+00	0.000E+00	---	DCNUCS(4)
016	Leach rate (/yr)	0.000E+00	0.000E+00	3.360E-01	ALEACH(4)
016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(4)
016	Distribution coefficients for Pm-147				
016	Contaminated zone (cm**3/g)	-1.000E+00	-1.000E+00	8.249E+02	DCNUCC(6)
016	Saturated zone (cm**3/g)	-1.000E+00	-1.000E+00	8.249E+02	DCNUCS(6)
016	Leach rate (/yr)	0.000E+00	0.000E+00	9.120E-05	ALEACH(6)
016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(6)
016	Distribution coefficients for Th-232				
016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCC(11)
016	Saturated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCS(11)
016	Leach rate (/yr)	0.000E+00	0.000E+00	1.254E-06	ALEACH(11)
016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(11)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R016	Distribution coefficients for daughter Np-237				
R016	Contaminated zone (cm**3/g)	-1.000E+00	-1.000E+00	2.574E+02	DCNUCC(5)
R016	Saturated zone (cm**3/g)	-1.000E+00	-1.000E+00	2.574E+02	DCNUCS(5)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.921E-04	ALEACH(5)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(5)
R016	Distribution coefficients for daughter Ra-228				
R016	Contaminated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCC(7)
R016	Saturated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCS(7)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.072E-03	ALEACH(7)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(7)
R016	Distribution coefficients for daughter Sm-147				
R016	Contaminated zone (cm**3/g)	-1.000E+00	-1.000E+00	8.249E+02	DCNUCC(8)
R016	Saturated zone (cm**3/g)	-1.000E+00	-1.000E+00	8.249E+02	DCNUCS(8)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	9.120E-05	ALEACH(8)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(8)
R016	Distribution coefficients for daughter Th-228				
R016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCC(9)
R016	Saturated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCS(9)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.254E-06	ALEACH(9)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(9)
R016	Distribution coefficients for daughter Th-229				
R016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCC(10)
R016	Saturated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCS(10)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.254E-06	ALEACH(10)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(10)
R016	Distribution coefficients for daughter U-233				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(12)
R016	Saturated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCS(12)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.498E-03	ALEACH(12)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(12)
R017	Inhalation rate (m**3/yr)	8.513E+03	8.400E+03	---	INHALR
R017	Mass loading for inhalation (g/m**3)	4.000E-04	1.000E-04	---	MLINH
R017	Exposure duration	3.000E+01	3.000E+01	---	ED
R017	Shielding factor, inhalation	2.500E-01	4.000E-01	---	SHF3
R017	Shielding factor, external gamma	5.512E-01	7.000E-01	---	SHF1
R017	Fraction of time spent indoors	6.571E-01	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	1.101E-01	2.500E-01	---	FOTD
R017	Shape factor flag, external gamma	1.000E+00	1.000E+00	>0 shows circular AREA.	FS

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
017	Radii of shape factor array (used if FS = -1):				
017	Outer annular radius (m), ring 1:	not used	5.000E+01	---	RAD_SHAPE(1)
017	Outer annular radius (m), ring 2:	not used	7.071E+01	---	RAD_SHAPE(2)
017	Outer annular radius (m), ring 3:	not used	0.000E+00	---	RAD_SHAPE(3)
017	Outer annular radius (m), ring 4:	not used	0.000E+00	---	RAD_SHAPE(4)
017	Outer annular radius (m), ring 5:	not used	0.000E+00	---	RAD_SHAPE(5)
017	Outer annular radius (m), ring 6:	not used	0.000E+00	---	RAD_SHAPE(6)
017	Outer annular radius (m), ring 7:	not used	0.000E+00	---	RAD_SHAPE(7)
017	Outer annular radius (m), ring 8:	not used	0.000E+00	---	RAD_SHAPE(8)
017	Outer annular radius (m), ring 9:	not used	0.000E+00	---	RAD_SHAPE(9)
017	Outer annular radius (m), ring 10:	not used	0.000E+00	---	RAD_SHAPE(10)
017	Outer annular radius (m), ring 11:	not used	0.000E+00	---	RAD_SHAPE(11)
017	Outer annular radius (m), ring 12:	not used	0.000E+00	---	RAD_SHAPE(12)
017	Fractions of annular areas within AREA:				
017	Ring 1	not used	1.000E+00	---	FRACA(1)
017	Ring 2	not used	2.732E-01	---	FRACA(2)
017	Ring 3	not used	0.000E+00	---	FRACA(3)
017	Ring 4	not used	0.000E+00	---	FRACA(4)
017	Ring 5	not used	0.000E+00	---	FRACA(5)
017	Ring 6	not used	0.000E+00	---	FRACA(6)
017	Ring 7	not used	0.000E+00	---	FRACA(7)
017	Ring 8	not used	0.000E+00	---	FRACA(8)
017	Ring 9	not used	0.000E+00	---	FRACA(9)
017	Ring 10	not used	0.000E+00	---	FRACA(10)
017	Ring 11	not used	0.000E+00	---	FRACA(11)
017	Ring 12	not used	0.000E+00	---	FRACA(12)
018	Fruits, vegetables and grain consumption (kg/yr)	1.118E+02	1.600E+02	---	DIET(1)
018	Leafy vegetable consumption (kg/yr)	2.140E+01	1.400E+01	---	DIET(2)
018	Milk consumption (L/yr)	2.330E+02	9.200E+01	---	DIET(3)
018	Meat and poultry consumption (kg/yr)	6.510E+01	6.300E+01	---	DIET(4)
018	Fish consumption (kg/yr)	2.060E+01	5.400E+00	---	DIET(5)
018	Other seafood consumption (kg/yr)	0.000E+00	9.000E-01	---	DIET(6)
018	Soil ingestion rate (g/yr)	1.826E+01	3.650E+01	---	SOIL
018	Drinking water intake (L/yr)	4.785E+02	5.100E+02	---	DWI
018	Contamination fraction of drinking water	1.000E+00	1.000E+00	---	FDW
018	Contamination fraction of household water	not used	1.000E+00	---	FHHW
018	Contamination fraction of livestock water	1.000E+00	1.000E+00	---	FLW
018	Contamination fraction of irrigation water	1.000E+00	1.000E+00	---	FIRW
018	Contamination fraction of aquatic food	1.000E+00	5.000E-01	---	FR9
018	Contamination fraction of plant food	1.000E+00	-1	---	FPLANT
018	Contamination fraction of meat	1.000E+00	-1	---	FMEAT
018	Contamination fraction of milk	1.000E+00	-1	---	FMILK
019	Livestock fodder intake for meat (kg/day)	2.685E+01	6.800E+01	---	LFI5
019	Livestock fodder intake for milk (kg/day)	6.325E+01	5.500E+01	---	LFI6
019	Livestock water intake for meat (L/day)	5.000E+01	5.000E+01	---	LWI5
019	Livestock water intake for milk (L/day)	6.000E+01	1.600E+02	---	LWI6
019	Livestock soil intake (kg/day)	2.000E-02	5.000E-01	---	LSI

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R019	Mass loading for foliar deposition (g/m**3)	1.000E-04	1.000E-04	---	MLFD
R019	Depth of soil mixing layer (m)	1.500E-01	1.500E-01	---	DM
019	Depth of roots (m)	9.000E-01	9.000E-01	---	DROOT
R019	Drinking water fraction from ground water	1.000E+00	1.000E+00	---	FGWDW
R019	Household water fraction from ground water	not used	1.000E+00	---	FGWHH
019	Livestock water fraction from ground water	1.000E+00	1.000E+00	---	FGWLW
019	Irrigation fraction from ground water	1.000E+00	1.000E+00	---	FGWIR
19B	Wet weight crop yield for Non-Leafy (kg/m**2)	4.000E+00	7.000E-01	---	YV(1)
19B	Wet weight crop yield for Leafy (kg/m**2)	2.000E+00	1.500E+00	---	YV(2)
R19B	Wet weight crop yield for Fodder (kg/m**2)	1.500E+00	1.100E+00	---	YV(3)
R19B	Growing Season for Non-Leafy (years)	2.500E-01	1.700E-01	---	TE(1)
19B	Growing Season for Leafy (years)	2.500E-01	2.500E-01	---	TE(2)
19B	Growing Season for Fodder (years)	8.000E-02	8.000E-02	---	TE(3)
R19B	Translocation Factor for Non-Leafy	1.000E-01	1.000E-01	---	TIV(1)
19B	Translocation Factor for Leafy	1.000E+00	1.000E+00	---	TIV(2)
19B	Translocation Factor for Fodder	1.000E+00	1.000E+00	---	TIV(3)
R19B	Dry Foliar Interception Fraction for Non-Leafy	2.500E-01	2.500E-01	---	RDRY(1)
R19B	Dry Foliar Interception Fraction for Leafy	2.500E-01	2.500E-01	---	RDRY(2)
19B	Dry Foliar Interception Fraction for Fodder	2.500E-01	2.500E-01	---	RDRY(3)
R19B	Wet Foliar Interception Fraction for Non-Leafy	2.500E-01	2.500E-01	---	RWET(1)
R19B	Wet Foliar Interception Fraction for Leafy	2.500E-01	2.500E-01	---	RWET(2)
19B	Wet Foliar Interception Fraction for Fodder	2.500E-01	2.500E-01	---	RWET(3)
19B	Weathering Removal Constant for Vegetation	2.000E+01	2.000E+01	---	WLAM
14	C-12 concentration in water (g/cm**3)	2.000E-05	2.000E-05	---	C12WTR
14	C-12 concentration in contaminated soil (g/g)	3.000E-02	3.000E-02	---	C12CZ
C14	Fraction of vegetation carbon from soil	2.000E-02	2.000E-02	---	CSOIL
C14	Fraction of vegetation carbon from air	9.800E-01	9.800E-01	---	CAIR
14	C-14 evasion layer thickness in soil (m)	3.000E-01	3.000E-01	---	DMC
14	C-14 evasion flux rate from soil (1/sec)	7.000E-07	7.000E-07	---	EVSN
C14	C-12 evasion flux rate from soil (1/sec)	1.000E-10	1.000E-10	---	REVSN
14	Fraction of grain in beef cattle feed	8.000E-01	8.000E-01	---	AVFG4
14	Fraction of grain in milk cow feed	2.000E-01	2.000E-01	---	AVFG5
C14	DCF correction factor for gaseous forms of C14	8.894E+01	0.000E+00	---	CO2F
TOR	Storage times of contaminated foodstuffs (days):				
STOR	Fruits, non-leafy vegetables, and grain	1.400E+01	1.400E+01	---	STOR_T(1)
STOR	Leafy vegetables	1.000E+00	1.000E+00	---	STOR_T(2)
TOR	Milk	1.000E+00	1.000E+00	---	STOR_T(3)
TOR	Meat and poultry	2.000E+01	2.000E+01	---	STOR_T(4)
STOR	Fish	7.000E+00	7.000E+00	---	STOR_T(5)
TOR	Crustacea and mollusks	7.000E+00	7.000E+00	---	STOR_T(6)
TOR	Well water	0.000E+00	1.000E+00	---	STOR_T(7)
STOR	Surface water	0.000E+00	1.000E+00	---	STOR_T(8)
STOR	Livestock fodder	0.000E+00	4.500E+01	---	STOR_T(9)
R021	Thickness of building foundation (m)	not used	1.500E-01	---	FLOOR1
R021	Bulk density of building foundation (g/cm**3)	not used	2.400E+00	---	DENSFL
021	Total porosity of the cover material	not used	4.000E-01	---	TPCV

Site-Specific Parameter Summary (continued)

nu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
)21	Total porosity of the building foundation	not used	1.000E-01	---	TPFL
)21	Volumetric water content of the cover material	not used	5.000E-02	---	PH2OCV
)21	Volumetric water content of the foundation	not used	3.000E-02	---	PH2OFL
)21	Diffusion coefficient for radon gas (m/sec):				
)21	in cover material	not used	2.000E-06	---	DIFCV
)21	in foundation material	not used	3.000E-07	---	DIFFL
)21	in contaminated zone soil	not used	2.000E-06	---	DIFCZ
)21	Radon vertical dimension of mixing (m)	not used	2.000E+00	---	HMIX
)21	Average building air exchange rate (1/hr)	not used	5.000E-01	---	REXG
)21	Height of the building (room) (m)	not used	2.500E+00	---	HRM
)21	Building interior area factor	not used	0.000E+00	---	FAI
)21	Building depth below ground surface (m)	not used	-1.000E+00	---	DMFL
)21	Emanating power of Rn-222 gas	not used	2.500E-01	---	EMANA(1)
)21	Emanating power of Rn-220 gas	not used	1.500E-01	---	EMANA(2)
ITL	Number of graphical time points	1024	---	---	NPTS
ITL	Maximum number of integration points for dose	17	---	---	LYMAX
ITL	Maximum number of integration points for risk	257	---	---	KYMAX

Summary of Pathway Selections

Pathway	User Selection
1 -- external gamma	active
2 -- inhalation (w/o radon)	active
3 -- plant ingestion	active
4 -- meat ingestion	active
5 -- milk ingestion	active
6 -- aquatic foods	active
7 -- drinking water	active
8 -- soil ingestion	active
9 -- radon	suppressed
Find peak pathway doses	active

Summary : Ft Belvoir Farmer 641m2 Farmer Max
File : RESRAD Ft Belvoir 641m2 Farmer Max ROC.RAD

Contaminated Zone Dimensions		Initial Soil Concentrations, pCi/g	
Area:	641.00 square meters	Am-241	8.500E-02
Thickness:	4.57 meters	C-14	1.240E+00
Cover Depth:	0.00 meters	Cs-137	2.690E-01
		H-3	4.360E+01
		Pm-147	4.700E+01
		Th-232	1.160E+00

Total Dose TDOSE(t), mrem/yr
Basic Radiation Dose Limit = 2.500E+01 mrem/yr
Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

t (years):	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
TDOSE(t):	2.706E+01	1.913E+01	1.910E+01	2.859E+01	3.365E+01	2.699E+01	2.047E+01	1.863E+01
M(t):	1.082E+00	7.654E-01	7.640E-01	1.144E+00	1.346E+00	1.079E+00	8.187E-01	7.450E-01

Maximum TDOSE(t): 3.376E+01 mrem/yr at t = 26.18 ± 0.05 years

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 2.618E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio-nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	1.387E-03	0.0000	3.893E-03	0.0001	0.000E+00	0.0000	3.579E-02	0.0011	4.112E-05	0.0000	1.044E-05	0.0000	2.410E-03	0.0001
C-14	1.287E-26	0.0000	3.246E-25	0.0000	0.000E+00	0.0000	2.550E-21	0.0000	8.820E-22	0.0000	8.383E-22	0.0000	4.166E-26	0.0000
Cs-137	2.049E-01	0.0061	5.506E-07	0.0000	0.000E+00	0.0000	3.867E-02	0.0011	1.551E-02	0.0005	3.450E-02	0.0010	6.518E-05	0.0000
H-3	0.000E+00	0.0000	2.117E-11	0.0000	0.000E+00	0.0000	4.760E-09	0.0000	5.323E-10	0.0000	4.107E-09	0.0000	8.798E-14	0.0000
Pm-147	8.801E-07	0.0000	1.904E-07	0.0000	0.000E+00	0.0000	1.429E-05	0.0000	4.869E-07	0.0000	3.564E-08	0.0000	3.852E-07	0.0000
Th-232	7.379E+00	0.2185	2.713E-01	0.0080	0.000E+00	0.0000	9.049E+00	0.2680	1.152E-01	0.0034	9.474E-01	0.0281	5.060E-02	0.0015
Total	7.585E+00	0.2247	2.752E-01	0.0081	0.000E+00	0.0000	9.124E+00	0.2702	1.307E-01	0.0039	9.819E-01	0.0291	5.308E-02	0.0016

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 2.618E+01 years

Water Dependent Pathways

adio-uclide uclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
m-241	6.335E+00	0.1876	5.245E-03	0.0002	0.000E+00	0.0000	4.439E-01	0.0131	3.695E-03	0.0001	8.892E-04	0.0000	6.832E+00	0.2023
-14	1.095E-20	0.0000	1.564E-20	0.0000	0.000E+00	0.0000	2.680E-21	0.0000	2.478E-21	0.0000	2.631E-21	0.0000	3.865E-20	0.0000
s-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.937E-01	0.0087
-3	2.164E-08	0.0000	6.049E-13	0.0000	0.000E+00	0.0000	4.683E-09	0.0000	1.454E-09	0.0000	6.369E-09	0.0000	4.357E-08	0.0000
m-147	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.626E-05	0.0000
h-232	7.640E+00	0.2263	1.056E-02	0.0003	0.000E+00	0.0000	5.496E-01	0.0163	8.946E-02	0.0026	5.365E-01	0.0159	2.664E+01	0.789C
otal	1.397E+01	0.4139	1.581E-02	0.0005	0.000E+00	0.0000	9.936E-01	0.0294	9.316E-02	0.0028	5.374E-01	0.0159	3.376E+01	1.000C

Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	1.594E-03	0.0001	4.475E-03	0.0002	0.000E+00	0.0000	4.113E-02	0.0015	4.714E-05	0.0000	1.200E-05	0.0000	2.771E-03	0.0001
C-14	3.349E-06	0.0000	8.447E-05	0.0000	0.000E+00	0.0000	6.612E-01	0.0244	2.284E-01	0.0084	2.181E-01	0.0081	1.084E-05	0.0000
Cs-137	3.754E-01	0.0139	1.009E-06	0.0000	0.000E+00	0.0000	7.084E-02	0.0026	2.841E-02	0.0010	6.320E-02	0.0023	1.194E-04	0.0000
H-3	0.000E+00	0.0000	4.282E-03	0.0002	0.000E+00	0.0000	9.621E-01	0.0356	1.075E-01	0.0040	8.306E-01	0.0307	1.779E-05	0.0000
Pm-147	8.898E-04	0.0000	1.925E-04	0.0000	0.000E+00	0.0000	1.444E-02	0.0005	4.923E-04	0.0000	3.603E-05	0.0000	3.894E-04	0.0000
Th-232	1.999E-01	0.0074	2.265E-01	0.0084	0.000E+00	0.0000	9.086E-01	0.0336	7.172E-03	0.0003	5.758E-02	0.0021	2.936E-02	0.0011
Total	5.777E-01	0.0214	2.356E-01	0.0087	0.000E+00	0.0000	2.658E+00	0.0982	3.720E-01	0.0137	1.170E+00	0.0432	3.267E-02	0.0012

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	6.910E+00	0.2554	5.624E-03	0.0002	0.000E+00	0.0000	4.792E-01	0.0177	3.776E-03	0.0001	9.678E-04	0.0000	7.449E+00	0.2753
C-14	2.519E+00	0.0931	3.473E+00	0.1283	0.000E+00	0.0000	5.692E-01	0.0210	5.009E-01	0.0185	6.023E-01	0.0223	8.772E+00	0.3242
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.379E-01	0.0199
H-3	4.062E+00	0.1501	1.109E-04	0.0000	0.000E+00	0.0000	8.387E-01	0.0310	2.503E-01	0.0093	1.192E+00	0.0441	8.248E+00	0.3048
Pm-147	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.644E-02	0.0006
Th-232	5.255E-01	0.0194	6.943E-04	0.0000	0.000E+00	0.0000	3.689E-02	0.0014	5.401E-03	0.0002	3.668E-02	0.0014	2.034E+00	0.0752
Total	1.402E+01	0.5180	3.479E+00	0.1286	0.000E+00	0.0000	1.924E+00	0.0711	7.604E-01	0.0281	1.832E+00	0.0677	2.706E+01	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

adio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
uclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
m-241	1.585E-03	0.0001	4.451E-03	0.0002	0.000E+00	0.0000	4.091E-02	0.0021	4.689E-05	0.0000	1.193E-05	0.0000	2.756E-03	0.0001
-14	5.604E-07	0.0000	1.413E-05	0.0000	0.000E+00	0.0000	1.110E-01	0.0058	3.837E-02	0.0020	3.650E-02	0.0019	1.814E-06	0.0000
s-137	3.668E-01	0.0192	9.855E-07	0.0000	0.000E+00	0.0000	6.922E-02	0.0036	2.776E-02	0.0015	6.176E-02	0.0032	1.167E-04	0.0000
-3	0.000E+00	0.0000	2.066E-03	0.0001	0.000E+00	0.0000	4.645E-01	0.0243	5.194E-02	0.0027	4.008E-01	0.0209	8.586E-06	0.0000
m-147	6.832E-04	0.0000	1.478E-04	0.0000	0.000E+00	0.0000	1.109E-02	0.0006	3.780E-04	0.0000	2.766E-05	0.0000	2.990E-04	0.0000
h-232	6.735E-01	0.0352	2.282E-01	0.0119	0.000E+00	0.0000	1.871E+00	0.0978	2.004E-02	0.0010	1.639E-01	0.0086	3.125E-02	0.0016
otal	1.043E+00	0.0545	2.349E-01	0.0123	0.000E+00	0.0000	2.568E+00	0.1342	1.385E-01	0.0072	6.630E-01	0.0346	3.443E-02	0.0018

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

Water Dependent Pathways

adio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
uclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
m-241	7.262E+00	0.3796	6.013E-03	0.0003	0.000E+00	0.0000	5.090E-01	0.0266	4.236E-03	0.0002	1.019E-03	0.0001	7.832E+00	0.4093
-14	4.728E-01	0.0247	6.750E-01	0.0353	0.000E+00	0.0000	1.157E-01	0.0060	1.069E-01	0.0056	1.136E-01	0.0059	1.670E+00	0.0873
s-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.256E-01	0.0275
-3	2.113E+00	0.1104	5.906E-05	0.0000	0.000E+00	0.0000	4.573E-01	0.0239	1.420E-01	0.0074	6.219E-01	0.0325	4.253E+00	0.2223
m-147	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.262E-02	0.0007
h-232	1.605E+00	0.0839	2.188E-03	0.0001	0.000E+00	0.0000	1.146E-01	0.0060	1.807E-02	0.0009	1.125E-01	0.0059	4.840E+00	0.2530
otal	1.145E+01	0.5986	6.833E-01	0.0357	0.000E+00	0.0000	1.196E+00	0.0625	2.712E-01	0.0142	8.490E-01	0.0444	1.913E+01	1.0000

Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-uclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	1.569E-03	0.0001	4.404E-03	0.0002	0.000E+00	0.0000	4.048E-02	0.0021	4.641E-05	0.0000	1.181E-05	0.0000	2.727E-03	0.0001
-14	1.566E-08	0.0000	3.950E-07	0.0000	0.000E+00	0.0000	3.101E-03	0.0002	1.073E-03	0.0001	1.020E-03	0.0001	5.070E-08	0.0000
s-137	3.502E-01	0.0183	9.409E-07	0.0000	0.000E+00	0.0000	6.609E-02	0.0035	2.651E-02	0.0014	5.897E-02	0.0031	1.114E-04	0.0000
H-3	0.000E+00	0.0000	4.808E-04	0.0000	0.000E+00	0.0000	1.081E-01	0.0057	1.209E-02	0.0006	9.327E-02	0.0049	1.998E-06	0.0000
Pm-147	4.027E-04	0.0000	8.710E-05	0.0000	0.000E+00	0.0000	6.536E-03	0.0003	2.228E-04	0.0000	1.630E-05	0.0000	1.762E-04	0.0000
h-232	1.774E+00	0.0929	2.339E-01	0.0122	0.000E+00	0.0000	3.486E+00	0.1825	4.157E-02	0.0022	3.413E-01	0.0179	3.492E-02	0.0018
Total	2.126E+00	0.1113	2.389E-01	0.0125	0.000E+00	0.0000	3.711E+00	0.1943	8.150E-02	0.0043	4.946E-01	0.0259	3.794E-02	0.0020

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+00 years

Water Dependent Pathways

adio-Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
m-241	7.184E+00	0.3761	5.948E-03	0.0003	0.000E+00	0.0000	5.035E-01	0.0264	4.190E-03	0.0002	1.008E-03	0.0001	7.748E+00	0.4057
C-14	1.322E-02	0.0007	1.888E-02	0.0010	0.000E+00	0.0000	3.235E-03	0.0002	2.991E-03	0.0002	3.176E-03	0.0002	4.670E-02	0.0024
s-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.019E-01	0.0263
-3	4.917E-01	0.0257	1.374E-05	0.0000	0.000E+00	0.0000	1.064E-01	0.0056	3.304E-02	0.0017	1.447E-01	0.0076	9.898E-01	0.0518
m-147	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.441E-03	0.0004
Th-232	3.372E+00	0.1765	4.638E-03	0.0002	0.000E+00	0.0000	2.419E-01	0.0127	3.893E-02	0.0020	2.367E-01	0.0124	9.806E+00	0.5134
otal	1.106E+01	0.5791	2.948E-02	0.0015	0.000E+00	0.0000	8.550E-01	0.0448	7.915E-02	0.0041	3.856E-01	0.0202	1.910E+01	1.0000

Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

adio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
uclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
m-241	1.511E-03	0.0001	4.243E-03	0.0001	0.000E+00	0.0000	3.900E-02	0.0014	4.474E-05	0.0000	1.138E-05	0.0000	2.627E-03	0.0001
-14	5.603E-14	0.0000	1.413E-12	0.0000	0.000E+00	0.0000	1.110E-08	0.0000	3.838E-09	0.0000	3.649E-09	0.0000	1.814E-13	0.0000
s-137	2.979E-01	0.0104	8.003E-07	0.0000	0.000E+00	0.0000	5.622E-02	0.0020	2.254E-02	0.0008	5.015E-02	0.0018	9.475E-05	0.0000
-3	0.000E+00	0.0000	2.910E-06	0.0000	0.000E+00	0.0000	6.543E-04	0.0000	7.316E-05	0.0000	5.645E-04	0.0000	1.209E-08	0.0000
m-147	6.330E-05	0.0000	1.369E-05	0.0000	0.000E+00	0.0000	1.028E-03	0.0000	3.503E-05	0.0000	2.563E-06	0.0000	2.770E-05	0.0000
h-232	4.972E+00	0.1739	2.546E-01	0.0089	0.000E+00	0.0000	6.872E+00	0.2403	8.643E-02	0.0030	7.108E-01	0.0249	4.411E-02	0.0015
otal	5.271E+00	0.1844	2.589E-01	0.0091	0.000E+00	0.0000	6.968E+00	0.2437	1.091E-01	0.0038	7.615E-01	0.0266	4.686E-02	0.0016

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

Water Dependent Pathways

adio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
uclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
m-241	6.916E+00	0.2419	5.726E-03	0.0002	0.000E+00	0.0000	4.847E-01	0.0170	4.034E-03	0.0001	9.709E-04	0.0000	7.459E+00	0.2609
-14	4.741E-08	0.0000	6.770E-08	0.0000	0.000E+00	0.0000	1.160E-08	0.0000	1.073E-08	0.0000	1.139E-08	0.0000	1.674E-07	0.0000
s-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.269E-01	0.0149
-3	2.975E-03	0.0001	8.317E-08	0.0000	0.000E+00	0.0000	6.439E-04	0.0000	1.999E-04	0.0000	8.757E-04	0.0000	5.990E-03	0.0002
m-147	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.170E-03	0.0000
h-232	6.717E+00	0.2349	9.277E-03	0.0003	0.000E+00	0.0000	4.830E-01	0.0169	7.844E-02	0.0027	4.716E-01	0.0165	2.070E+01	0.7239
otal	1.364E+01	0.4769	1.500E-02	0.0005	0.000E+00	0.0000	9.683E-01	0.0339	8.268E-02	0.0029	4.735E-01	0.0166	2.859E+01	1.0000

Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio-nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	1.359E-03	0.0000	3.814E-03	0.0001	0.000E+00	0.0000	3.507E-02	0.0010	4.030E-05	0.0000	1.023E-05	0.0000	2.362E-03	0.0001
-14	1.294E-29	0.0000	3.264E-28	0.0000	0.000E+00	0.0000	2.564E-24	0.0000	8.870E-25	0.0000	8.430E-25	0.0000	4.189E-29	0.0000
s-137	1.876E-01	0.0056	5.040E-07	0.0000	0.000E+00	0.0000	3.540E-02	0.0011	1.420E-02	0.0004	3.159E-02	0.0009	5.967E-05	0.0000
H-3	0.000E+00	0.0000	1.285E-12	0.0000	0.000E+00	0.0000	2.890E-10	0.0000	3.232E-11	0.0000	2.493E-10	0.0000	5.341E-15	0.0000
m-147	3.204E-07	0.0000	6.932E-08	0.0000	0.000E+00	0.0000	5.201E-06	0.0000	1.773E-07	0.0000	1.297E-08	0.0000	1.402E-07	0.0000
h-232	7.528E+00	0.2237	2.723E-01	0.0081	0.000E+00	0.0000	9.181E+00	0.2728	1.169E-01	0.0035	9.617E-01	0.0286	5.100E-02	0.0015
Total	7.717E+00	0.2293	2.761E-01	0.0082	0.000E+00	0.0000	9.251E+00	0.2749	1.312E-01	0.0039	9.933E-01	0.0295	5.342E-02	0.0016

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years

Water Dependent Pathways

Radio-Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	6.205E+00	0.1844	5.137E-03	0.0002	0.000E+00	0.0000	4.348E-01	0.0129	3.619E-03	0.0001	8.710E-04	0.0000	6.692E+00	0.1988
C-14	1.103E-23	0.0000	1.575E-23	0.0000	0.000E+00	0.0000	2.699E-24	0.0000	2.496E-24	0.0000	2.649E-24	0.0000	3.891E-23	0.0000
s-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.688E-01	0.0080
H-3	1.314E-09	0.0000	3.672E-14	0.0000	0.000E+00	0.0000	2.843E-10	0.0000	8.829E-11	0.0000	3.867E-10	0.0000	2.645E-09	0.0000
Pm-147	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.921E-06	0.0000
h-232	7.430E+00	0.2208	1.027E-02	0.0003	0.000E+00	0.0000	5.346E-01	0.0159	8.702E-02	0.0026	5.218E-01	0.0155	2.669E+01	0.7932
Total	1.363E+01	0.4051	1.541E-02	0.0005	0.000E+00	0.0000	9.694E-01	0.0288	9.064E-02	0.0027	5.227E-01	0.0155	3.365E+01	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

adio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
uclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
m-241	9.368E-04	0.0000	2.628E-03	0.0001	0.000E+00	0.0000	2.417E-02	0.0009	2.802E-05	0.0000	7.057E-06	0.0000	1.627E-03	0.0001
-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
s-137	3.718E-02	0.0014	9.989E-08	0.0000	0.000E+00	0.0000	7.017E-03	0.0003	2.814E-03	0.0001	6.260E-03	0.0002	1.183E-05	0.0000
-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
m-147	2.955E-15	0.0000	1.024E-11	0.0000	0.000E+00	0.0000	7.107E-11	0.0000	2.422E-12	0.0000	1.773E-13	0.0000	1.916E-12	0.0000
h-232	7.778E+00	0.2882	2.740E-01	0.0102	0.000E+00	0.0000	9.402E+00	0.3484	1.199E-01	0.0044	9.858E-01	0.0365	5.167E-02	0.0019
otal	7.816E+00	0.2896	2.767E-01	0.0103	0.000E+00	0.0000	9.434E+00	0.3496	1.227E-01	0.0045	9.920E-01	0.0368	5.331E-02	0.0020

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

Water Dependent Pathways

adio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
uclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
m-241	4.243E+00	0.1572	3.513E-03	0.0001	0.000E+00	0.0000	2.973E-01	0.0110	2.475E-03	0.0001	5.955E-04	0.0000	4.576E+00	0.1696
-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
s-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.328E-02	0.0020
-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
m-147	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.582E-11	0.0000
h-232	3.243E+00	0.1202	4.484E-03	0.0002	0.000E+00	0.0000	2.333E-01	0.0086	3.799E-02	0.0014	2.277E-01	0.0084	2.236E+01	0.8285
otal	7.485E+00	0.2774	7.996E-03	0.0003	0.000E+00	0.0000	5.306E-01	0.0197	4.046E-02	0.0015	2.283E-01	0.0085	2.699E+01	1.0000

Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

Radio-nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	3.245E-04	0.0000	9.062E-04	0.0000	0.000E+00	0.0000	8.372E-03	0.0004	1.017E-05	0.0000	2.454E-06	0.0000	5.611E-04	0.0000
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Cs-137	3.648E-04	0.0000	9.801E-10	0.0000	0.000E+00	0.0000	6.884E-05	0.0000	2.761E-05	0.0000	6.142E-05	0.0000	1.160E-07	0.0000
H-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pm-147	0.000E+00	0.0000	1.005E-11	0.0000	0.000E+00	0.0000	6.974E-11	0.0000	2.377E-12	0.0000	1.740E-13	0.0000	1.880E-12	0.0000
Th-232	7.776E+00	0.3800	2.740E-01	0.0134	0.000E+00	0.0000	9.400E+00	0.4593	1.198E-01	0.0059	9.855E-01	0.0482	5.166E-02	0.0025
Total	7.777E+00	0.3800	2.749E-01	0.0134	0.000E+00	0.0000	9.409E+00	0.4597	1.199E-01	0.0059	9.856E-01	0.0482	5.222E-02	0.0026

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years

Water Dependent Pathways

Radio-Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	1.430E+00	0.0699	1.184E-03	0.0001	0.000E+00	0.0000	1.002E-01	0.0049	8.345E-04	0.0000	2.008E-04	0.0000	1.543E+00	0.0754
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.227E-04	0.0000
H-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pm-147	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.422E-11	0.0000
Th-232	2.732E-01	0.0134	3.778E-04	0.0000	0.000E+00	0.0000	1.966E-02	0.0010	3.201E-03	0.0002	1.919E-02	0.0009	1.892E+01	0.9246
Total	1.703E+00	0.0832	1.562E-03	0.0001	0.000E+00	0.0000	1.199E-01	0.0059	4.035E-03	0.0002	1.939E-02	0.0009	2.047E+01	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years

Water Independent Pathways (Inhalation excludes radon)

adio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
uclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
m-241	9.650E-06	0.0000	2.206E-05	0.0000	0.000E+00	0.0000	2.484E-04	0.0000	8.834E-07	0.0000	8.549E-08	0.0000	1.366E-05	0.000C
-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.000C
s-137	3.412E-11	0.0000	9.167E-17	0.0000	0.000E+00	0.0000	6.439E-12	0.0000	2.582E-12	0.0000	5.745E-12	0.0000	1.085E-14	0.000C
-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.000C
m-147	0.000E+00	0.0000	9.430E-12	0.0000	0.000E+00	0.0000	6.542E-11	0.0000	2.230E-12	0.0000	1.632E-13	0.0000	1.764E-12	0.000C
h-232	7.770E+00	0.4172	2.737E-01	0.0147	0.000E+00	0.0000	9.392E+00	0.5043	1.197E-01	0.0064	9.847E-01	0.0529	5.161E-02	0.0028
otal	7.770E+00	0.4172	2.738E-01	0.0147	0.000E+00	0.0000	9.392E+00	0.5043	1.197E-01	0.0064	9.847E-01	0.0529	5.162E-02	0.0028

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years

Water Dependent Pathways

adio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
uclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
m-241	3.128E-02	0.0017	2.590E-05	0.0000	0.000E+00	0.0000	2.192E-03	0.0001	1.860E-05	0.0000	4.398E-06	0.0000	3.381E-02	0.0018
-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.000C
s-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.890E-11	0.000C
-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.000C
m-147	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.901E-11	0.000C
h-232	4.724E-05	0.0000	6.532E-08	0.0000	0.000E+00	0.0000	3.399E-06	0.0000	5.534E-07	0.0000	3.317E-06	0.0000	1.859E+01	0.9982
otal	3.132E-02	0.0017	2.596E-05	0.0000	0.000E+00	0.0000	2.195E-03	0.0001	1.915E-05	0.0000	7.715E-06	0.0000	1.863E+01	1.000C

Sum of all water independent and dependent pathways.

Summary : Ft Belvoir Farmer 641m2 Farmer Max
File : RESRAD Ft Belvoir 641m2 Farmer Max ROC.RAD

Dose/Source Ratios Summed Over All Pathways
Parent and Progeny Principal Radionuclide Contributions Indicated

Parent (i)	Product (j)	Thread Fraction	DSR(j,t) At Time in Years (mrem/yr)/(pCi/g) 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Am-241	Am-241	1.000E+00	8.764E+01	9.215E+01	9.115E+01	8.775E+01	7.873E+01	5.383E+01	1.815E+01	3.968E-01
Am-241	Np-237+D	1.000E+00	4.925E-06	1.199E-05	2.571E-05	7.246E-05	1.960E-04	5.325E-04	9.817E-04	1.010E-03
Am-241	U-233	1.000E+00	2.373E-11	5.608E-11	1.116E-10	2.991E-10	2.310E-09	2.076E-08	1.030E-07	3.007E-07
Am-241	Th-229+D	1.000E+00	1.450E-12	1.170E-12	1.581E-12	7.092E-13	7.446E-12	6.248E-11	5.924E-10	8.036E-09
Am-241	∑DSR(j)		8.764E+01	9.215E+01	9.115E+01	8.775E+01	7.873E+01	5.383E+01	1.815E+01	3.978E-01
C-14	C-14	1.000E+00	7.074E+00	1.347E+00	3.766E-02	1.350E-07	3.138E-23	0.000E+00	0.000E+00	0.000E+00
Cs-137+D	Cs-137+D	1.000E+00	2.000E+00	1.954E+00	1.866E+00	1.587E+00	9.994E-01	1.981E-01	1.943E-03	1.818E-10
H-3	H-3	1.000E+00	1.892E-01	9.755E-02	2.270E-02	1.374E-04	6.066E-11	2.151E-33	0.000E+00	0.000E+00
Pm-147	Pm-147	1.000E+00	3.499E-04	2.686E-04	1.583E-04	2.489E-05	1.260E-07	1.162E-15	1.281E-38	0.000E+00
Pm-147	Sm-147	1.000E+00	2.232E-13	5.989E-13	1.109E-12	1.725E-12	1.836E-12	1.825E-12	1.792E-12	1.681E-12
Pm-147	∑DSR(j)		3.499E-04	2.686E-04	1.583E-04	2.489E-05	1.260E-07	1.826E-12	1.792E-12	1.681E-12
Th-232	Th-232	1.000E+00	5.846E-01	5.846E-01	5.846E-01	5.846E-01	5.846E-01	5.846E-01	5.844E-01	5.839E-01
Th-232	Ra-228+D	1.000E+00	1.138E+00	3.404E+00	7.152E+00	1.462E+01	1.815E+01	1.425E+01	1.129E+01	1.101E+01
Th-232	Th-228+D	1.000E+00	3.155E-02	1.845E-01	7.166E-01	2.636E+00	4.281E+00	4.441E+00	4.437E+00	4.433E+00
Th-232	∑DSR(j)		1.754E+00	4.173E+00	8.453E+00	1.784E+01	2.301E+01	1.927E+01	1.631E+01	1.603E+01

The DSR includes contributions from associated (half-life ≤ 30 days) daughters.

Single Radionuclide Soil Guidelines G(i,t) in pCi/g
Basic Radiation Dose Limit = 2.500E+01 mrem/yr

Nuclide (i)	t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Am-241	2.853E-01	2.713E-01	2.743E-01	2.849E-01	3.176E-01	4.644E-01	1.377E+00	6.285E+01
C-14	3.534E+00	1.856E+01	6.638E+02	1.852E+08	*4.455E+12	*4.455E+12	*4.455E+12	*4.455E+12
Cs-137	1.250E+01	1.279E+01	1.340E+01	1.575E+01	2.502E+01	1.262E+02	1.286E+04	1.375E+11
H-3	1.322E+02	2.563E+02	1.101E+03	1.820E+05	4.121E+11	*9.597E+15	*9.597E+15	*9.597E+15
Pm-147	7.145E+04	9.307E+04	1.579E+05	1.004E+06	1.984E+08	1.369E+13	1.395E+13	1.487E+13
Th-232	1.426E+01	5.991E+00	2.957E+00	1.401E+00	1.086E+00	1.297E+00	1.533E+00	1.560E+00

*At specific activity limit

ummary : Ft Belvoir Farmer 641m2 Farmer Max
ile : RESRAD Ft Belvoir 641m2 Farmer Max ROC.RAD

Summed Dose/Source Ratios DSR(i,t) in (mrem/yr)/(pCi/g)
and Single Radionuclide Soil Guidelines G(i,t) in pCi/g
at tmin = time of minimum single radionuclide soil guideline
and at tmax = time of maximum total dose = 26.18 ± 0.05 years

uclide (i)	Initial (pCi/g)	tmin (years)	DSR(i,tmin)	G(i,tmin) (pCi/g)	DSR(i,tmax)	G(i,tmax) (pCi/g)
m-241	8.500E-02	0.1031 ± 0.0002	9.258E+01	2.700E-01	8.038E+01	3.110E-01
-14	1.240E+00	0.000E+00	7.074E+00	3.534E+00	3.117E-20	*4.455E+12
s-137	2.690E-01	0.000E+00	2.000E+00	1.250E+01	1.092E+00	2.290E+01
-3	4.360E+01	0.000E+00	1.892E-01	1.322E+02	9.993E-10	2.502E+10
m-147	4.700E+01	0.000E+00	3.499E-04	7.145E+04	3.460E-07	7.225E+07
h-232	1.160E+00	29.08 ± 0.06	2.302E+01	1.086E+00	2.296E+01	1.089E+00

At specific activity limit

Individual Nuclide Dose Summed Over All Pathways
Parent Nuclide and Branch Fraction Indicated

uclide (j)	Parent (i)	THF(i)	DOSE(j,t), mrem/yr t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Am-241	Am-241	1.000E+00	7.449E+00	7.832E+00	7.748E+00	7.459E+00	6.692E+00	4.576E+00	1.543E+00	3.373E-02
p-237	Am-241	1.000E+00	4.186E-07	1.020E-06	2.185E-06	6.159E-06	1.666E-05	4.527E-05	8.345E-05	8.586E-05
-233	Am-241	1.000E+00	2.017E-12	4.767E-12	9.483E-12	2.542E-11	1.963E-10	1.764E-09	8.752E-09	2.556E-08
Th-229	Am-241	1.000E+00	1.232E-13	9.942E-14	1.344E-13	6.028E-14	6.329E-13	5.311E-12	5.036E-11	6.831E-10
-14	C-14	1.000E+00	8.772E+00	1.670E+00	4.670E-02	1.674E-07	3.891E-23	0.000E+00	0.000E+00	0.000E+00
Cs-137	Cs-137	1.000E+00	5.379E-01	5.256E-01	5.019E-01	4.269E-01	2.688E-01	5.328E-02	5.227E-04	4.890E-11
-3	H-3	1.000E+00	8.248E+00	4.253E+00	9.898E-01	5.990E-03	2.645E-09	0.000E+00	0.000E+00	0.000E+00
m-147	Pm-147	1.000E+00	1.644E-02	1.262E-02	7.441E-03	1.170E-03	5.921E-06	5.461E-14	0.000E+00	0.000E+00
Sm-147	Pm-147	1.000E+00	1.049E-11	2.815E-11	5.211E-11	8.106E-11	8.629E-11	8.577E-11	8.422E-11	7.901E-11
h-232	Th-232	1.000E+00	6.782E-01	6.782E-01	6.782E-01	6.782E-01	6.782E-01	6.781E-01	6.779E-01	6.773E-01
Ra-228	Th-232	1.000E+00	1.320E+00	3.948E+00	8.296E+00	1.696E+01	2.105E+01	1.653E+01	1.310E+01	1.277E+01
h-228	Th-232	1.000E+00	3.660E-02	2.140E-01	8.312E-01	3.058E+00	4.966E+00	5.151E+00	5.147E+00	5.142E+00

THF(i) is the thread fraction of the parent nuclide.

Individual Nuclide Soil Concentration
Parent Nuclide and Branch Fraction Indicated

uclide (j)	Parent (i)	THF(i)	S(j,t), pCi/g							
		t=	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
m-241	Am-241	1.000E+00	8.500E-02	8.455E-02	8.365E-02	8.059E-02	7.245E-02	4.991E-02	1.721E-02	4.140E-04
p-237	Am-241	1.000E+00	0.000E+00	2.745E-08	8.190E-08	2.677E-07	7.599E-07	2.101E-06	3.904E-06	4.058E-06
-233	Am-241	1.000E+00	0.000E+00	6.006E-14	5.380E-13	5.879E-12	5.048E-11	4.775E-10	2.792E-09	8.996E-09
h-229	Am-241	1.000E+00	0.000E+00	1.892E-18	5.089E-17	1.861E-15	4.849E-14	1.589E-12	3.091E-11	4.435E-10
-14	C-14	1.000E+00	1.240E+00	2.075E-01	5.803E-03	2.079E-08	4.825E-24	0.000E+00	0.000E+00	0.000E+00
s-137	Cs-137	1.000E+00	2.690E-01	2.629E-01	2.510E-01	2.135E-01	1.344E-01	2.664E-02	2.614E-04	2.445E-11
-3	H-3	1.000E+00	4.360E+01	2.104E+01	4.897E+00	2.965E-02	1.311E-08	4.676E-31	0.000E+00	0.000E+00
m-147	Pm-147	1.000E+00	4.700E+01	3.608E+01	2.127E+01	3.344E+00	1.692E-02	1.561E-10	1.721E-33	0.000E+00
m-147	Pm-147	1.000E+00	0.000E+00	2.701E-10	6.365E-10	1.079E-09	1.160E-09	1.153E-09	1.132E-09	1.062E-09
h-232	Th-232	1.000E+00	1.160E+00	1.160E+00	1.160E+00	1.160E+00	1.160E+00	1.160E+00	1.160E+00	1.159E+00
a-228	Th-232	1.000E+00	0.000E+00	1.317E-01	3.515E-01	8.090E-01	1.120E+00	1.150E+00	1.149E+00	1.148E+00
h-228	Th-232	1.000E+00	0.000E+00	2.162E-02	1.441E-01	6.524E-01	1.105E+00	1.150E+00	1.149E+00	1.148E+00

HF(i) is the thread fraction of the parent nuclide.

ESCALC.EXE execution time = 2078.33 seconds

Summary : Ft Belvoir Industrial 15 mrem/yr 641m2
File : RESRAD Ft Belvoir 641m2 Industrial Max ROC.RAD

Table of Contents

Part I: Mixture Sums and Single Radionuclide Guidelines

Dose Conversion Factor (and Related) Parameter Summary
File: HEAST 2001 MORBIDITY

enu	Parameter	Current Value	Base Case*	Parameter Name
-1	Dose conversion factors for inhalation, mrem/pCi:			
-1	Am-241	4.440E-01	4.440E-01	DCF2(1)
-1	C-14	2.090E-06	2.090E-06	DCF2(2)
-1	Cs-137+D	3.190E-05	3.190E-05	DCF2(3)
-1	H-3	6.400E-08	6.400E-08	DCF2(4)
-1	Np-237+D	5.400E-01	5.400E-01	DCF2(5)
-1	Pm-147	3.920E-05	3.920E-05	DCF2(6)
-1	Ra-228+D	5.078E-03	4.770E-03	DCF2(7)
-1	Sm-147	7.470E-02	7.470E-02	DCF2(8)
-1	Th-228+D	3.454E-01	3.420E-01	DCF2(9)
-1	Th-229+D	2.169E+00	2.150E+00	DCF2(10)
-1	Th-232	1.640E+00	1.640E+00	DCF2(11)
-1	U-233	1.350E-01	1.350E-01	DCF2(12)
-1	Dose conversion factors for ingestion, mrem/pCi:			
-1	Am-241	3.640E-03	3.640E-03	DCF3(1)
-1	C-14	2.090E-06	2.090E-06	DCF3(2)
-1	Cs-137+D	5.000E-05	5.000E-05	DCF3(3)
-1	H-3	6.400E-08	6.400E-08	DCF3(4)
-1	Np-237+D	4.444E-03	4.440E-03	DCF3(5)
-1	Pm-147	1.050E-06	1.050E-06	DCF3(6)
-1	Ra-228+D	1.442E-03	1.440E-03	DCF3(7)
-1	Sm-147	1.850E-04	1.850E-04	DCF3(8)
-1	Th-228+D	8.086E-04	3.960E-04	DCF3(9)
-1	Th-229+D	4.027E-03	3.530E-03	DCF3(10)
-1	Th-232	2.730E-03	2.730E-03	DCF3(11)
-1	U-233	2.890E-04	2.890E-04	DCF3(12)
-34	Food transfer factors:			
-34	Am-241 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(1,1)
-34	Am-241 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	5.000E-05	5.000E-05	RTF(1,2)
-34	Am-241 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-06	2.000E-06	RTF(1,3)
-34				
-34	C-14 , plant/soil concentration ratio, dimensionless	5.500E+00	5.500E+00	RTF(2,1)
-34	C-14 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.100E-02	3.100E-02	RTF(2,2)
-34	C-14 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.200E-02	1.200E-02	RTF(2,3)
-34				
-34	Cs-137+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(3,1)
-34	Cs-137+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.000E-02	3.000E-02	RTF(3,2)
-34	Cs-137+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	8.000E-03	8.000E-03	RTF(3,3)
-34				
-34	H-3 , plant/soil concentration ratio, dimensionless	4.800E+00	4.800E+00	RTF(4,1)
-34	H-3 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.200E-02	1.200E-02	RTF(4,2)
-34	H-3 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-02	1.000E-02	RTF(4,3)
-34				
-34	Np-237+D , plant/soil concentration ratio, dimensionless	2.000E-02	2.000E-02	RTF(5,1)
-34	Np-237+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(5,2)
-34	Np-237+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(5,3)
-34				

Dose Conversion Factor (and Related) Parameter Summary (continued)
File: HEAST 2001 MORBIDITY

Menu	Parameter	Current Value	Base Case*	Parameter Name
D-34	Pm-147 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(6,1)
D-34	Pm-147 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-03	2.000E-03	RTF(6,2)
D-34	Pm-147 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-05	2.000E-05	RTF(6,3)
D-34				
D-34	Ra-228+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(7,1)
D-34	Ra-228+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(7,2)
D-34	Ra-228+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-03	1.000E-03	RTF(7,3)
D-34				
D-34	Sm-147 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(8,1)
D-34	Sm-147 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-03	2.000E-03	RTF(8,2)
D-34	Sm-147 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-05	2.000E-05	RTF(8,3)
D-34				
D-34	Th-228+D , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(9,1)
D-34	Th-228+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(9,2)
D-34	Th-228+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(9,3)
D-34				
D-34	Th-229+D , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(10,1)
D-34	Th-229+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(10,2)
D-34	Th-229+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(10,3)
D-34				
D-34	Th-232 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(11,1)
D-34	Th-232 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(11,2)
D-34	Th-232 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(11,3)
D-34				
D-34	U-233 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(12,1)
D-34	U-233 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(12,2)
D-34	U-233 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(12,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	Am-241 , fish	3.000E+01	3.000E+01	BIOFAC(1,1)
D-5	Am-241 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(1,2)
D-5				
D-5	C-14 , fish	5.000E+04	5.000E+04	BIOFAC(2,1)
D-5	C-14 , crustacea and mollusks	9.100E+03	9.100E+03	BIOFAC(2,2)
D-5				
D-5	Cs-137+D , fish	2.000E+03	2.000E+03	BIOFAC(3,1)
D-5	Cs-137+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(3,2)
D-5				
D-5	H-3 , fish	1.000E+00	1.000E+00	BIOFAC(4,1)
D-5	H-3 , crustacea and mollusks	1.000E+00	1.000E+00	BIOFAC(4,2)
D-5				
D-5	Np-237+D , fish	3.000E+01	3.000E+01	BIOFAC(5,1)
D-5	Np-237+D , crustacea and mollusks	4.000E+02	4.000E+02	BIOFAC(5,2)
D-5				
D-5	Pm-147 , fish	3.000E+01	3.000E+01	BIOFAC(6,1)
D-5	Pm-147 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(6,2)
D-5				
D-5	Ra-228+D , fish	5.000E+01	5.000E+01	BIOFAC(7,1)
D-5	Ra-228+D , crustacea and mollusks	2.500E+02	2.500E+02	BIOFAC(7,2)
D-5				

Dose Conversion Factor (and Related) Parameter Summary (continued)
File: HEAST 2001 MORBIDITY

Menu	Parameter	Current Value	Base Case*	Parameter Name
)-5	Sm-147 , fish	2.500E+01	2.500E+01	BIOFAC(8,1)
)-5	Sm-147 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(8,2)
)-5				
)-5	Th-228+D , fish	1.000E+02	1.000E+02	BIOFAC(9,1)
)-5	Th-228+D , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(9,2)
)-5				
)-5	Th-229+D , fish	1.000E+02	1.000E+02	BIOFAC(10,1)
)-5	Th-229+D , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(10,2)
)-5				
)-5	Th-232 , fish	1.000E+02	1.000E+02	BIOFAC(11,1)
)-5	Th-232 , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(11,2)
)-5				
)-5	U-233 , fish	1.000E+01	1.000E+01	BIOFAC(12,1)
)-5	U-233 , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(12,2)

Base Case means Default.Lib w/o Associate Nuclide contributions.

Summary : Ft Belvoir Industrial 15 mrem/yr 641m2
File : RESRAD Ft Belvoir 641m2 Industrial Max ROC.RAD

Site-Specific Parameter Summary

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R011	Area of contaminated zone (m**2)	6.410E+02	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	4.573E+00	2.000E+00	---	THICK0
R011	Length parallel to aquifer flow (m)	not used	1.000E+02	---	LCZPAQ
R011	Basic radiation dose limit (mrem/yr)	1.500E+01	3.000E+01	---	BRDL
R011	Time since placement of material (yr)	0.000E+00	0.000E+00	---	TI
R011	Times for calculations (yr)	1.000E+00	1.000E+00	---	T(2)
R011	Times for calculations (yr)	3.000E+00	3.000E+00	---	T(3)
R011	Times for calculations (yr)	1.000E+01	1.000E+01	---	T(4)
R011	Times for calculations (yr)	3.000E+01	3.000E+01	---	T(5)
R011	Times for calculations (yr)	1.000E+02	1.000E+02	---	T(6)
R011	Times for calculations (yr)	3.000E+02	3.000E+02	---	T(7)
R011	Times for calculations (yr)	1.000E+03	1.000E+03	---	T(8)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(9)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(10)
R012	Initial principal radionuclide (pCi/g): Am-241	8.500E-02	0.000E+00	---	S1(1)
R012	Initial principal radionuclide (pCi/g): C-14	1.240E+00	0.000E+00	---	S1(2)
R012	Initial principal radionuclide (pCi/g): Cs-137	2.690E-01	0.000E+00	---	S1(3)
R012	Initial principal radionuclide (pCi/g): H-3	4.360E+01	0.000E+00	---	S1(4)
R012	Initial principal radionuclide (pCi/g): Pm-147	4.700E+01	0.000E+00	---	S1(6)
R012	Initial principal radionuclide (pCi/g): Th-232	1.160E+00	0.000E+00	---	S1(11)
R012	Concentration in groundwater (pCi/L): Am-241	not used	0.000E+00	---	W1(1)
R012	Concentration in groundwater (pCi/L): C-14	not used	0.000E+00	---	W1(2)
R012	Concentration in groundwater (pCi/L): Cs-137	not used	0.000E+00	---	W1(3)
R012	Concentration in groundwater (pCi/L): H-3	not used	0.000E+00	---	W1(4)
R012	Concentration in groundwater (pCi/L): Pm-147	not used	0.000E+00	---	W1(6)
R012	Concentration in groundwater (pCi/L): Th-232	not used	0.000E+00	---	W1(11)
R013	Cover depth (m)	0.000E+00	0.000E+00	---	COVER0
R013	Density of cover material (g/cm**3)	not used	1.500E+00	---	DENSCV
R013	Cover depth erosion rate (m/yr)	not used	1.000E-03	---	VCV
R013	Density of contaminated zone (g/cm**3)	1.431E+00	1.500E+00	---	DENSCZ
R013	Contaminated zone erosion rate (m/yr)	1.000E-03	1.000E-03	---	VCZ
R013	Contaminated zone total porosity	4.000E-01	4.000E-01	---	TPCZ
R013	Contaminated zone field capacity	2.000E-01	2.000E-01	---	FCCZ
R013	Contaminated zone hydraulic conductivity (m/yr)	1.000E+01	1.000E+01	---	HCCZ
R013	Contaminated zone b parameter	5.300E+00	5.300E+00	---	BCZ
R013	Average annual wind speed (m/sec)	2.000E+00	2.000E+00	---	WIND
R013	Humidity in air (g/m**3)	8.000E+00	8.000E+00	---	HUMID
R013	Evapotranspiration coefficient	5.000E-01	5.000E-01	---	EVAPTR
R013	Precipitation (m/yr)	9.812E-01	1.000E+00	---	PRECIP
R013	Irrigation (m/yr)	2.000E-01	2.000E-01	---	RI
R013	Irrigation mode	overhead	overhead	---	IDITCH
R013	Runoff coefficient	2.000E-01	2.000E-01	---	RUNOFF
R013	Watershed area for nearby stream or pond (m**2)	not used	1.000E+06	---	WAREA
R013	Accuracy for water/soil computations	not used	1.000E-03	---	EPS
R014	Density of saturated zone (g/cm**3)	not used	1.500E+00	---	DENSAQ
R014	Saturated zone total porosity	not used	4.000E-01	---	TPSZ
R014	Saturated zone effective porosity	not used	2.000E-01	---	EPSZ

Site-Specific Parameter Summary (continued)

enu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
014	Saturated zone field capacity	not used	2.000E-01	---	FCSZ
014	Saturated zone hydraulic conductivity (m/yr)	not used	1.000E+02	---	HCSZ
014	Saturated zone hydraulic gradient	not used	2.000E-02	---	HGWT
014	Saturated zone b parameter	not used	5.300E+00	---	BSZ
014	Water table drop rate (m/yr)	not used	1.000E-03	---	VWT
014	Well pump intake depth (m below water table)	not used	1.000E+01	---	DWIBWT
014	Model: Nondispersion (ND) or Mass-Balance (MB)	not used	ND	---	MODEL
014	Well pumping rate (m**3/yr)	not used	2.500E+02	---	UW
015	Number of unsaturated zone strata	not used	1	---	NS
016	Distribution coefficients for Am-241				
016	Contaminated zone (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCC(1)
016	Saturated zone (cm**3/g)	not used	2.000E+01	---	DCNUCS(1)
016	Leach rate (/yr)	0.000E+00	0.000E+00	3.721E-03	ALEACH(1)
016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
016	Distribution coefficients for C-14				
016	Contaminated zone (cm**3/g)	0.000E+00	0.000E+00	---	DCNUCC(2)
016	Saturated zone (cm**3/g)	not used	0.000E+00	---	DCNUCS(2)
016	Leach rate (/yr)	0.000E+00	0.000E+00	3.360E-01	ALEACH(2)
016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(2)
016	Distribution coefficients for Cs-137				
016	Contaminated zone (cm**3/g)	4.600E+03	4.600E+03	---	DCNUCC(3)
016	Saturated zone (cm**3/g)	not used	4.600E+03	---	DCNUCS(3)
016	Leach rate (/yr)	0.000E+00	0.000E+00	1.636E-05	ALEACH(3)
016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(3)
016	Distribution coefficients for H-3				
016	Contaminated zone (cm**3/g)	0.000E+00	0.000E+00	---	DCNUCC(4)
016	Saturated zone (cm**3/g)	not used	0.000E+00	---	DCNUCS(4)
016	Leach rate (/yr)	0.000E+00	0.000E+00	3.360E-01	ALEACH(4)
016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(4)
016	Distribution coefficients for Pm-147				
016	Contaminated zone (cm**3/g)	-1.000E+00	-1.000E+00	8.249E+02	DCNUCC(6)
016	Saturated zone (cm**3/g)	not used	-1.000E+00	---	DCNUCS(6)
016	Leach rate (/yr)	0.000E+00	0.000E+00	9.120E-05	ALEACH(6)
016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(6)
016	Distribution coefficients for Th-232				
016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCC(11)
016	Saturated zone (cm**3/g)	not used	6.000E+04	---	DCNUCS(11)
016	Leach rate (/yr)	0.000E+00	0.000E+00	1.254E-06	ALEACH(11)
016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(11)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R016	Distribution coefficients for daughter Np-237				
R016	Contaminated zone (cm**3/g)	-1.000E+00	-1.000E+00	2.574E+02	DCNUCC(5)
R016	Saturated zone (cm**3/g)	not used	-1.000E+00	---	DCNUCS(5)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.921E-04	ALEACH(5)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(5)
R016	Distribution coefficients for daughter Ra-228				
R016	Contaminated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCC(7)
R016	Saturated zone (cm**3/g)	not used	7.000E+01	---	DCNUCS(7)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.072E-03	ALEACH(7)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(7)
R016	Distribution coefficients for daughter Sm-147				
R016	Contaminated zone (cm**3/g)	-1.000E+00	-1.000E+00	8.249E+02	DCNUCC(8)
R016	Saturated zone (cm**3/g)	not used	-1.000E+00	---	DCNUCS(8)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	9.120E-05	ALEACH(8)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(8)
R016	Distribution coefficients for daughter Th-228				
R016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCC(9)
R016	Saturated zone (cm**3/g)	not used	6.000E+04	---	DCNUCS(9)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.254E-06	ALEACH(9)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(9)
R016	Distribution coefficients for daughter Th-229				
R016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCC(10)
R016	Saturated zone (cm**3/g)	not used	6.000E+04	---	DCNUCS(10)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.254E-06	ALEACH(10)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(10)
R016	Distribution coefficients for daughter U-233				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(12)
R016	Saturated zone (cm**3/g)	not used	5.000E+01	---	DCNUCS(12)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.498E-03	ALEACH(12)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(12)
R017	Inhalation rate (m**3/yr)	8.513E+03	8.400E+03	---	INHALR
R017	Mass loading for inhalation (g/m**3)	4.000E-04	1.000E-04	---	MLINH
R017	Exposure duration	3.000E+01	3.000E+01	---	ED
R017	Shielding factor, inhalation	2.500E-01	4.000E-01	---	SHF3
R017	Shielding factor, external gamma	5.512E-01	7.000E-01	---	SHF1
R017	Fraction of time spent indoors	1.712E-01	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	5.710E-02	2.500E-01	---	FOTD
R017	Shape factor flag, external gamma	1.000E+00	1.000E+00	>0 shows circular AREA.	FS

Site-Specific Parameter Summary (continued)

anu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
017	Radii of shape factor array (used if FS = -1):				
017	Outer annular radius (m), ring 1:	not used	5.000E+01	---	RAD_SHAPE(1)
017	Outer annular radius (m), ring 2:	not used	7.071E+01	---	RAD_SHAPE(2)
017	Outer annular radius (m), ring 3:	not used	0.000E+00	---	RAD_SHAPE(3)
017	Outer annular radius (m), ring 4:	not used	0.000E+00	---	RAD_SHAPE(4)
017	Outer annular radius (m), ring 5:	not used	0.000E+00	---	RAD_SHAPE(5)
017	Outer annular radius (m), ring 6:	not used	0.000E+00	---	RAD_SHAPE(6)
017	Outer annular radius (m), ring 7:	not used	0.000E+00	---	RAD_SHAPE(7)
017	Outer annular radius (m), ring 8:	not used	0.000E+00	---	RAD_SHAPE(8)
017	Outer annular radius (m), ring 9:	not used	0.000E+00	---	RAD_SHAPE(9)
017	Outer annular radius (m), ring 10:	not used	0.000E+00	---	RAD_SHAPE(10)
017	Outer annular radius (m), ring 11:	not used	0.000E+00	---	RAD_SHAPE(11)
017	Outer annular radius (m), ring 12:	not used	0.000E+00	---	RAD_SHAPE(12)
017	Fractions of annular areas within AREA:				
017	Ring 1	not used	1.000E+00	---	FRACA(1)
017	Ring 2	not used	2.732E-01	---	FRACA(2)
017	Ring 3	not used	0.000E+00	---	FRACA(3)
017	Ring 4	not used	0.000E+00	---	FRACA(4)
017	Ring 5	not used	0.000E+00	---	FRACA(5)
017	Ring 6	not used	0.000E+00	---	FRACA(6)
017	Ring 7	not used	0.000E+00	---	FRACA(7)
017	Ring 8	not used	0.000E+00	---	FRACA(8)
017	Ring 9	not used	0.000E+00	---	FRACA(9)
017	Ring 10	not used	0.000E+00	---	FRACA(10)
017	Ring 11	not used	0.000E+00	---	FRACA(11)
017	Ring 12	not used	0.000E+00	---	FRACA(12)
018	Fruits, vegetables and grain consumption (kg/yr)	not used	1.600E+02	---	DIET(1)
018	Leafy vegetable consumption (kg/yr)	not used	1.400E+01	---	DIET(2)
018	Milk consumption (L/yr)	not used	9.200E+01	---	DIET(3)
018	Meat and poultry consumption (kg/yr)	not used	6.300E+01	---	DIET(4)
018	Fish consumption (kg/yr)	not used	5.400E+00	---	DIET(5)
018	Other seafood consumption (kg/yr)	not used	9.000E-01	---	DIET(6)
018	Soil ingestion rate (g/yr)	1.826E+01	3.650E+01	---	SOIL
018	Drinking water intake (L/yr)	not used	5.100E+02	---	DWI
018	Contamination fraction of drinking water	not used	1.000E+00	---	FDW
018	Contamination fraction of household water	not used	1.000E+00	---	FHHW
018	Contamination fraction of livestock water	not used	1.000E+00	---	FLW
018	Contamination fraction of irrigation water	not used	1.000E+00	---	FIRW
018	Contamination fraction of aquatic food	not used	5.000E-01	---	FR9
018	Contamination fraction of plant food	not used	-1	---	FPLANT
018	Contamination fraction of meat	not used	-1	---	FMEAT
018	Contamination fraction of milk	not used	-1	---	FMILK
019	Livestock fodder intake for meat (kg/day)	not used	6.800E+01	---	LFI5
019	Livestock fodder intake for milk (kg/day)	not used	5.500E+01	---	LFI6
019	Livestock water intake for meat (L/day)	not used	5.000E+01	---	LWI5
019	Livestock water intake for milk (L/day)	not used	1.600E+02	---	LWI6
019	Livestock soil intake (kg/day)	not used	5.000E-01	---	LSI

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R019	Mass loading for foliar deposition (g/m**3)	not used	1.000E-04	---	MLFD
R019	Depth of soil mixing layer (m)	1.500E-01	1.500E-01	---	DM
019	Depth of roots (m)	not used	9.000E-01	---	DROOT
R019	Drinking water fraction from ground water	not used	1.000E+00	---	FGWDW
R019	Household water fraction from ground water	not used	1.000E+00	---	FGWHH
019	Livestock water fraction from ground water	not used	1.000E+00	---	FGWLW
019	Irrigation fraction from ground water	not used	1.000E+00	---	FGWIR
19B	Wet weight crop yield for Non-Leafy (kg/m**2)	not used	7.000E-01	---	YV(1)
19B	Wet weight crop yield for Leafy (kg/m**2)	not used	1.500E+00	---	YV(2)
R19B	Wet weight crop yield for Fodder (kg/m**2)	not used	1.100E+00	---	YV(3)
R19B	Growing Season for Non-Leafy (years)	not used	1.700E-01	---	TE(1)
19B	Growing Season for Leafy (years)	not used	2.500E-01	---	TE(2)
19B	Growing Season for Fodder (years)	not used	8.000E-02	---	TE(3)
R19B	Translocation Factor for Non-Leafy	not used	1.000E-01	---	TIV(1)
19B	Translocation Factor for Leafy	not used	1.000E+00	---	TIV(2)
19B	Translocation Factor for Fodder	not used	1.000E+00	---	TIV(3)
R19B	Dry Foliar Interception Fraction for Non-Leafy	not used	2.500E-01	---	RDRY(1)
19B	Dry Foliar Interception Fraction for Leafy	not used	2.500E-01	---	RDRY(2)
19B	Dry Foliar Interception Fraction for Fodder	not used	2.500E-01	---	RDRY(3)
R19B	Wet Foliar Interception Fraction for Non-Leafy	not used	2.500E-01	---	RWET(1)
R19B	Wet Foliar Interception Fraction for Leafy	not used	2.500E-01	---	RWET(2)
19B	Wet Foliar Interception Fraction for Fodder	not used	2.500E-01	---	RWET(3)
19B	Weathering Removal Constant for Vegetation	not used	2.000E+01	---	WLAM
14	C-12 concentration in water (g/cm**3)	2.000E-05	2.000E-05	---	C12WTR
14	C-12 concentration in contaminated soil (g/g)	3.000E-02	3.000E-02	---	C12CZ
C14	Fraction of vegetation carbon from soil	2.000E-02	2.000E-02	---	CSOIL
C14	Fraction of vegetation carbon from air	9.800E-01	9.800E-01	---	CAIR
14	C-14 evasion layer thickness in soil (m)	3.000E-01	3.000E-01	---	DMC
14	C-14 evasion flux rate from soil (1/sec)	7.000E-07	7.000E-07	---	EVSN
C14	C-12 evasion flux rate from soil (1/sec)	1.000E-10	1.000E-10	---	REVSN
14	Fraction of grain in beef cattle feed	8.000E-01	8.000E-01	---	AVFG4
14	Fraction of grain in milk cow feed	2.000E-01	2.000E-01	---	AVFG5
C14	DCF correction factor for gaseous forms of C14	8.894E+01	0.000E+00	---	CO2F
TOR	Storage times of contaminated foodstuffs (days):				
STOR	Fruits, non-leafy vegetables, and grain	1.400E+01	1.400E+01	---	STOR_T(1)
STOR	Leafy vegetables	1.000E+00	1.000E+00	---	STOR_T(2)
TOR	Milk	1.000E+00	1.000E+00	---	STOR_T(3)
STOR	Meat and poultry	2.000E+01	2.000E+01	---	STOR_T(4)
STOR	Fish	7.000E+00	7.000E+00	---	STOR_T(5)
TOR	Crustacea and mollusks	7.000E+00	7.000E+00	---	STOR_T(6)
TOR	Well water	0.000E+00	1.000E+00	---	STOR_T(7)
STOR	Surface water	0.000E+00	1.000E+00	---	STOR_T(8)
TOR	Livestock fodder	0.000E+00	4.500E+01	---	STOR_T(9)
R021	Thickness of building foundation (m)	not used	1.500E-01	---	FLOOR1
R021	Bulk density of building foundation (g/cm**3)	not used	2.400E+00	---	DENSFL
021	Total porosity of the cover material	not used	4.000E-01	---	TPCV

Site-Specific Parameter Summary (continued)

nu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
21	Total porosity of the building foundation	not used	1.000E-01	---	TPFL
21	Volumetric water content of the cover material	not used	5.000E-02	---	PH2OCV
21	Volumetric water content of the foundation	not used	3.000E-02	---	PH2OFL
21	Diffusion coefficient for radon gas (m/sec):				
21	in cover material	not used	2.000E-06	---	DIFCV
21	in foundation material	not used	3.000E-07	---	DIFFL
21	in contaminated zone soil	not used	2.000E-06	---	DIFCZ
21	Radon vertical dimension of mixing (m)	not used	2.000E+00	---	HMIX
21	Average building air exchange rate (1/hr)	not used	5.000E-01	---	REXG
21	Height of the building (room) (m)	not used	2.500E+00	---	HRM
21	Building interior area factor	not used	0.000E+00	---	FAI
21	Building depth below ground surface (m)	not used	-1.000E+00	---	DMFL
21	Emanating power of Rn-222 gas	not used	2.500E-01	---	EMANA(1)
21	Emanating power of Rn-220 gas	not used	1.500E-01	---	EMANA(2)
ITL	Number of graphical time points	1024	---	---	NPTS
ITL	Maximum number of integration points for dose	17	---	---	LYMAX
ITL	Maximum number of integration points for risk	257	---	---	KYMAX

Summary of Pathway Selections

Pathway	User Selection
1 -- external gamma	active
2 -- inhalation (w/o radon)	active
3 -- plant ingestion	suppressed
4 -- meat ingestion	suppressed
5 -- milk ingestion	suppressed
6 -- aquatic foods	suppressed
7 -- drinking water	suppressed
8 -- soil ingestion	active
9 -- radon	suppressed
Find peak pathway doses	active

ummary : Ft Belvoir Industrial 15 mrem/yr 641m2
ile : RESRAD Ft Belvoir 641m2 Industrial Max ROC.RAD

Contaminated Zone Dimensions		Initial Soil Concentrations, pCi/g	
Area:	641.00 square meters	Am-241	8.500E-02
Thickness:	4.57 meters	C-14	1.240E+00
over Depth:	0.00 meters	Cs-137	2.690E-01
		H-3	4.360E+01
		Pm-147	4.700E+01
		Th-232	1.160E+00

Total Dose TDOSE(t), mrem/yr
Basic Radiation Dose Limit = 1.500E+01 mrem/yr
Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

t (years):	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
TDOSE(t):	2.805E-01	4.300E-01	7.800E-01	1.799E+00	2.591E+00	2.623E+00	2.610E+00	2.607E+00
M(t):	1.870E-02	2.867E-02	5.200E-02	1.199E-01	1.727E-01	1.749E-01	1.740E-01	1.738E-01

aximum TDOSE(t): 2.643E+00 mrem/yr at t = 49.75 ± 0.10 years

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 4.975E+01 years

Water Independent Pathways (Inhalation excludes radon)

adio-uclide Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
m-241	3.924E-04	0.0001	1.250E-03	0.0005	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.327E-04	0.0002
-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Cs-137	3.810E-02	0.0144	1.162E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.125E-05	0.0000
-3	0.000E+00	0.0000	1.909E-19	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.933E-22	0.0000
m-147	5.552E-10	0.0000	1.401E-10	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.260E-10	0.0000
Th-232	2.487E+00	0.9412	9.973E-02	0.0377	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.536E-02	0.0058
otal	2.526E+00	0.9557	1.010E-01	0.0382	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.600E-02	0.0061

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 4.975E+01 years

Water Dependent Pathways

adio-uclide / uclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
m-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.275E-03	0.0009
-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
s-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.811E-02	0.0144
-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.917E-19	0.0000
m-147	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.214E-10	0.0000
h-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.602E+00	0.9847
otal	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.643E+00	1.0000

Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	5.111E-04	0.0018	1.629E-03	0.0058	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.246E-04	0.0029
C-14	1.074E-06	0.0000	2.515E-05	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.227E-06	0.0000
Cs-137	1.204E-01	0.4292	3.672E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.553E-05	0.0001
H-3	0.000E+00	0.0000	1.274E-03	0.0045	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.295E-06	0.0000
Pm-147	2.854E-04	0.0010	7.009E-05	0.0002	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.159E-04	0.0004
Th-232	6.409E-02	0.2285	8.248E-02	0.2941	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.737E-03	0.0312
Total	1.853E-01	0.6606	8.548E-02	0.3048	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.722E-03	0.0347

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.965E-03	0.0106
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.945E-05	0.0001
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.204E-01	0.4293
H-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.280E-03	0.0046
Pm-147	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.713E-04	0.0017
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.553E-01	0.5538
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.805E-01	1.0000

* Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
m-241	5.084E-04	0.0012	1.621E-03	0.0038	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.202E-04	0.0019
-14	1.798E-07	0.0000	4.209E-06	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.399E-07	0.0000
s-137	1.176E-01	0.2736	3.588E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.472E-05	0.0001
-3	0.000E+00	0.0000	6.149E-04	0.0014	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.555E-06	0.0000
m-147	2.191E-04	0.0005	5.381E-05	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.897E-05	0.0002
h-232	2.160E-01	0.5024	8.308E-02	0.1932	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.298E-03	0.0216
Total	3.344E-01	0.7776	8.538E-02	0.1986	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.025E-02	0.0238

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

Water Dependent Pathways

Radio-nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
m-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.949E-03	0.0069
-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.928E-06	0.0000
s-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.177E-01	0.2736
-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.174E-04	0.0014
m-147	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.619E-04	0.0008
h-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.084E-01	0.7172
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.300E-01	1.0000

Sum of all water independent and dependent pathways.

Summary : Ft Belvoir Industrial 15 mrem/yr 641m2
File : RESRAD Ft Belvoir 641m2 Industrial Max ROC.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	5.030E-04	0.0006	1.604E-03	0.0021	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.115E-04	0.001C
-14	5.024E-09	0.0000	1.176E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.509E-08	0.000C
s-137	1.123E-01	0.1440	3.426E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.315E-05	0.000C
H-3	0.000E+00	0.0000	1.431E-04	0.0002	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.946E-07	0.000C
Pm-147	1.291E-04	0.0002	3.171E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.244E-05	0.0001
h-232	5.688E-01	0.7293	8.517E-02	0.1092	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.039E-02	0.0133
Total	6.818E-01	0.8741	8.695E-02	0.1115	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.129E-02	0.0145

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+00 years

Water Dependent Pathways

adio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
m-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.918E-03	0.0037
-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.377E-07	0.000C
s-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.123E-01	0.144C
-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.437E-04	0.0002
m-147	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.133E-04	0.0003
h-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.644E-01	0.8518
otal	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.800E-01	1.000C

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

adio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
uclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
m-241	4.847E-04	0.0003	1.545E-03	0.0009	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.818E-04	0.0004
-14	1.797E-14	0.0000	4.208E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.398E-14	0.0000
s-137	9.553E-02	0.0531	2.914E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.819E-05	0.0000
-3	0.000E+00	0.0000	8.659E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.598E-09	0.0000
m-147	2.030E-05	0.0000	4.986E-06	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.244E-06	0.0000
h-232	1.594E+00	0.8865	9.270E-02	0.0515	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.313E-02	0.0073
otal	1.690E+00	0.9398	9.425E-02	0.0524	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.394E-02	0.0078

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

Water Dependent Pathways

adio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
uclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
m-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.811E-03	0.0016
-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.927E-13	0.0000
s-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.556E-02	0.0531
-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.695E-07	0.0000
m-147	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.353E-05	0.0000
h-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.700E+00	0.9453
otal	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.799E+00	1.0000

Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
uclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	4.358E-04	0.0002	1.389E-03	0.0005	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.029E-04	0.0003
-14	4.151E-30	0.0000	9.719E-29	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.247E-29	0.0000
s-137	6.016E-02	0.0232	1.835E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.776E-05	0.0000
H-3	0.000E+00	0.0000	3.825E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.589E-15	0.0000
m-147	1.027E-07	0.0000	2.524E-08	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.173E-08	0.0000
h-232	2.414E+00	0.9317	9.915E-02	0.0383	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.518E-02	0.0059
Total	2.475E+00	0.9551	1.005E-01	0.0388	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.590E-02	0.0061

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
m-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.527E-03	0.0010
-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.138E-28	0.0000
s-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.018E-02	0.0232
-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.841E-13	0.0000
Pm-147	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.697E-07	0.0000
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.528E+00	0.9758
otal	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.591E+00	1.0000

Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

adio-uclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
m-241	3.004E-04	0.0001	9.568E-04	0.0004	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.842E-04	0.0002
-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
s-137	1.192E-02	0.0045	3.637E-08	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.519E-06	0.0000
-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
m-147	9.476E-16	0.0000	3.727E-12	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.702E-13	0.0000
h-232	2.495E+00	0.9509	9.978E-02	0.0380	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.538E-02	0.0059
otal	2.507E+00	0.9556	1.007E-01	0.0384	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.586E-02	0.0060

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

Water Dependent Pathways

adio-uclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
m-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.741E-03	0.0007
-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
s-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.193E-02	0.0045
-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
m-147	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.298E-12	0.0000
h-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.610E+00	0.9948
otal	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.623E+00	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

Radio-nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	1.041E-04	0.0000	3.299E-04	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.670E-04	0.0001
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Cs-137	1.170E-04	0.0000	3.568E-10	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.453E-08	0.0000
H-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pm-147	0.000E+00	0.0000	3.660E-12	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.595E-13	0.0000
Th-232	2.494E+00	0.9556	9.976E-02	0.0382	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.537E-02	0.0059
Total	2.494E+00	0.9557	1.001E-01	0.0384	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.554E-02	0.0060

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years

Water Dependent Pathways

Radio-Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.010E-04	0.0002
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.170E-04	0.0000
H-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pm-147	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.219E-12	0.0000
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.609E+00	0.9997
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.610E+00	1.0000

* Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years

Water Independent Pathways (Inhalation excludes radon)

adio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
uclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
m-241	3.095E-06	0.0000	8.032E-06	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.065E-06	0.0000
-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
s-137	1.094E-11	0.0000	3.338E-17	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.230E-15	0.0000
-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
m-147	0.000E+00	0.0000	3.433E-12	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.249E-13	0.0000
h-232	2.492E+00	0.9559	9.967E-02	0.0382	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.536E-02	0.0059
otal	2.492E+00	0.9559	9.968E-02	0.0382	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.536E-02	0.0059

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years

Water Dependent Pathways

adio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
uclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
m-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.519E-05	0.0000
-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
s-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.095E-11	0.0000
-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
m-147	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.958E-12	0.0000
h-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.607E+00	1.0000
otal	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.607E+00	1.0000

*Sum of all water independent and dependent pathways.

Dose/Source Ratios Summed Over All Pathways
Parent and Progeny Principal Radionuclide Contributions Indicated

Parent (i)	Product (j)	Thread Fraction	DSR(j,t) At Time in Years (mrem/yr)/(pCi/g) 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Am-241	Am-241	1.000E+00	3.488E-02	3.470E-02	3.433E-02	3.307E-02	2.973E-02	2.048E-02	7.062E-03	1.699E-04
m-241	Np-237+D	1.000E+00	2.980E-08	8.916E-08	2.069E-07	6.087E-07	1.673E-06	4.573E-06	8.471E-06	8.798E-06
m-241	U-233	1.000E+00	1.604E-15	1.121E-14	5.897E-14	5.190E-13	4.175E-12	3.859E-11	2.242E-10	7.207E-10
Am-241	Th-229+D	1.000E+00	1.785E-18	2.673E-17	3.108E-16	8.140E-15	1.921E-13	6.081E-12	1.171E-10	1.675E-09
m-241	∑DSR(j)		3.488E-02	3.470E-02	3.433E-02	3.308E-02	2.974E-02	2.049E-02	7.070E-03	1.787E-04
C-14	C-14	1.000E+00	2.375E-05	3.974E-06	1.111E-07	3.974E-13	9.178E-29	0.000E+00	0.000E+00	0.000E+00
s-137+D	Cs-137+D	1.000E+00	4.476E-01	4.374E-01	4.176E-01	3.552E-01	2.237E-01	4.434E-02	4.350E-04	4.069E-11
H-3	H-3	1.000E+00	2.935E-05	1.416E-05	3.295E-06	1.994E-08	8.809E-15	3.127E-37	0.000E+00	0.000E+00
m-147	Pm-147	1.000E+00	1.003E-05	7.699E-06	4.538E-06	7.134E-07	3.611E-09	3.330E-17	3.672E-40	0.000E+00
Pm-147	Sm-147	1.000E+00	1.118E-14	3.001E-14	5.555E-14	8.641E-14	9.198E-14	9.142E-14	8.977E-14	8.422E-14
m-147	∑DSR(j)		1.003E-05	7.699E-06	4.538E-06	7.134E-07	3.611E-09	9.146E-14	8.977E-14	8.422E-14
Th-232	Th-232	1.000E+00	7.836E-02	7.836E-02	7.836E-02	7.836E-02	7.836E-02	7.835E-02	7.833E-02	7.826E-02
Th-232	Ra-228+D	1.000E+00	4.656E-02	1.325E-01	2.760E-01	5.747E-01	7.775E-01	7.970E-01	7.968E-01	7.961E-01
h-232	Th-228+D	1.000E+00	8.964E-03	5.498E-02	2.184E-01	8.127E-01	1.324E+00	1.374E+00	1.374E+00	1.373E+00
Th-232	∑DSR(j)		1.339E-01	2.659E-01	5.728E-01	1.466E+00	2.180E+00	2.250E+00	2.249E+00	2.247E+00

he DSR includes contributions from associated (half-life ≤ 30 days) daughters.

Single Radionuclide Soil Guidelines G(i,t) in pCi/g
Basic Radiation Dose Limit = 1.500E+01 mrem/yr

Nuclide (i)	t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Am-241	4.300E+02	4.323E+02	4.369E+02	4.535E+02	5.045E+02	7.322E+02	2.122E+03	8.393E+04
-14	6.316E+05	3.774E+06	1.350E+08	*4.455E+12	*4.455E+12	*4.455E+12	*4.455E+12	*4.455E+12
s-137	3.351E+01	3.429E+01	3.592E+01	4.223E+01	6.705E+01	3.383E+02	3.448E+04	3.686E+11
H-3	5.111E+05	1.059E+06	4.552E+06	7.521E+08	1.703E+15	*9.597E+15	*9.597E+15	*9.597E+15
m-147	1.496E+06	1.948E+06	3.305E+06	2.102E+07	4.154E+09	1.640E+14	1.671E+14	1.781E+14
h-232	1.120E+02	5.642E+01	2.619E+01	1.023E+01	6.882E+00	6.667E+00	6.669E+00	6.675E+00

*At specific activity limit

mmary : Ft Belvoir Industrial 15 mrem/yr 641m2
.le : RESRAD Ft Belvoir 641m2 Industrial Max ROC.RAD

Summed Dose/Source Ratios DSR(i,t) in (mrem/yr)/(pCi/g)
and Single Radionuclide Soil Guidelines G(i,t) in pCi/g
at tmin = time of minimum single radionuclide soil guideline
and at tmax = time of maximum total dose = 49.75 ± 0.10 years

ıclide (i)	Initial (pCi/g)	tmin (years)	DSR(i,tmin)	G(i,tmin) (pCi/g)	DSR(i,tmax)	G(i,tmax) (pCi/g)
ı-241	8.500E-02	0.000E+00	3.488E-02	4.300E+02	2.677E-02	5.604E+02
-14	1.240E+00	0.000E+00	2.375E-05	6.316E+05	0.000E+00	*4.455E+12
ı-137	2.690E-01	0.000E+00	4.476E-01	3.351E+01	1.417E-01	1.059E+02
-3	4.360E+01	0.000E+00	2.935E-05	5.111E+05	4.397E-21	*9.597E+15
ı-147	4.700E+01	0.000E+00	1.003E-05	1.496E+06	1.960E-11	7.652E+11
ı-232	1.160E+00	95.7 ± 0.2	2.250E+00	6.667E+00	2.244E+00	6.686E+00

\t specific activity limit

ummary : Ft Belvoir Industrial 15 mrem/yr 641m2
File : RESRAD Ft Belvoir 641m2 Industrial Max ROC.RAD

Individual Nuclide Dose Summed Over All Pathways
Parent Nuclide and Branch Fraction Indicated

uclide (j)	Parent (i)	THF(i)	DOSE(j,t), mrem/yr t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
m-241	Am-241	1.000E+00	2.965E-03	2.949E-03	2.918E-03	2.811E-03	2.527E-03	1.741E-03	6.002E-04	1.444E-05
Np-237	Am-241	1.000E+00	2.533E-09	7.579E-09	1.759E-08	5.174E-08	1.422E-07	3.887E-07	7.201E-07	7.478E-07
-233	Am-241	1.000E+00	1.364E-16	9.527E-16	5.013E-15	4.411E-14	3.549E-13	3.280E-12	1.906E-11	6.126E-11
Th-229	Am-241	1.000E+00	1.517E-19	2.272E-18	2.642E-17	6.919E-16	1.633E-14	5.169E-13	9.955E-12	1.423E-10
-14	C-14	1.000E+00	2.945E-05	4.928E-06	1.377E-07	4.927E-13	1.138E-28	0.000E+00	0.000E+00	0.000E+00
s-137	Cs-137	1.000E+00	1.204E-01	1.177E-01	1.123E-01	9.556E-02	6.018E-02	1.193E-02	1.170E-04	1.095E-11
-3	H-3	1.000E+00	1.280E-03	6.174E-04	1.437E-04	8.695E-07	3.841E-13	0.000E+00	0.000E+00	0.000E+00
m-147	Pm-147	1.000E+00	4.713E-04	3.619E-04	2.133E-04	3.353E-05	1.697E-07	1.565E-15	0.000E+00	0.000E+00
Sm-147	Pm-147	1.000E+00	5.256E-13	1.410E-12	2.611E-12	4.061E-12	4.323E-12	4.297E-12	4.219E-12	3.958E-12
h-232	Th-232	1.000E+00	9.090E-02	9.090E-02	9.090E-02	9.090E-02	9.089E-02	9.089E-02	9.086E-02	9.078E-02
Ra-228	Th-232	1.000E+00	5.401E-02	1.537E-01	3.202E-01	6.666E-01	9.019E-01	9.245E-01	9.243E-01	9.235E-01
h-228	Th-232	1.000E+00	1.040E-02	6.378E-02	2.533E-01	9.428E-01	1.536E+00	1.594E+00	1.594E+00	1.593E+00

HF(i) is the thread fraction of the parent nuclide.

Individual Nuclide Soil Concentration
Parent Nuclide and Branch Fraction Indicated

uclide (j)	Parent (i)	THF(i)	S(j,t), pCi/g t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
m-241	Am-241	1.000E+00	8.500E-02	8.455E-02	8.365E-02	8.059E-02	7.245E-02	4.991E-02	1.721E-02	4.140E-04
p-237	Am-241	1.000E+00	0.000E+00	2.745E-08	8.190E-08	2.677E-07	7.599E-07	2.101E-06	3.904E-06	4.058E-06
-233	Am-241	1.000E+00	0.000E+00	6.006E-14	5.380E-13	5.879E-12	5.048E-11	4.775E-10	2.792E-09	8.996E-09
h-229	Am-241	1.000E+00	0.000E+00	1.892E-18	5.089E-17	1.861E-15	4.849E-14	1.589E-12	3.091E-11	4.435E-10
-14	C-14	1.000E+00	1.240E+00	2.075E-01	5.803E-03	2.079E-08	4.825E-24	0.000E+00	0.000E+00	0.000E+00
s-137	Cs-137	1.000E+00	2.690E-01	2.629E-01	2.510E-01	2.135E-01	1.344E-01	2.664E-02	2.614E-04	2.445E-11
-3	H-3	1.000E+00	4.360E+01	2.104E+01	4.897E+00	2.965E-02	1.311E-08	4.676E-31	0.000E+00	0.000E+00
m-147	Pm-147	1.000E+00	4.700E+01	3.608E+01	2.127E+01	3.344E+00	1.692E-02	1.561E-10	1.721E-33	0.000E+00
m-147	Pm-147	1.000E+00	0.000E+00	2.701E-10	6.365E-10	1.079E-09	1.160E-09	1.153E-09	1.132E-09	1.062E-09
h-232	Th-232	1.000E+00	1.160E+00	1.160E+00	1.160E+00	1.160E+00	1.160E+00	1.160E+00	1.160E+00	1.159E+00
a-228	Th-232	1.000E+00	0.000E+00	1.317E-01	3.515E-01	8.090E-01	1.120E+00	1.150E+00	1.149E+00	1.148E+00
h-228	Th-232	1.000E+00	0.000E+00	2.162E-02	1.441E-01	6.524E-01	1.105E+00	1.150E+00	1.149E+00	1.148E+00

HF(i) is the thread fraction of the parent nuclide.

ESCALC.EXE execution time = 947.03 seconds