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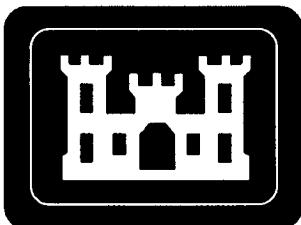
**PRE-DESIGN INVESTIGATION SUMMARY  
REPORT AND FINAL STATUS SURVEY  
EVALUATION FOR THE ACCESSIBLE  
SOILS WITHIN THE ST. LOUIS DOWNTOWN  
SITE VICINITY PROPERTY DT-34**

**ST. LOUIS, MISSOURI**

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**SEPTEMBER 21, 2012**

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

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## BACK COVER

- \*CD-ROM      Appendices E, G, and I; and Attachments H-1, EPC Calculations (Pro-UCL Output Files); and H-2, RESRAD Output Summary Reports

## ACRONYMS AND ABBREVIATIONS

Common unit abbreviations are not defined in this list. Both English and metric units are used in this report. The units used in a specific situation are based on common unit usage or regulatory language. For example, depths are given in feet (common usage) and areas are given in square meters (regulatory usage).

|                       |   |
|-----------------------|---|
| $\Delta/\sigma$       | relative shift  |
| $\sigma$              | standard deviation  |
| $\sigma_{\text{eff}}$ | effective standard deviation  |
| Ac                    | actinium  |
| AEC                   | U.S. Atomic Energy Commission   |
| ANL                   | Argonne National Laboratory   |
| ARAR                  | applicable or relevant and appropriate requirement  |
| bcm                   | below cover material  |
| bgs                   | below ground surface  |
| CERCLA                | Comprehensive Environmental Response, Compensation, and Liability Act   |
| CFR                   | <i>Code of Federal Regulations</i>  |
| COC                   | contaminant of concern  |
| cm                    | centimeter  |
| cpm                   | counts per minute   |
| DCGL                  | derived concentration guideline level   |
| DOD                   | U.S. Department of Defense  |
| <i>DOD QSM</i>        | <i>Department of Defense Quality Systems Manual for Environmental Laboratories</i>  |
| DOE                   | U.S. Department of Energy   |
| DQA                   | data quality assessment   |
| DQO                   | data quality objective  |
| ELAP                  | Environmental Laboratory Accreditation Program  |
| EPC                   | exposure point concentration  |
| <i>FR</i>             | <i>Federal Register</i>   |
| FS                    | <i>Feasibility Study for the St. Louis Downtown Site</i>  |
| FSS                   | final status survey   |
| FSSE                  | final status survey evaluation  |
| FSSP                  | <i>Final Status Survey Plan for Accessible Soil within Mallinckrodt Property and the Vicinity Properties, Excluding Plants 1, 2, and the City Property at the St. Louis Downtown Site</i> |
| ft                    | foot/feet   |
| FUSRAP                | Formerly Utilized Sites Remedial Action Program   |
| g                     | gram(s)   |
| g/cm <sup>3</sup>     | gram(s) per cubic centimeter  |
| g/m <sup>3</sup>      | gram(s) per cubic meter   |
| GIS                   | geographic information system   |

## ACRONYMS AND ABBREVIATIONS (Continued)

|               |  |
|---------------|--|
| GWS           | gamma walkover survey  |
| HEAST         | <i>Health Effects Assessment Summary Tables</i>                    |
| HISS          | Hazelwood Interim Storage Site                                     |
| HTZ           | hot zone   |
| HU            | hydrostratigraphic unit  |
| kg            | kilogram(s)  |
| LBGR          | lower bound of the grey region                                     |
| LCS           | laboratory control sample  |
| m             | meter(s)   |
| $m^2$         | square meter(s)  |
| Mallinckrodt  | Mallinckrodt Chemical Works  |
| MARSSIM       | <i>Multi-Agency Radiation Survey and Site Investigation Manual</i> |
| MDC           | minimum detectable concentration                                   |
| MDNR          | Missouri Department of Natural Resources                           |
| MED           | Manhattan Engineer District  |
| mg/kg         | milligram(s) per kilogram  |
| mrem          | millirem   |
| mrem/yr       | millirem per year  |
| NAD           | normalized absolute difference                                     |
| NaI           | sodium iodide  |
| NCP           | National Oil and Hazardous Substances Contingency Plan             |
| NESHAP        | National Emissions Standards for Hazardous Air Pollutants          |
| NRC           | U.S. Nuclear Regulatory Commission                                 |
| NUREG         | U.S. Nuclear Regulatory Commission Regulation                      |
| OSWER         | Office of Solid Waste and Emergency Response                       |
| Pa            | protactinium   |
| Pb            | lead   |
| pCi/g         | picocuries per gram  |
| pCi/ $m^2$ /s | picocuries per square meter per second                             |
| PDI           | pre-design investigation   |
| PP            | Proposed Plan  |
| QA            | quality assurance  |
| QAPP          | Quality Assurance Project Plan                                     |
| QC            | quality control  |
| QCSR          | Quality Control Summary Report                                     |
| Ra            | radium   |
| RA            | remedial action  |
| RAO           | remedial action objective  |
| RESRAD        | RESidual RADioactivity (computer model)                            |
| RG            | remediation goal   |

## ACRONYMS AND ABBREVIATIONS (Continued)

|                   |  |
|-------------------|--|
| ROD               | <i>Record of Decision for the St. Louis Downtown Site</i>  |
| ROW               | right-of-way   |
| RPD               | relative percent difference                                |
| SAG               | <i>Sampling and Analysis Guide for the St. Louis Sites</i> |
| SAIC              | Science Applications International Corporation             |
| SLDS              | St. Louis Downtown Site                                    |
| SOR               | sum of the ratio   |
| SOR <sub>G</sub>  | gross sum of the ratio                                     |
| SOR <sub>N</sub>  | net sum of the ratio                                       |
| SU                | survey unit  |
| TEDE              | total effective dose equivalent                            |
| Th                | thorium  |
| U                 | uranium  |
| UCL <sub>95</sub> | 95 percent upper confidence limit                          |
| USACE             | U.S. Army Corps of Engineers                               |
| USEPA             | U.S. Environmental Protection Agency                       |
| VP                | vicinity property  |
| VQ                | validation qualifier                                       |
| WRS               | Wilcoxon Rank Sum  |

## ABSTRACT

|  |  |
|--|--|
| Site Name                                  | St. Louis Downtown Site Vicinity Property: Hjersted (DT-34)  |
| Operable Unit                              | Accessible soil and ground water   |
| Location                                   | St. Louis, Missouri  |
| Regulatory Oversight                       | U.S. Environmental Protection Agency, Region 7<br>Missouri Department of Natural Resources   |
| Contract Oversight                         | U.S. Army Corps of Engineers, St. Louis District (USACE)   |
| Verification Contractor                    | Science Applications International Corporation   |
| Waste Source                               | Manhattan Engineer District and the U.S. Atomic Energy Commission uranium ore processing and uranium metal production in the 1940s and 1950s.  |
| Contaminants                               | Radionuclides from the uranium-238, thorium-232, and uranium-235 decay series.<br><br>Non-radiological contaminants are not applicable to the property addressed in this report per the <i>Record of Decision for the St. Louis Downtown Site (ROD)</i> (USACE 1998a).   |
| Remediation Method, Quantity, and Date     | Accessible Soils: None required  |
| Regulatory Requirements/ Remediation Goals | See Section 2.1.3 for ROD requirements.  |
| Results                                    | <p><b>The remaining accessible soil on DT-34 can be released for unrestricted use based on a comparison of the analytical data, radiological surveys, and a risk and dose assessment to the ROD remediation goals.</b></p> <p>The highest residual radiological risk<sup>1</sup> calculated for this property was <math>8.3 \times 10^{-7}</math>, which met the target risk range of <math>10^{-6}</math> to <math>10^{-4}</math>. The highest residual radiological dose calculated for this property was <math>4.3 \times 10^{-2}</math> millirem per year (mrem/yr), which is compliant with the dose criterion of 25 mrem/yr. This potential risk and dose was the highest resulting risk and dose while evaluating each year over the next 1,000 years based on a residential use scenario and does not account for cover material.</p> <p>Within the 1,000-year evaluation period, the highest total residual lifetime risk and dose are estimated to occur at year zero (2011) for both the industrial worker and residential scenarios, relative to the year of the evaluation. However, as time passes after the peak year, risk and dose is expected to decline due to the natural decay of parent and progeny radionuclides.</p> |
| Description                                | <p>This report addresses a property in downtown St. Louis that is owned by Lawrence Hjersted. DT-34 is located in the northeast corner of the ROD boundary. The property lies south of Bremen Avenue, east and north of PSC Metals, and west of the Burlington-Northern Santa Fe Railway. Further east of this property is land owned by Terminal Railroad that contains the Riverfront Bike Trail and levee for the Mississippi River.</p> <p>DT-34 is occupied by numerous buildings and tanks that encompass approximately 1,300 square meters (<math>m^2</math>) of the total property area of 15,158 <math>m^2</math>. The remainder of the property is primarily covered by gravel, with some small areas of asphalt or concrete. Based on a review of aerial photographs, the southern part of the property near the railroad tracks was developed before 1941, and steady development of the remainder of the property has occurred since 1975.</p>  |

<sup>1</sup> When estimating cancer risk, a lifetime risk level for an exposed individual and how many additional cancer cases might occur in a population of exposed people (i.e.,  $1 \times 10^{-6}$  is equal to one additional case in a population of one million) are predicted. These are cancers that may or may not occur, but if they were to occur, they would be in addition to cancers from other causes, such as smoking tobacco. For non-cancer toxicity, a daily exposure level that is likely to be of little risk to people is estimated.

## 1.0 INTRODUCTION

The *Record of Decision for the St. Louis Downtown Site* (ROD) (USACE 1998a) provides the final remedial action (RA) for the accessible soil and ground water contaminated as a result of Manhattan Engineer District (MED) and U.S. Atomic Energy Commission (AEC) uranium (U) manufacturing and processing activities at the St. Louis Downtown Site (SLDS).

The response actions described in this report were performed by the St. Louis District U.S. Army Corps of Engineers (USACE) as part of the Formerly Utilized Sites Remedial Action Program (FUSRAP). The FUSRAP was initiated by the AEC in 1974 to identify, remediate, or otherwise control sites where residual radioactivity remains from operations conducted for the MED and was continued by the successor agencies to the AEC until 1997 when the U.S. Congress transferred responsibility for the execution aspect of the FUSRAP from the U.S. Department of Energy (DOE) to the USACE. The DOE will assume a stewardship responsibility beginning two years after completion of the response action at the SLDS.

The USACE was authorized by the U.S. Congress as the lead agency for implementation of the selected remedy. The remedy was selected by the USACE in consultation with the U.S. Environmental Protection Agency (USEPA) and with the concurrence of the Missouri Department of Natural Resources (MDNR).

The work within the scope of this report was managed by the USACE St. Louis District FUSRAP Project Office, and was accomplished in accordance with the National Oil and Hazardous Substances Contingency Plan (NCP) and the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

This report specifically documents the pre-design investigation (PDI) and final status survey evaluation (FSSE) conducted at the property described in Section 1.1 (SLDS vicinity property Hjersted [DT-34]) and shown on Figure 1. The PDI was conducted at this property because it was potentially impacted by the inadvertent release of materials from uranium processing at Mallinckrodt Chemical Works (Mallinckrodt). Mallinckrodt is currently owned by Mallinckrodt LLC.

When it was determined that RA was not necessary at this property, an FSSE was conducted using procedures compatible with the *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)* (DOD 2000) to ensure that any residual radioactivity complied with the criteria specified in the ROD (USACE 1998a). Non-radiological contaminants are not applicable to this property. Non-radiological contaminants of concern (COCs) that may have been introduced by MED/AEC operations include arsenic and cadmium in uranium ore processing areas (USACE 1998a). Based on the distribution of non-radiological COCs at SLDS as shown in Figure 5-7 of the ROD, arsenic and cadmium are COCs only in Plants 2, 6, 7N, 7S, and 7W and DT-10 (USACE 1998a). Therefore, non-radiological contamination does not apply to the property included within the scope of this report.

Inaccessible soils that contain MED/AEC contamination and the surfaces of buildings and other permanent structures are excluded from the scope of the ROD and will be addressed in a subsequent CERCLA action. Inaccessible soils on DT-34 are shown on Figure 2.

### 1.1 PROPERTY DESCRIPTION

This report addresses a property in downtown St. Louis that is currently owned by Lawrence Hjersted. DT-34 is located in the northeast corner of the ROD boundary and lies south of

Bremen Avenue, east and north of PSC Metals, and west of BNSF Railway. Further east of this property is land owned by Terminal Railroad that contains the Riverfront Bike Trail and the levee for the Mississippi River.

The property is being addressed in this report because it was potentially impacted by the inadvertent release of residual radioactivity from uranium metal production processes. DT-34 was not specifically identified as part of the SLDS in the ROD. However, the SLDS boundaries were later clarified to include this and other properties, in accordance with the Memorandum, *Non-Significant Change to the Record of Decision for the St. Louis Downtown Site* (USACE 2005a).

DT-34 is occupied by numerous buildings and tanks that encompass about 1,300 square meters ( $m^2$ ) of the total property area of 15,158  $m^2$ . The remainder of the property is primarily covered by gravel, with some small areas of asphalt or concrete. Based on a review of aerial photographs, the southern part of the property near the railroad tracks was developed before 1941, and steady development of the remainder of the property has occurred since 1975.

Table 1 contains the address of the property being addressed in this report, the parcel designation established by St. Louis City (STLCity 2012), and whether the right-of-way (ROW) was included. The area within the scope of this report is shown on Figure 1.

**Table 1. Addresses, Parcels, and Designations**

| Address          | Parcel      | Designation for this Project | ROW Included    |
|------------------|-------------|------------------------------|-----------------|
| 10 Bremen Avenue | 25260000750 | DT-34                        | No <sup>a</sup> |

<sup>a</sup> The Bremen Avenue ROW is being addressed in a separate investigation.

## 1.2 GEOPHYSICAL FEATURES

The regional geological setting of the subsurface soils at the SLDS is generally characterized by a fill layer that extends from the surface down to a layer of alluvial sediments (i.e., silty sediments deposited by flowing water). The alluvial sediments overlay the bedrock. The fill, discernible as multiple horizons at most locations, has an average thickness of 13 feet (ft) and may contain concrete, brick, glass, coal cinders, slag material, and/or other miscellaneous material that was placed on top of the original flood plain sediments in the late 1800s and early 1900s. The alluvial flood plain deposits underlying the fill material consist of stratified clays, silts, sands, and gravels that range in thickness from 5 to 30 ft. The alluvial deposits generally become coarser grained with depth. Earthquake faults are not evident.

Under the fill and alluvial deposits, the uppermost bedrock unit underlying the SLDS is the Mississippian-age Sainte Genevieve Formation. The formation is composed of limestone with some dolomite. The depth to bedrock at SLDS ranges from approximately 10 ft below ground surface (bgs) on the western side of the property to 80 ft bgs near the Mississippi River.

The current topographic ground surface of DT-34 is covered primarily with gravel, with some small areas of concrete or asphalt. The shallow sampling performed in conjunction with the PDI at DT-34 confirmed the presence of a fill layer from the ground surface (or below the cover material) to the bottom of each boring. The maximum depth of the PDI borings was 6 ft bgs. The fill materials consisted primarily of gravel, silt, clay, and cinders. To a lesser extent, the fill matrix also included broken pieces of brick and slag.

Surface water runoff on DT-34 follows the surface topography, which primarily slopes from the north to the south of the property. The surface water runoff is collected in various inlets to the

St. Louis Municipal storm-water underground drainage system, which conveys the water to the Mississippi River. Review of records from the 1993 flooding indicates that the area was not affected by overtopping of the floodwall, although ponding due to storm-water backup on the west side of the floodwall occurred in the DT-34 area.

### **1.3 GROUND WATER**

Ground water at the SLDS is found within three horizons (or hydrostratigraphic units [HUs]): the upper, nonlithified (soil) unit, referred to as HU-A; the lower, nonlithified unit, referred to as either the Mississippi Alluvial Aquifer or HU-B; and the bedrock (the lithified water-bearing unit), referred to as HU-C. The Mississippi Alluvial Aquifer is the principal aquifer in the St. Louis area, including the SLDS area. Aquifers in this region also exist in the bedrock formations underlying the alluvial deposits.

The upper ground-water unit at the SLDS (HU-A) consists of fill overlying naturally deposited clays and silts. The shallow ground-water system is not considered to be a potential source of drinking water because of its poor quality due to the naturally occurring dissolved solid and metal content and very low yields. The HU-A is underlain by the sandy silts and silty sands of the Mississippi Alluvial Aquifer (HU-B). Ground waters of the St. Louis area are generally of poor quality and do not meet drinking water standards without treatment. Expected future use of ground water at the SLDS is minimal, because the higher quality and large quantity of water from the Mississippi and Missouri Rivers is readily available. There are no ground-water monitoring wells on the DT-34 property.

### **1.4 NATURE AND EXTENT OF CONTAMINATION**

From 1942 to 1957, Mallinckrodt processed uranium ore and other feed materials to produce various forms of uranium compounds and uranium metal for U.S. military purposes under contract to the MED/AEC. Mallinckrodt performed this processing at its facilities in downtown St. Louis, Missouri. Materials from uranium processing were inadvertently released into the environment. The primary COCs for this property are the metals radium (Ra), thorium (Th), and uranium and their decay products. Soil on various parts of the Mallinckrodt property and some Vicinity Properties (VPs) has been determined to have COCs above background levels. VPs may have been impacted by contaminant migration in air, water, waste handling, or a combination thereof. Non-radiological contaminants are not applicable to DT-34.

### **1.5 ENVIRONMENTAL MONITORING**

#### **1.5.1 Radiological Air Monitoring at the SLDS**

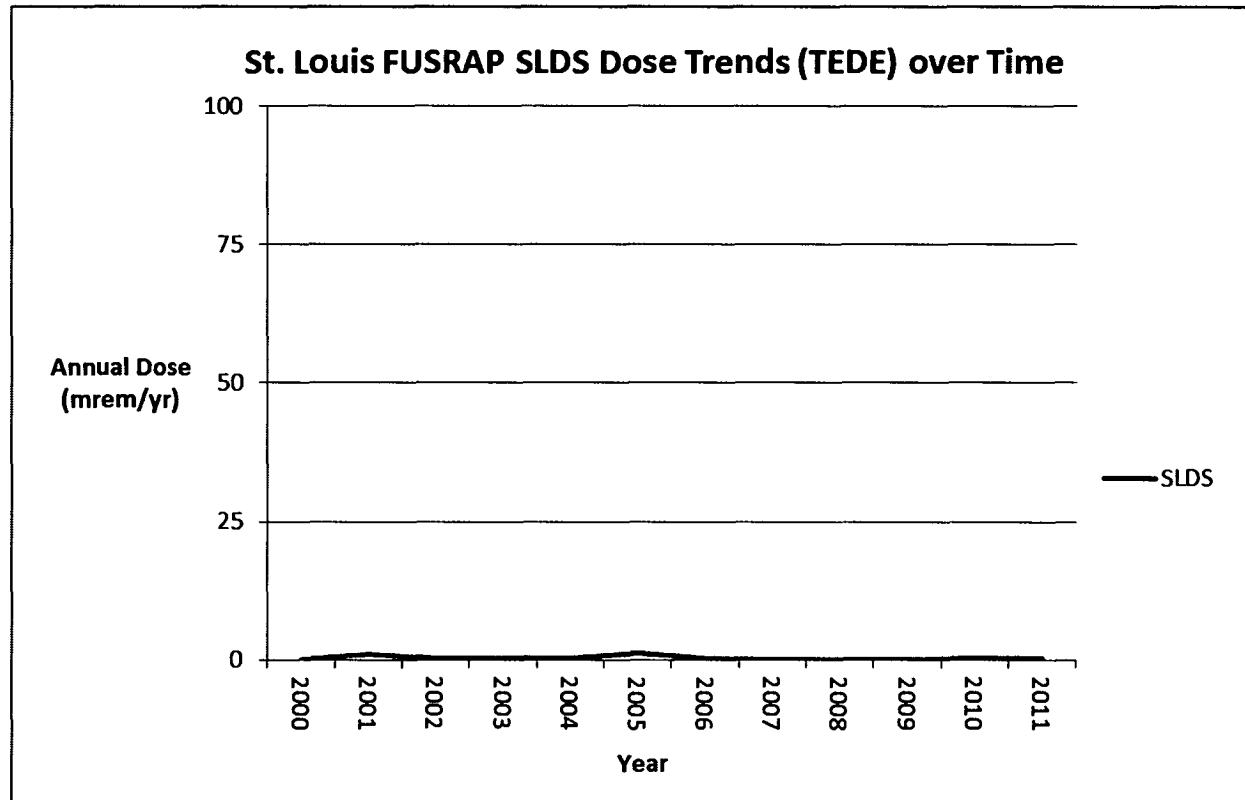
Radiological air data was collected and evaluated at the SLDS through airborne radioactive particulate, outdoor radon (Rn), and gamma radiation monitoring. In addition to environmental monitoring purposes, radiological air data was also used as inputs to calculate total effective dose equivalent (TEDE) to the hypothetical maximally exposed individual at a critical receptor location to assess dose due to radiological releases from the SLDS.

The TEDE calculated for the hypothetical maximally exposed individual at the SLDS for 2006 (i.e., the year sampling occurred at DT-34) was < 0.2 millirem per year (mrem/yr) (0.002 milliseivert per year [mSv/yr]). The results of the radiological air monitoring conducted at the

SLDS demonstrated compliance with ARARs for the SLDS. The graph below documents the annual dose trend from calendar year (CY) 2000 to CY 2011 at the SLDS.

The applicable radiological public dose limits for the SLDS are as follows:

- National Emissions Standards for Hazardous Air Pollutants (NESHAP) limit of 10 millirem (mrem) effective dose equivalent annually due to airborne emissions other than Rn-222 at off-site receptor locations.
- U.S. Nuclear Regulatory Commission (NRC) limit of 100 mrem TEDE for all exposure pathways on an annual basis (excluding background).



### 1.5.2 Ground-Water Monitoring at the SLDS

The selected remedy presented in the ROD (USACE 1998a) involves excavation and disposal of radiologically contaminated accessible soils and ground-water monitoring. The goal of the ground-water portion of the selected remedy is to maintain protection of the Mississippi Alluvial Aquifer (HU-B) and to establish the effectiveness of the source removal action. This goal is achieved by monitoring perimeter wells at the SLDS (there are no groundwater monitoring wells on DT-34) on a routine basis to ensure that there are no significant impacts from COCs on HU-B. The HU-B ground-water results for the COCs are compared to the following ROD ground-water criteria (USACE 1998a):

- 1) The investigative limits (ILs): 50 µg/L arsenic, 5 µg/L cadmium, and 20 µg/L total U; and
- 2) The concentration limits from the Uranium Mill Tailings Radiation Control Act regulations listed in the *Code of Federal Regulations (CFR)*, 40 CFR 192.02, Table 1 to Subpart A: 5 pCi/L combined Ra-226 and Ra-228.

The concentration limits for other COCs listed in 40 CFR 192.02, Table 1 to Subpart A (50 µg/L arsenic, 10 µg/L cadmium, and 30 pCi/L combined U-234 and U-238) are not relevant or appropriate because these limits are equal to or less stringent than the ILs.

If monitoring of HU-B indicates that the concentrations of the COCs significantly exceed the above criteria, the ROD requires that a Ground-Water Remedial Action Alternative Assessment (GRAAA) be initiated to further assess the fate and transport of the COCs in HU-B. Total U concentrations were above the IL in HU-B well DW19 over an extended period, initiating Phase 1 of the GRAAA. *Phase 1 Ground-Water Remedial Action Alternative Assessment (GRAAA) at SLDS* (USACE 2003b) was completed in CY 2003. Phase 1 summarized the sampling data available for each of the monitoring wells completed in HU-B and provided recommendations for further investigation of HU-B. The Annual Environmental Monitoring Data and Analysis Report, published for each CY, reviews the HU-B data for that year to provide additional information for future phases of the GRAAA. The ground-water monitoring data for the period sampling occurred at DT-34 are contained in the *Annual Environmental Monitoring Data and Analysis Report for Calendar Year 2006* (USACE 2007).

In addition to the evaluation for HU-B, an evaluation of concentration trends is conducted for the COCs detected in HU-A ground water to support assessment of the effectiveness of the RA in the CERCLA five-year reviews. Because the upper HU, (i.e., HU-A) which consists of fill overlying clay and silt, is not considered a potential source of drinking water, the ROD did not establish ground-water criteria for HU-A ground water.

The Mann-Kendall trend test was performed to determine trends in the SLDS ground water for the period between January 1999 and December 2011 (see Section 4.2.3 of the *St. Louis Downtown Site Annual Environmental Monitoring Data and Analysis Report for Calendar Year 2011* [USACE 2012] for additional information). Although arsenic concentrations in one well (DW18) are above the IL, concentrations have been relatively stable since 2007. No other significant changes in the concentrations of the inorganic COCs occurred in shallow or deep ground water during this period. There have been no significant changes from radiological COCs on HU-B ground water. The Mann-Kendall trend test results indicate that there is no trend for total U in HU-B. Concentrations of total U have not shown significant increases since 1999.

## **1.6 CURRENT AND REASONABLY ANTICIPATED FUTURE USE**

The current land uses of DT-34 are predominantly commercial/industrial. The SLDS is generally commercial/industrial with some residences and a recreational bike trail adjacent to the Mississippi River. The closest residential dwelling is located approximately 200 ft southwest of the southwestern corner of the SLDS. As described in the ROD, the SLDS area is zoned "K" (unrestricted district) by the City of St. Louis. This zoning category allows all uses except "...that no building shall be hereafter erected, nor shall any existing building be converted, reconstructed or structurally altered for dwelling purposes" (City of St. Louis 2008). No significant changes in land use are expected.

## **1.7 SUMMARY OF COMMUNITY INVOLVEMENT ACTIVITIES PERFORMED**

The community has been provided with multiple opportunities to be involved with the decision-making process at the SLDS. In 1994, two committees were established for the purpose of working closely with FUSRAP representatives and serving as a "voice of the people." These organizations were the St. Louis Radioactive and Hazardous Waste Oversight Committee and the

City of St. Louis Mayor's Advisory Task Force on Radioactive Waste. In 1994, the St. Louis Sites Remediation Task Force, made up of members from the previously referenced two groups plus other community stakeholders, was established. Working together as the St. Louis Sites Remediation Task Force, these organizations studied cleanup activities at the St. Louis Sites and, in 1996, issued the *St. Louis Site Remediation Task Force Report* (STLOC 1996) detailing the community's recommendations for cleanup and removal of MED/AEC contaminants. Eventually, in 1997, the smaller St. Louis Oversight Committee was formed from members of these organizations. These organizations have developed strong working relationships with the FUSRAP and have been active participants in the decision-making process. The USACE has provided regular briefings to the St. Louis Oversight Committee, which meets roughly twice per year and whose meetings are open to the public. The USACE maintains a website with current information about the status of the St. Louis FUSRAP Sites and historical documentation. Newsletters and fact sheets are distributed throughout the community on an as-needed basis.

The *Feasibility Study for the St. Louis Downtown Site* (FS) (USACE 1998b) and *Proposed Plan for the St. Louis Downtown Site* (PP) (USACE 1998c) were made available to the public in April 1998. A public meeting was advertised and held on April 21, 1998, to hear comments and answer questions regarding the FS and PP. A 30-day comment period for the PP for the SLDS began on April 8, 1998, and ended on May 8, 1998. Responses to the comments received from the public, and from local, state, and federal agencies, are provided in the Responsiveness Summary included as Part 12 to the ROD.

A public meeting was held on April 21, 1998, to present the FS and PP to interested members of the community. A notice announcing the availability of the FS and PP and the intent to hold a public meeting to discuss the documents was published in the *Federal Register (FR)* and in the *St. Louis Post-Dispatch*. The meeting included an open-house session allowing one-on-one discussions with agency representatives, an informal presentation, and an open-microphone question-and-answer period. The transcript of the public meeting and comment period was made available to the public on the USACE's St. Louis District FUSRAP website (<http://www.mvs.usace.army.mil/eng-con/expertise/fusrap.html>) and is included as part of the Administrative Record.

Program documents are made available to the public. They can be found in the Administrative Record maintained at the USACE FUSRAP Project Office, 8945 Latty Avenue, Berkeley, Missouri, or at the St. Louis Public Library, Government Information Section, 1302 Olive Street, St. Louis, Missouri. In addition, SLDS documents are also available for public access at Henry Clay Elementary School, 3820 North 14th Street, St. Louis, Missouri.

## 2.0 BACKGROUND ON THE REMEDIATION PROCESS AND PRE-DESIGN INVESTIGATION

The purpose of a PDI is to obtain data to address historical data gaps, further define the nature and extent of contamination, and provide data needed to support remedial design (if required) and/or the FSSE. The PDI was executed on DT-34 to collect additional data to be used in the design or to confirm that the property met the remediation goals (RGs) as presented in the ROD. This section describes the PDI conducted in 2006 and the associated conclusions. Although no remediation was required at DT-34, this section also summarizes the remedial action objectives (RAOs), the selected remedy, and the RGs specified in the ROD.

### 2.1 REMEDIAL ACTION

The CERCLA process began with gathering existing information about the SLDS and determining if there was a threat to human health and the environment. In 1986, the DOE began gathering this information. A remedial investigation was performed to characterize the extent and type of release, and to evaluate the risk to human health and the environment. The results of the investigation were documented in the *Remedial Investigation Report for the St. Louis Site* (DOE 1994). The FS (USACE 1998b) was developed to evaluate remedial alternatives.

While DT-34 was not specifically addressed during the remedial investigation activities, the nearby Mallinckrodt plants were included. The Mallinckrodt plants generated the types of potential radiological contamination that could be expected at the SLDS.

#### 2.1.1 Remedial Action Objectives

RAOs were established early in the CERCLA process for the SLDS. The RAOs served as a basis for developing RA alternatives for the ROD. The RAOs describe what the RA needed to accomplish in order to be protective of human health and the environment. Table 2 identifies the following RAOs for the SLDS (USACE 1998a).

**Table 2. SLDS Remedial Action Objectives**

| Medium          | Remedial Action Objective   |
|-----------------|---|
| Accessible Soil | Prevent exposures from surface residual contamination in soils greater than the criteria prescribed in 40 CFR Part 192.<br>Eliminate or minimize the potential for humans or biota to contact, ingest, or inhale soil containing COCs.<br>Eliminate or minimize volume, toxicity, and mobility of impacted soil.<br>Eliminate or minimize the potential for migration of radioactive materials off site.<br>Comply with applicable or relevant and appropriate requirements (ARARs).<br>Eliminate or minimize potential exposure to external gamma radiation. |
| Ground Water    | Remove sources of COCs in HU-A.<br>Continue to maintain low concentrations of operable unit COCs in HU-B.   |

#### 2.1.2 Selected Remedy

The selected remedy for the SLDS, pertinent to DT-34, was Alternative 6 from the FS, "Selective Excavation and Disposal" (USACE 1998b). The selected remedy addresses accessible soil and ground water contaminated as a result of MED/AEC uranium ore processing activities.

Contaminants from other sources that are commingled with the MED/AEC COCs would be addressed at the same time.

The main components of the selected remedy for the SLDS consist of the following.

- Excavation of all accessible contaminated soils to RGs that support release and disposal off site at a permitted facility.
- Perimeter monitoring of the ground water in the HU-B will be performed, and the need for ground-water remediation will be evaluated as part of the periodic reviews performed for the site. Ground-water monitoring is currently being conducted at the SLDS. The need for ground-water remediation will be investigated as part of Phase II of the Ground-Water Remedial Action Alternative Assessment.

The following points were identified in the ROD in selecting this remedy.

- The current land use is generally commercial/industrial with some residences and a recreational bike trail adjacent to the Mississippi River. The closest residential dwelling is located approximately 200 ft southwest of the southwestern corner of the SLDS. Zoning regulations prohibit new residences from being established in the area. No significant changes in land use are expected (USACE 1998a).
- Ground water is not currently used as a water-supply source. The shallow ground-water system (HU-A) is not considered a potential source of drinking water because of its poor quality due to the naturally occurring dissolved solid and metal content and very low yields.
- Approved borrow obtained from an off-site location will be used to backfill excavations.
- The final status survey (FSS) will be compatible with MARSSIM (DOD 2000).

### 2.1.3 Remediation Goals

Achievement of RGs demonstrates that residual concentrations of COCs within accessible soil on the property are protective and can be released in accordance with the selected remedy. Table 3 lists the RGs, their applicability to DT-34, and the method for confirming that the applicable RGs have been achieved.

The media to be evaluated at DT-34 is limited to accessible soil. Accessible soils are defined as soils that are not beneath buildings or other permanent structures. DT-34 does not have any ground-water monitoring wells. Ground-water monitoring results associated with the SLDS are documented in annual environmental monitoring reports. There is no creek or other such surface water or sediment on this property.

Inaccessible soils and structures are not within the scope of the ROD or the FSSE. Inaccessible soils include the footprint of a building, the supporting soils beneath the footprint, and the soils adjacent to the building necessary for the structural stability and safety of the building. Similarly, inaccessible soils may be associated with other structures, such as roadways, rail lines, or flood control levees.

Using this concept of inaccessible soils, there are inaccessible soils associated with the railroad spur and buildings on DT-34, as shown on Figure 2. The structures and the inaccessible soils associated with the structures on DT-34 will be evaluated in subsequent CERCLA activities.

**Table 3. Remediation Goals and Assessment Methods**

| Type   | Specification                   |  | Methods  |
|--|---------------------------------|--|--|
| Soil Radionuclide<br><br>(Results from a 0.5-ft soil interval can be averaged over 100 m <sup>2</sup> ). | Ra-226<br>Th-230                | < 5 picocuries per gram (pCi/g) above background for soil less than 0.5 ft below cover material (bcm)<br><br>< 15 pCi/g above background for soil deeper than 0.5 ft bcm   | Use analytical results to calculate the net sum-of-the-ratio (SOR <sub>N</sub> ) and gross sum of the ratio (SOR <sub>G</sub> ). Calculate area-weighted averages as necessary. Use MARSSIM to determine the required number of random soil samples. |
|  | Ra-228<br>Th-232                | < 5 pCi/g above background for soil less than 0.5 ft bcm<br><br>< 15 pCi/g above background for soil deeper than 0.5 ft bcm  |  |
|  | U-238                           | < 50 pCi/g above background for soil   |  |
|  | SOR <sub>N</sub> <sup>a,b</sup> | $SOR_N^{depth \leq 0.5ft} = \frac{(greater\ of\ Th-230_N\ or\ Ra-226_N)}{5\ pCi/g} + \frac{(greater\ of\ Th-232_N\ or\ Ra-228_N)}{5\ pCi/g} + \frac{U-238_N}{50\ pCi/g}$ $SOR_N^{depth > 0.5ft} = \frac{(greater\ of\ Th-230_N\ or\ Ra-226_N)}{15\ pCi/g} + \frac{(greater\ of\ Th-232_N\ or\ Ra-228_N)}{15\ pCi/g} + \frac{U-238_N}{50\ pCi/g}$ <p>SOR<sub>N</sub> &lt; 1.0 over 100 m<sup>2</sup> using area-weighted average<br/>SOR<sub>N</sub> &lt; 1.0 when soil analytical results averaged over survey unit (SU)</p> |  |
|  | SOR <sub>G</sub>                | Pass MARSSIM Wilcoxon Rank Sum (WRS) test  |  |
| Soil Non-Radionuclide  |                                 | N/A  |  |
| Structure Surfaces   |                                 | N/A  |  |
| Health Risk  |                                 | 10 <sup>-6</sup> to 10 <sup>-4</sup>   | For radioactivity, use analytical results as inputs to the RESidual RADIoactivity (RESRAD) computer model to estimate health risk.   |
| Dose   |                                 | Total Effective Dose Equivalent (TEDE) < 25 millirem/year (mrem/yr)  |  |
| Toxicity   |                                 | N/A  |  |

<sup>a</sup> In the SOR<sub>N</sub> equations, the radioactivity (e.g., Ra-226) is measured as a concentration (i.e., pCi/g). The radioactivity concentration is divided by the RG for that specific radionuclide (e.g., 5 pCi/g for Ra-226). The subscript "N" represents net concentration above background. Background values were determined using 32 soil samples collected from non-impacted areas near the SLDS. The background reference analytical data are summarized in Appendix A (Attachment A-3).

<sup>b</sup> A soil concentration of 5 pCi/g of Th-230 would result in the in-growth of < 5 pCi/g Ra-226 (approximately 2 pCi/g) at the end of the 1,000-year time period stated in 40 CFR 192.02(a). Therefore, constraining the concentration to 5 pCi/g for the higher of Ra-226 or Th-230 in surface soil along with the use of the unity rule assures that the concentration of Ra-226 does not exceed 5 pCi/g during the 1,000-year time period. These RGs achieve doses that are less than typically < 15 mrem/yr in practice. In addition, risk assessments performed to date have determined that soils that meet the RGs achieve protectiveness to levels within the CERCLA risk range.

Notes:

The ROD lists RG components addressing ground-water monitoring of the Mississippi Alluvial Aquifer (HU-B). This aquifer is addressed separately from this report on accessible soil.

The ROD lists an RG component addressing sewer and drain sediments. The sewer systems used for MED/AEC processing operations are not located within the boundary of DT-34; therefore, soils on DT-34 would not have been impacted by flow from areas within MED/AEC operations. Sewers (i.e., structures and interior sediment) will be addressed in a subsequent CERCLA action.

### **2.1.4 Applicable or Relevant and Appropriate Requirements**

Section 121(d) of CERCLA and the NCP §300.430(f)(1)(ii)(B) require that RAs at CERCLA sites at least attain legally applicable or relevant and appropriate federal and state requirements, standards, criteria, and limitations, which are collectively referred to as “ARARs,” unless such ARARs are waived under CERCLA Section 121(d)(4).

Relevant and appropriate requirements are cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility citing laws that, while not “applicable” to a hazardous substance, pollutant, contaminant, RA, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that are well-suited to the particular site. Only those state standards that are identified in a timely manner and are more stringent than federal requirements may be relevant and appropriate. The key ARARs for the SLDS, as presented in the ROD, for the selected remedy are listed in the following paragraphs.

40 CFR Part 192, Section 192.12(a) is relevant and appropriate: Residual radioactive material concentration of Ra-226 and Ra-228 in land averaged over any 100-m<sup>2</sup> area shall not exceed the background level by >5 picocuries per gram (pCi/g) averaged over the first 15 centimeters (cm) of soil (6 inches) and 15 pCi/g averaged over 15 cm thick layers of soil >15 cm below the surface (USEPA 2002).

40 CFR Part 192, Subpart A, Section 192.02(b)(1-2) is relevant and appropriate: Radon-222 releases will not exceed an average rate of 20 picocuries per square meter per second (pCi/m<sup>2</sup>/s) or increase the average annual concentration by more than 0.5 pCi/L in air outside the site (USEPA 2002).

40 CFR Part 192, Sections 192.40 and 192.41 are relevant and appropriate: This regulation was used in developing the thorium cleanup criteria for sites where thorium ores were processed (USEPA 2002).

40 CFR Parts 257-272 are relevant and appropriate: The selected remedy will comply with 40 CFR Parts 257-272, which establish accountability in handling hazardous waste from generation to disposal.

10 CFR 20, Subpart E is applicable: This rule provides consistent standards to NRC licensees for determining the extent to which lands must be remediated before decommissioning of a site can be considered complete and the license terminated.

## **2.2 PRE-DESIGN INVESTIGATION INFORMATION**

The purpose of a PDI is to obtain data to address historical data gaps, to further define the nature and extent of contamination, and to provide data needed to support remedial design (if required) and/or the FSSE.

### **2.2.1 Historical Information Review**

Between 1909 and 1950, commercial cattle herding, staging, and slaughtering were conducted on DT-34. After 1950, property use transitioned from animal tissue rendering to chemical processing (Willibald Schaeffer Co.). Since 1988, Midland Resources has occupied the property and has continued to process chemicals on site.

Thirty historical aerial photographs from 1941, 1945, 1947, 1949, 1952, 1953, 1955, 1958, 1962, 1964, 1968, 1971, 1973-1977, 1979-1981, 1983, 1984, 1986-1990, 1993-1995 (USACE 1941-1995) were evaluated to determine DT-34 property conditions over time. Notable events and information are:

- July 1941: Aerial Photograph - A group of buildings, tanks, and a pond are visible at the south end of the property, next to a set of railroad tracks. The northern half of the property appears to be tree covered. Railroad tracks are also present to the east of the property.
- July 1945: Aerial Photograph – More structures have been added alongside the 1941 group of structures. A small building near Bremen Avenue is visible.
- July 1947: Aerial Photograph – Mississippi River floodwater submerges DT-34.
- January 1953: Aerial Photograph – No apparent changes since July 1945.
- August 1953: Aerial Photograph – No apparent changes since January 1953.
- February 1964: Aerial Photograph – No apparent changes since August 1953.
- March 1968: Aerial Photograph – The small building near Bremen Avenue has been removed since the February 1964 aerial photograph.
- August 1971: Aerial Photograph – No apparent changes since March 1968.
- April 1973: Aerial Photograph – Some of the trees on the northern half of the property have been removed since the August 1971 aerial photograph.
- August 1975: Aerial Photograph – Two more ponds are present, both near the middle of the property.
- February 1979: Aerial Photograph – No apparent changes since August 1975.
- July 1980: Aerial Photograph – Two ponds near the middle of the property have been removed since the February 1979 aerial photograph.
- February 1987: Aerial Photograph – No apparent changes since July 1980.
- June 1988: Aerial Photograph – The original pond near the railroad tracks has been removed since the February 1987 aerial photograph.
- May 1990: Aerial Photograph – Tanks have been added over the former location of the original pond.
- August 1993, February 1994, and May 1995: Aerial Photographs – Tanks and a building were built over the former location of the two ponds circa late 1970s (center of property). The 1993 flood did not overtop the levee for downtown St. Louis and storm water backup on the west side of the levee did not affect DT-34.
- Since 1995: Field Observation, Google Earth, and the City of St. Louis Building Division Website – An office building, a trailer, and a small weigh station shed were added near Bremen Avenue. Additional tanks and buildings were added in the southern grouping of structures. The southern third of what was the largest building in 1941 has been removed. Railroad tracks were added along the southern edge of the property, and the spur was extended up the eastern side of the property.

Potential contaminant migration scenarios were identified through the review of historical documentation. The potential migration scenarios include:

- Airborne transport via dust from former processing operations and/or wind erosion from stockpiles.
- Direct loss of materials from hauling trucks and railcars. Given the configuration of roads and railroads and the proximity of this property to the former Mallinckrodt processing operations, this migration scenario could not be ruled out.

Transport of radioactive materials via flood water from the Mississippi River was considered as a potential migration scenario. The elevation of the flood water was approximately 420 ft above mean sea level, which is greater than most of the ground surface elevation of DT-34; however, DT-34 is northeast and upstream of the Mallinckrodt plants, and after 1955, the SLDS was protected from flooding by the USACE-constructed floodwall, further reducing the potential for floodwater impacting DT-34.

These potential contaminant migration scenarios were investigated through the PDI and FSS processes.

### **2.2.2 Pre-Design Investigation Survey**

While no soil sampling had previously taken place directly on DT-34, information from the gamma walkover survey (GWS), performed in 2002, and information obtained from surrounding areas indicated that existing conditions on DT-34 could meet the RGs. Accordingly, the PDI survey was designed to meet MARSSIM in the event that the results could also serve as the FSS. As described in MARSSIM, in certain situations, when no remediation is anticipated, results of the characterization survey may indicate compliance with the derived concentration guideline levels (DCGLs). When planning for the potential use of the characterization survey analytical data as part of the FSS, this data must be of adequate quality and quantity for that use (DOD 2000). For the PDI sampling, the random soil sample locations were developed in anticipation that the analytical results could be used for the FSS. All PDI sampling analytical data was used in the FSS. The FSS analytical data are presented in Appendix B. The FSS design and methodology are discussed in Sections 3.2.1 through 3.2.3.

## **2.3 CONCLUSIONS FROM EXISTING DATA**

PDI analytical data indicated that no residual radioactivity above the RGs was present on DT-34 and that the property was ready for an FSS. All of the PDI analytical data was of sufficient quality and quantity to be included in the FSS. No additional surveying or sampling on DT-34 was conducted during the FSS. The FSS analytical data indicated that remediation on DT-34 was not required.

### 3.0 FINAL STATUS SURVEY PROCESS

#### 3.1 DATA QUALITY OBJECTIVES

The data quality objective (DQO) process is a strategic planning approach for a data collection activity. It provides a systematic procedure for defining the criteria that a data collection design should satisfy, including where to collect samples, how many samples to collect, and the tolerable level of decision errors for the study. The DQO process includes the following seven steps from the USEPA's *Guidance on Systematic Planning Using the Data Quality Objectives Process* (USEPA 2006a).

- State the problem. Inadvertent release of contaminants into the environment.
- Identify the decision. Determine if the accessible soil on DT-34 can be released for unrestricted use in accordance with the ROD.
- Identify inputs to the decision. Radiological soil analytical data for accessible soil.
- Define the study boundaries. Accessible soil on DT-34.
- Develop a decision rule. See Table 3.
- Specify tolerable limits on decision errors. The desired tolerable limits included minimum detectable concentrations (MDCs) for soil samples equating to less than 50 percent of the RG, with the goal of 10 percent of the RG. Sample error is reported with the sample result. The MARSSIM evaluation was based on decision errors of less than 5 percent false negatives and less than 20 percent false positives. This means that the decision is more likely to conclude contamination is present when it is not, than to conclude that contamination is not present when it is.
- Optimize the design for obtaining data. For the PDI sampling, the random soil sample locations were developed in anticipation that the analytical data could be used for the FSS.

The FSS analytical data were examined using data quality assessment (DQA) guidance to ensure two things: (1) that the data met the quality requirements of the *Final Status Survey Plan for Accessible Soil within Mallinckrodt Property and the Vicinity Properties, Excluding Plants 1, 2, and the City Property at the St. Louis Downtown Site* (FSSP) (USACE 2002a) and the *Sampling and Analysis Guide for the St. Louis Sites* (SAG) (USACE 2000), and (2) that the data provided the necessary basis for determining whether the property could be released for unrestricted use. The DQA involves scientific and statistical evaluations to determine if data are of the right type, quality, and quantity to support the intended use. The DQA process is based on guidance from Chapter 8 and Appendix E in MARSSIM (DOD 2000) and follows the USEPA's *Data Quality Assessment: A Reviewer's Guide* (USEPA 2006b). The five steps in the DQA process are listed below and are addressed by the subsequent report sections and appendices.

- Review the FSS design, including DQOs.
- Conduct a preliminary data review.
- Select a statistical test.
- Verify the assumptions of the statistical test.
- Draw conclusions from the data.

## 3.2 FINAL STATUS SURVEY PROCESS FOR SOIL

### 3.2.1 Final Status Survey Design for Soil

In accordance with MARSSIM, land areas receiving an FSS should be classified into Class 1, Class 2, or Class 3 soil survey units (SUs). The classification is based on their potential for radioactive contamination in soils. Class 1 areas have the greatest potential for contamination, while Class 3 areas have the lowest potential. Per the FSSP, Class 1 SUs are typically limited in size to 2,000 m<sup>2</sup> plus 10 percent, Class 2 SUs are typically limited in size to 10,000 m<sup>2</sup> plus 10 percent, and Class 3 SUs are unlimited in size. MARSSIM states that Class 1 and 2 areas are to be sampled using a systematic grid, and that Class 3 areas are to be sampled using random locations.

Based on a review of site information and analytical data from adjacent properties, the accessible soil making up DT-34 was classified as one Class 3 area (SU-1), as shown on Figure 2. SU-1 consists of approximately 9,846 m<sup>2</sup>.

Random soil sample locations were identified for the Class 3 area. The random locations for Class 3 areas were designed to ensure that the analytical data were representative of the SU.

The number of soil samples estimated for the SU was determined based on experience with other properties. Appendix C contains the detailed process for determining the minimum number of samples.

### 3.2.2 Final Status Survey Methodology for Soil

FSS sampling of soil involves collecting soil samples at the locations identified in the FSS design. Figure 2 depicts the sampling locations on DT-34. These soil samples were collected from the top 0.5 ft bgs or within the top 0.5 ft of soil below cover material (bcm) (e.g., gravel).

Per the FSSP, subsurface soils were sampled to confirm that no unexpected subsurface radioactive contamination was present. These soil samples are generally collected at the same locations as the FSS surface soil samples. For Class 3 areas, the process for collecting subsurface soil samples for laboratory analysis starts with removing a soil column that is 1.5- to 2.0-ft long until a total depth of 6 ft below original grade is obtained. In the first soil column, two soil samples will be collected. The first soil sample will be from the first 0.5 ft of the uppermost soil layer below any cover material (i.e., asphalt and associated gravel). The second soil sample with a span of 0.5 ft will be collected from the remaining column in the area exhibiting the greatest radioactivity determined by using appropriate radiological survey instrumentation. If the remaining soil column has a relatively uniform count rate, the second soil sample interval should be the deepest 0.5-ft portion of the column. One soil sample will be collected from each subsequent soil column below the first soil column. A soil sample with a span of 15 cm (0.5 ft) will be collected from each column in the area exhibiting the greatest radioactivity. If the soil column has a relatively uniform count rate, the soil sample interval should be the deepest 15-cm (0.5-ft) portion of the column. In the deepest soil column removed, one-third of the soil samples will be subject to laboratory analysis with two-thirds subject to field screening. The results of radiological screening provide qualitative data regarding the potential for elevated radiological COCs in soil cores.

Per the FSSP, a minimum of one-third of the locations should continue this process for each 1.5- to 2.0-ft soil column to a depth of 6 ft bgs.

MARSSIM also recommends performing radiological scans of the ground surface (with any cover material). For Class 3 areas, the size of the area is based on the professional judgment of the survey supervisor (typically about 10 percent of the area). These radiological scans are GWSs. The GWSs are used to select biased soil sample locations as an additional effort to locate areas requiring further investigation and ensure that the soil samples are representative of the SU. There are no RGs specifying an unacceptable GWS result. Additional information on GWS, including a figure illustrating the evaluation of GWS data, is in Appendix D. The GWS files have been included in Appendix E (on the CD-ROM attached to the back cover of this report).

The biased soil sample locations determined from the GWSs are designated with the hot zone (“HTZ”) prefix and are assigned an area, in square meters, that the sample represents. (The “HTZ” prefix can also be used for biased soil samples that are taken to bound the extent of contaminated soil, but no areas are assigned to these HTZ samples.) The biased soil sample locations are shown on Figure 2. GWS-based biased surface soil samples were collected within the upper 0.5 ft of the surface soil.

### **3.2.3 Final Status Survey Methodology for Asphalt**

When soil sampling was performed in an area covered by asphalt, an asphalt plug was removed to allow access to the underlying soil. The area of the asphalt plug that was in contact with the soil was subjected to a radiological survey. The results of the radiological surveys were comparable to background levels.

The asphalt on DT-34 was not subjected to laboratory analysis. The determination that asphalt did not require analysis was based on the analytical data from the asphalt samples from Plants 1 and 2 at the SLDS. The soil under the asphalt at Plants 1 and 2 had some of the highest contamination found anywhere on the SLDS. However, sampling results showed that the asphalt had not become contaminated from the soil it was covering.

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## 4.0 ASSESSMENT OF FINAL STATUS SURVEY RESULTS

### 4.1 ASSESSMENT OF SOIL SAMPLE RESULTS

The background reference soil data set used in the evaluation of the FSS soil samples is summarized in Appendix A. The radiological soil sample analytical data are reported in Appendix F. A copy of the boring logs and field logbook entries for these samples are provided in Appendix I (on the CD-ROM attached to the back cover of this report). The surface and subsurface RGs were applied, as follows, to calculate the net sum of the ratio ( $SOR_N$ ).

- $SOR_N$  using surface RGs: If no cover material was present, the soil sample was collected from the upper 0.5 ft of the soil. If cover material was less than 0.5 ft, the soil sample was collected from the first 0.5 ft of soil bcm.
- $SOR_N$  using subsurface RGs: The soil sample was collected from below 0.5 ft of the ground surface.

All of the soil sample analytical data for SU-1 was evaluated to ensure the average  $SOR_N$  over the entire SU did not exceed 1.0. All of the surface soil sample analytical data had  $SOR_N$  values that were less than 1.0 (ranging from 0.0 to 0.07). Because the mean  $SOR_N$  (0.01) was less than 1.0 and all individual  $SOR_N$  values were also less than 1.0, the radionuclide RGs were met for the SU. The analytical data are summarized in Appendix F.

In addition to a direct comparison to the RGs, MARSSIM recommends that an investigation level be established to investigate results that pass the statistical test but potentially represent the edge of more significant contamination. For Class 3 areas, MARSSIM states that the investigation level should be a fraction of the DCGL. A Class 3 investigation level of 0.5 or greater for the  $SOR_N$  was established for this report. No samples required further investigation.

Soil samples collected at three (SLD97096, SLD97104, SLD97106) out of nine random stations were from 4 to 6 ft bcm soil column intervals, meeting the one-third FSSP requirement.

#### 4.1.1 Statistical Test for Soil Sample Results

Because soil contains natural background levels of the radionuclide COCs, the Wilcoxon Rank Sum (WRS) statistical test is used for soil sample results per MARSSIM. Data from biased and subsurface soil samples were not included in the statistical tests per MARSSIM guidance: “Judgment measurements are not included in the statistical evaluation of the survey unit data because they violate the assumption of randomly selected, independent measurements. Instead, judgmental measurements are individually compared to the DCGL” (DOD 2000).

MARSSIM also states that “if the difference between the largest survey unit measurement and the smallest reference area measurement is less than or equal to the DCGL... [i.e.,  $SOR_G^{\max \text{ systematic or random}} - SOR_G^{\min \text{ reference}} < 1.0$ ], the WRS test will always show the survey unit meets the release criterion” (DOD 2000). From the SLDS background reference data set, the smallest surface gross sum of ratios ( $SOR_G$ ) is 0.53 and the largest SU measurement is  $SOR_G$  0.69. (Background values are not subtracted in the  $SOR_G$  calculation.)

For SU-1, this difference was less than 1.0 (e.g., for SU-1,  $0.69 - 0.53 = 0.16$ ). Therefore, a WRS test is not necessary.

#### **4.1.2 Asphalt Survey Results**

There were no elevated radiation survey results for any of the asphalt plugs that were removed to allow access for sampling the soil underneath the asphalt.

#### **4.1.3 Non-Radiological Soil Sample Results**

Non-radiological sampling is not required for the areas included within the scope of this report per the ROD.

#### **4.1.4 Review of Final Status Survey Design for Soil**

An important factor in MARSSIM is determining an appropriate number of samples for the statistical test. Collecting too few samples can result in an inaccurate conclusion. Collecting an excessive number of samples diverts resources that could be better used elsewhere. MARSSIM establishes a method for determining the minimum number of samples. Appendix C contains the detailed process for determining the minimum number of random samples. The calculated minimum number of samples for SU-1 was six samples. Table 4 lists the calculated minimum number samples and the actual number of FSS samples collected from SU-1.

**Table 4. Number of Random Samples**

| SU   | Class | Minimum Number of Samples for the Statistical Test | Number of Random Samples Collected |
|------|-------|--|------------------------------------|
| SU-1 | 3     | 6  | 9                                  |

## **4.2 DATA QUALITY**

Quality control (QC) and quality assurance (QA) measures for FSS analytical data are summarized in the FSSP and are presented in the QA/QC sections of the SAG. The Quality Control Summary Report (QCSR) contained in Appendix G discusses these measures in detail for DT-34. The FSS analytical data met QA/QC requirements.

#### **4.2.1 Minimum Detectable Concentration for Soil Samples**

Soil samples were analyzed in the USACE FUSRAP laboratory in order to measure the radioactivity at very low levels. The USACE FUSRAP laboratory is certified through the U.S. Department of Defense (DOD) Environmental Laboratory Accreditation Program (ELAP). In general, the MDC represents the lowest amount of activity that the laboratory could detect for a given sample. Variables, including detection efficiencies and conversion factors due to influences such as individual sample aliquot and sample density and variations in analyte background radioactivity at the laboratory, are taken into account when determining the MDC. The MDC is reported with each soil sample result in Appendix F.

MARSSIM recommends that analytical methods should be capable of measuring levels of activity (i.e., the MDCs) between 10 to 50 percent of the established RGs. These MDC limits for surface soils are listed in Table 5.

The MDCs for all soil samples included in the FSS are less than 10 percent of the established RGs for the radionuclides listed in Table 5. As discussed in MARSSIM, the reported radionuclide concentrations from the laboratory were used in this FSSE even if those results

were below the MDCs. These data were used to complete the MARSSIM evaluation and assess the risk and dose for the SU.

**Table 5. Minimum Detectable Concentration Limits**

| Radionuclide | Maximum MDC             |                            | Preferred MDC           |                            |
|--------------|-------------------------|----------------------------|-------------------------|----------------------------|
|              | Surface Soil<br>(pCi/g) | Subsurface Soil<br>(pCi/g) | Surface Soil<br>(pCi/g) | Subsurface Soil<br>(pCi/g) |
| Ra-226       | 2.5                     | 7.5                        | 0.5                     | 1.5                        |
| Ra-228       | 2.5                     | 7.5                        | 0.5                     | 1.5                        |
| Th-230       | 2.5                     | 7.5                        | 0.5                     | 1.5                        |
| Th-232       | 2.5                     | 7.5                        | 0.5                     | 1.5                        |
| U-238        | 25                      | 25                         | 5.0                     | 5.0                        |

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## 5.0 RESIDUAL RISK AND DOSE ASSESSMENT

A property-specific residual risk and dose assessment was performed for the subject property, in accordance with the ROD, to confirm that the conditions are protective of human health and the environment. The ROD established the CERCLA target risk range as the risk RG and the 10 CFR 20 Subpart E dose limit of 25 millirem per year (mrem/yr) as the dose RG. The USEPA defines the CERCLA target risk range as  $10^{-6}$  to  $10^{-4}$  where “the upper boundary of the risk range is not a discrete line at  $10^{-4}$ . A specific risk estimate around  $10^{-4}$  may be considered acceptable if justified based on site-specific conditions” per Memorandum Office of Solid Waste and Emergency Response (OSWER) 9200.4-18 *Establishment of Cleanup Levels for CERCLA Sites with Radioactive Contamination* (USEPA 1997a).

The risk and dose scenario for the ROD is based on the industrial worker and utility worker exposure scenarios defined in the FS. The assessment for DT-34 was performed for each of these scenarios, and an additional on-site residential scenario was considered at the request of the regulators.

CERCLA recommends a lifetime exposure assessment period of 30 years for individuals under a residential exposure scenario. Subpart A of 40 CFR 192 requires a 1,000-year exposure assessment scenario that takes into account the risk posed by residual levels of long-lived radionuclides and the in-growth of their decay daughter products. This is the period of time over which achievement of the cleanup standard must be reasonably assured.

Section C.2.1.3 of the FS states: “To estimate a dose or risk, the appropriate exposure parameters, the source term (concentrations of radionuclides), and other variables such as depth of contamination and distribution coefficients are selected to provide conservative yet realistic estimates of exposure” (USACE 1998b). This means that the actual risk and dose received by an individual from residual MED/AEC material on this property will be lower than the estimates in this assessment. Additionally, much of the property is covered by asphalt, concrete, or gravel. These cover materials provide additional protection that is not accounted for in the estimates. This is another example of how the actual MED/AEC-related risk and dose will be lower than the estimates provided in this assessment.

Based on the results of risk and dose assessments, it can be concluded that residual risk and dose for soil at DT-34 are protective for all receptor scenarios (including the on-site resident) and are protective of public health and environment, and that the accessible soils on the property can be released for unrestricted use. More information on how these risk and dose values were calculated is provided in Appendix H.

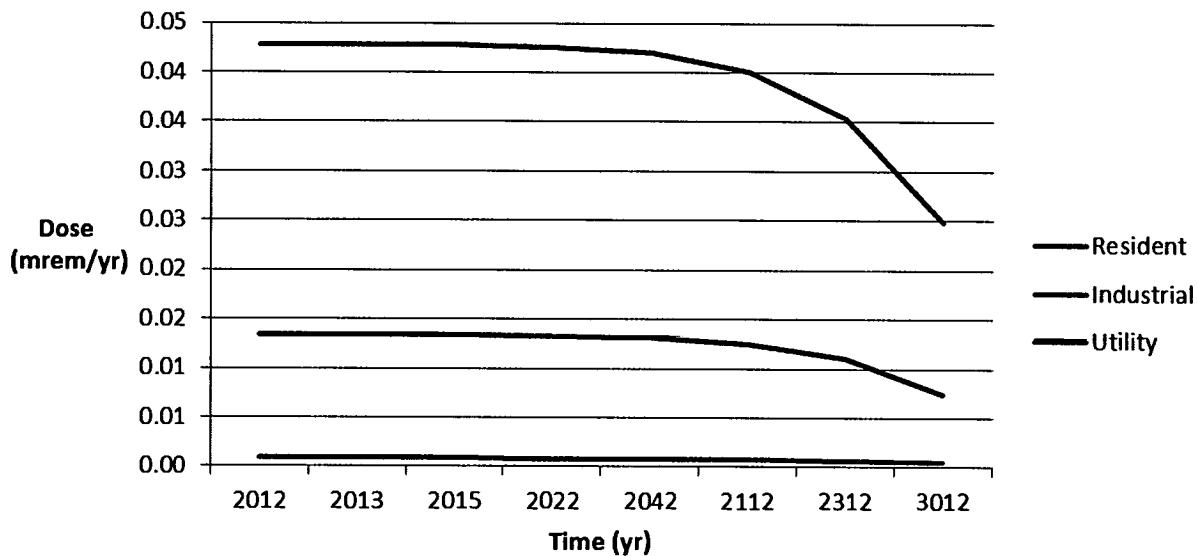
The results of random, biased, and subsurface soil samples were used in the residual risk and dose assessment. The risk and dose estimates are provided in Table 6.

**Table 6. Risk and Dose Estimate**

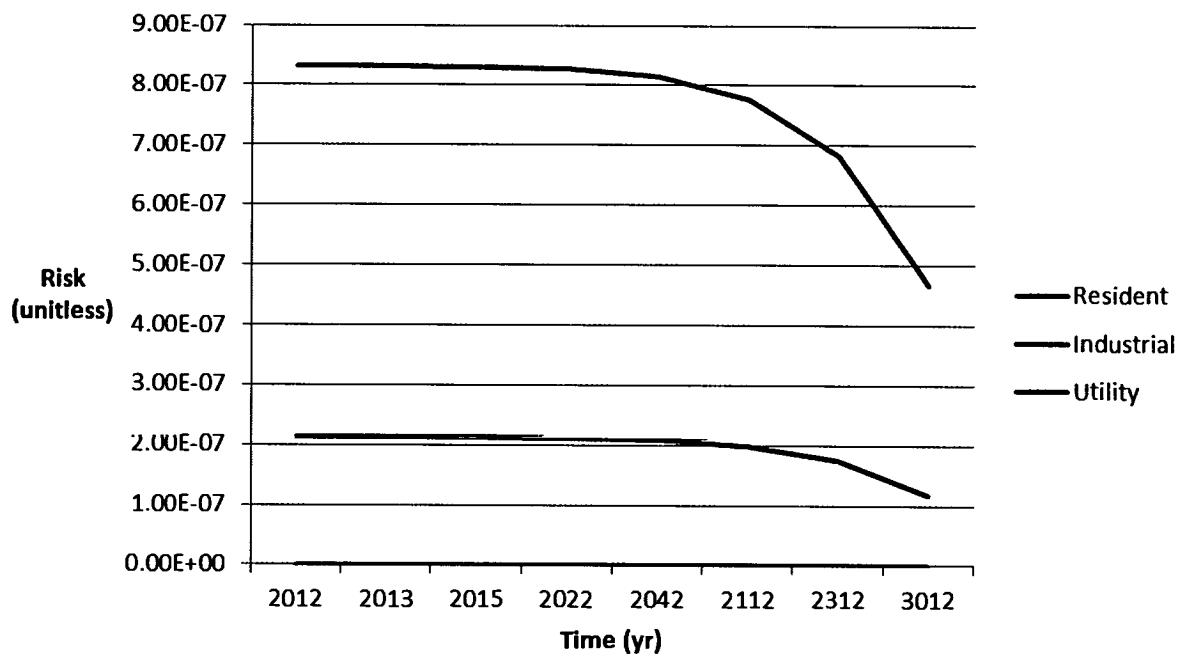
| Scenario          | Period Assessed<br>(years) | Maximum Risk          | Maximum Dose<br>(mrem/yr) |
|-------------------|----------------------------|-----------------------|---------------------------|
| Industrial Worker | 0 to 1,000                 | $2.1 \times 10^{-7}$  | $1.3 \times 10^{-2}$      |
| Utility Worker    | 0 to 1,000                 | $5.3 \times 10^{-10}$ | $8.4 \times 10^{-4}$      |
| On-Site Resident  | 0 to 1,000                 | $8.3 \times 10^{-7}$  | $4.3 \times 10^{-2}$      |

The following graphs illustrate the radiological risk and dose for a 1,000-year period for the on-site resident and the industrial and utility worker receptors.

**Dose: On-Site Resident and Industrial and Utility Worker  
Receptors vs. Time**



**Risk: On-Site Resident and Industrial and Utility Worker  
Receptors vs. Time**



## 6.0 CONCLUSIONS

The conditions established in the ROD for protecting human health and the environment have been met for accessible soils on DT-34. This conclusion is the result of a comparison of the ROD requirements and the current conditions, as presented in Table 7. The survey results and the risk and dose assessment demonstrate that the accessible soils on DT-34 can be released for unrestricted use in accordance with the ROD.

**Table 7. Comparison of Results to Remediation Goals**

| RG Type   | Specification  | Results  |
|---|--|--|
| Soil Radionuclide<br><br>(Note: 40 CFR 192 allows area-weighted averaging over a 0.5-ft layer of soil.) | Sample SOR <sub>N</sub> < 1.0 when averaged over 100 m <sup>2</sup><br><br>SOR <sub>N</sub> < 1.0 when random sample results averaged over SU<br><br>Pass MARSSIM WRS test (if required) | All soil samples had SOR <sub>N</sub> < 1.0.<br><br>SU-1: Average SOR <sub>N</sub> = 0.01<br><br>WRS test not required (see Section 4.1.1) |
| Health Risk   | $10^{-6}$ to $10^{-4}$   | $8.3 \times 10^{-7}$   |
| Dose  | TEDE < 25 mrem/yr  | $4.3 \times 10^{-2}$ mrem/yr   |

The main components of the ROD selected remedy are summarized in the following list (i.e., bulleted/italicized items), along with a brief summary of conclusions drawn from this report.

- *Excavation of accessible soils according to the ARAR-based composite cleanup criteria (i.e., RG) of 5/15 pCi/g above background for Ra-226, Ra-228, Th-232, and Th-230, and 50 pCi/g above background for U-238 in the uppermost 1.8 m (6 ft) (USACE 1998a).*

FSS analytical data has confirmed that no accessible soils have been left in place on DT-34 with contamination exceeding the RGs. Excavation was not required.

- *On the portion of the Mallinckrodt property addressed in the operable unit, site-specific target removal levels of 50 pCi/g above background for Ra-226, 100 pCi/g above background for Th-230, and 150 pCi/g above background for U-238 (50/100/150 RGs) will be used as the deep-soil cleanup guidelines (RGs) below 1.8 meters (m) (6 ft), as described in Section 7.3.6 of the ROD (USACE 1998a).*

Not applicable. Deep-soil RGs do not apply, because DT-34 is a VP, not a Mallinckrodt property.

- *For arsenic and cadmium:*

*1) within the upper 1.2 or 1.8 m (4 or 6 ft) of grade, soil concentrations of arsenic greater than 60 mg/kg and/or cadmium concentrations greater than 17 mg/kg will be removed, or*

*2) below 1.2 or 1.8 m (4 or 6 ft) of grade, soil concentrations of arsenic greater than 2,500 milligrams per kilogram (mg/kg) and/or cadmium are greater than 400 mg/kg will be removed (USACE 1998a).*

Non-radiological requirements are not applicable to the area addressed by this report.

- *Remediation goals for radiological contaminants are applied to soil concentrations above background consistent with the ARAR (40 CFR 192) from which they derive. However, addition of background concentrations to these goals would not alter any judgments regarding protectiveness. Remediation goals for non-radiological RGs are applied to soil concentrations, including background, consistent with the NCP (USACE 1998a).*

FSS analytical data has confirmed that no accessible soils have been left in place at DT-34 that exceed the RGs. This statement in the ROD is true for SU-1 on DT-34. The SOR<sub>G</sub> (the raw data including background) are also less than 1.0 when averaged across the SU. Non-radiological requirements are not applicable to DT-34.

- *Compliance with soil contamination criteria (RGs) will be verified by methods that are compatible with MARSSIM for soils being cleaned up in the operable unit effective with MARSSIM publication. (A representative number of samples obtained in the bottom of excavations will also be subjected to chemical analysis and comparison to chemical RGs) (USACE 1998a).*

The FSSP was designed in accordance with MARSSIM methodology and applied to DT-34. Chemical (non-radiological) analysis is not applicable to the area addressed by this report.

- *A post-remedial action risk assessment will be performed to describe the level of risk remaining from MED/AEC contaminants following completion of remedial activities (USACE 1998a).*

A post-remedial action risk and dose assessment was performed for the modeled scenarios stated in the ROD. In addition, regulators requested that the USACE develop an on-site residential scenario to document protectiveness if land use changed from industrial to residential. The residual risk and dose calculated for DT-34 meet the criteria stated in the ROD (USACE 1998a).

- *Final determinations as to whether institutional controls and use restrictions are necessary will be based on calculations of post-remedial action risk derived from actual residual conditions. Five-year reviews will be conducted, per the NCP, for residual conditions that are unsuitable for release without restrictions (USACE 1998a).*

The risk and dose from actual residual conditions (without regard to cover materials) are acceptable to release DT-34 accessible areas without restrictions. There are no accessible areas on the SU where it is necessary to apply restrictions or institutional controls.

- *Institutional controls may include land use restrictions for those areas having residual concentrations of contaminants unsuitable for unrestricted use. This determination will be made based on risk analysis of the actual post-remedial action conditions. Until a decision is developed to address the ultimate disposition of inaccessible soils, steps will be taken to control uses inconsistent with current uses and to learn of anticipated changes in conditions that might make these soils accessible or increase the potential for exposure. Periodic reviews with affected property owners will be conducted throughout the duration of active site remediation. For residual conditions requiring use restrictions after the period of active remediation, coordination with property owners and local land use planning authorities will be necessary to implement deed restrictions or other mechanisms to maintain industrial/commercial land use (USACE 1998a).*

The risk and dose from actual residual conditions (without regard to cover materials) are acceptable to release the DT-34 accessible areas without use restrictions. There are no accessible areas on DT-34 that necessitate application of use restrictions or institutional controls.

- *A long-term, ground-water monitoring strategy will be implemented to confirm expectations that significant impacts to the Mississippi Alluvial Aquifer (HU-B) will not occur. Although ground-water use in this area is not anticipated, agreements will be proposed to state and local water authorities to prevent well drilling, which may be impacted by the surficially contaminated HU-B (USACE 1998a).*

The areas covered by this report have no ground-water monitoring wells; however, a long-term, ground-water monitoring strategy for the SLDS has been implemented to confirm expectations that significant impacts to the Mississippi Alluvial Aquifer (HU-B) will not occur.

- *Perimeter wells in the Mississippi Alluvial Aquifer will be monitored to determine if further action will be required with respect to ground water (USACE 1998a).*

The areas covered by this report have no ground-water monitoring wells; however, ground-water monitoring wells in the Mississippi Alluvial Aquifer are being monitored at the SLDS.

- *Protactinium (Pa)-231 and actinium (Ac)-227 will be included in the analyses for the post-remedial action residual site risk (USACE 1998a).*

Pa-231 and Ac-227 were included in the residual risk and dose assessments.

- *Contaminated sediments in sewers and drains considered to be accessible will be remediated along with the soils (USACE 1998a).*

The sewer systems used for MED/AEC-processing operations are not located within the boundary of DT-34.

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## 7.0 CONTACT INFORMATION

Following is a summary of the contact information for the project team participants:

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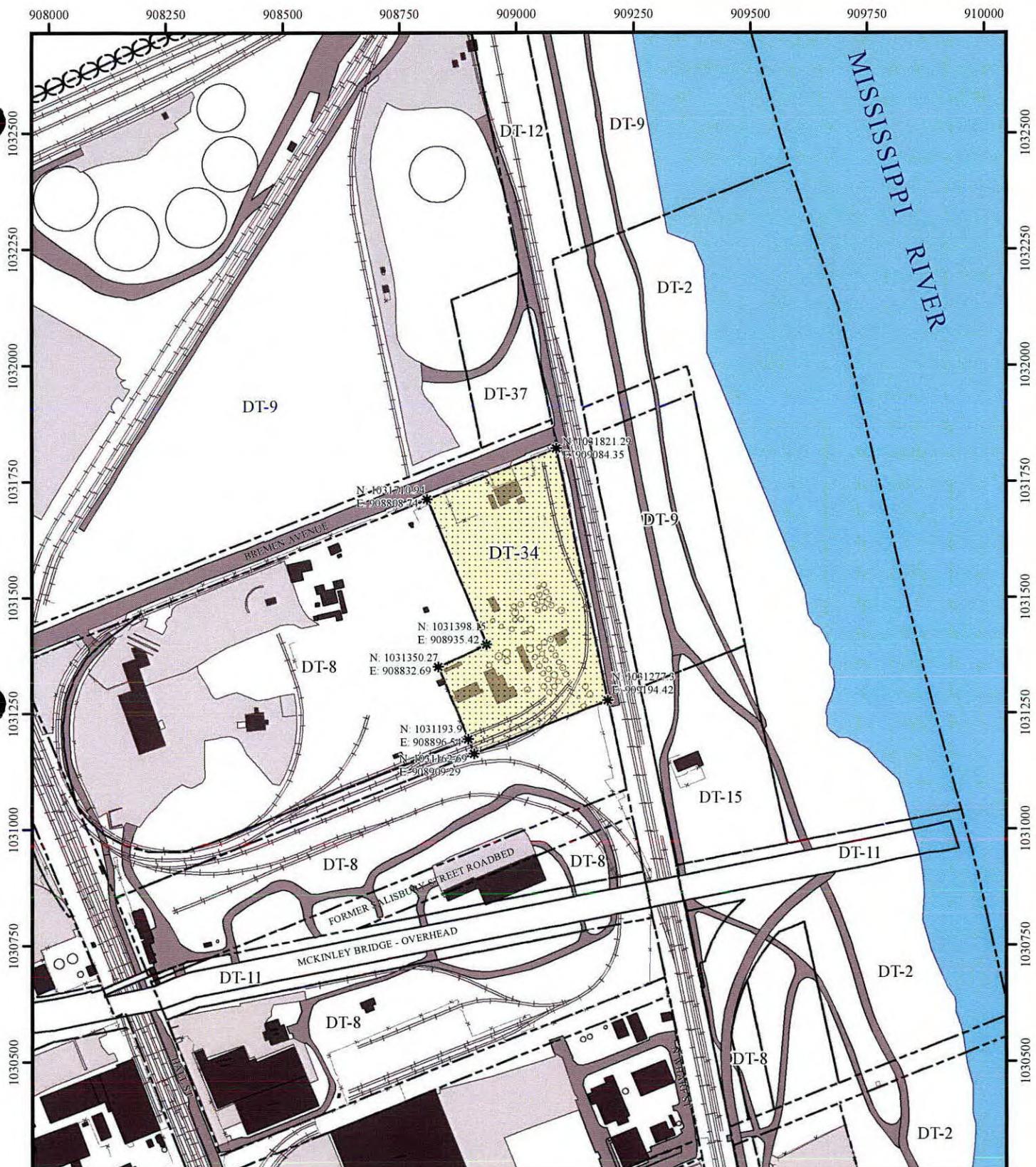
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## FIGURES

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**LEGEND:**

- \* Corner Points
- [Yellow Dotted Line] DT-34 Property Boundary
- [XX] SLDS ROD Boundary
- Railroad Track
- Fence
- Road
- Parking Lot
- Building
- Tank
- Mississippi River



MO-East State Plane  
(NAD 83, Feet)

0 180 360 Feet

DT-34  
St. Louis Downtown Site  
St. Louis, Missouri

**FUSRAP**

|                       |           |                     |
|-----------------------|-----------|---------------------|
| DRAWN BY:<br>KLP, DLL | REV:<br>0 | DATE:<br>05/01/2012 |
|-----------------------|-----------|---------------------|

Figure 1. Property Location



**LEGEND:**

- ★ Biased Sample Locations
- Class 3 Sample Locations
- Property Boundary
- Railroad Track
- Fence
- Tank
- Building
- Road
- Parking Lot
- SLDS Inaccessible Area
- Class 3 Area



MO-East State Plane  
(NAD 83, Feet)

0 50 100 Feet

**DT-34**  
St. Louis Downtown Site  
St. Louis, Missouri

**FUSRAP**

|                       |           |                     |
|-----------------------|-----------|---------------------|
| DRAWN BY:<br>KLP, DLL | REV:<br>1 | DATE:<br>05/10/2012 |
|-----------------------|-----------|---------------------|

Figure 2. DT-34 Final Status Survey Soil Sample Locations

**APPENDIX A**  
**BACKGROUND REFERENCE SOIL SAMPLE DATA**

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**Table A-1. Background Reference Soil Data**

| Background Reference Subsurface Soil Data Summary (32 Samples) |        |        |        |        |        |        |        |       |       |                        |                       |
|--|--------|--------|--------|--------|--------|--------|--------|-------|-------|------------------------|-----------------------|
| Statistic  | Ac-227 | Pa-231 | Ra-226 | Ra-228 | Th-228 | Th-230 | Th-232 | U-235 | U-238 | Surf. SOR <sub>G</sub> | Sub. SOR <sub>G</sub> |
| Mean   | 0.14   | 0.90   | 2.78   | 0.95   | 1.16   | 1.94   | 1.09   | 0.08  | 1.44  | 0.82                   | 0.29                  |
| Median   | 0.11   | 0.98   | 2.53   | 0.97   | 1.10   | 1.66   | 1.07   | 0.09  | 1.16  | 0.76                   | 0.27                  |
| Std. Dev.  | 0.14   | 0.76   | 0.89   | 0.17   | 0.35   | 0.76   | 0.29   | 0.08  | 0.75  | 0.21                   | 0.08                  |
| Maximum  | 0.70   | 2.34   | 5.46   | 1.28   | 2.10   | 4.15   | 1.68   | 0.31  | 3.78  | 1.48                   | 0.54                  |
| Minimum  | -0.10  | -0.21  | 1.53   | 0.46   | 0.51   | 0.96   | 0.43   | -0.02 | 0.59  | 0.53                   | 0.19                  |
| Range  | 0.80   | 2.55   | 3.93   | 0.82   | 1.59   | 3.19   | 1.25   | 0.33  | 3.19  | 0.95                   | 0.35                  |

| Background Reference Soil Sample Results |        |        |        |        |        |        |        |       |       |                        |                       |
|--|--------|--------|--------|--------|--------|--------|--------|-------|-------|------------------------|-----------------------|
| Statistic                                | Ac-227 | Pa-231 | Ra-226 | Ra-228 | Th-228 | Th-230 | Th-232 | U-235 | U-238 | Surf. SOR <sub>G</sub> | Sub. SOR <sub>G</sub> |
| SLD00001                                 | 0.18   | 0.62   | 1.94   | 0.97   | 1.29   | 2.07   | 1.11   | 0.25  | 1.66  | 0.67                   | 0.25                  |
| SLD00002                                 | -0.03  | 2.34   | 2.39   | 1.03   | 1.08   | 1.67   | 1.12   | 0.00  | 0.61  | 0.71                   | 0.25                  |
| SLD00022                                 | 0.36   | 1.33   | 2.56   | 1.17   | 1.00   | 1.83   | 1.49   | 0.24  | 1.38  | 0.84                   | 0.30                  |
| SLD00023                                 | 0.29   | 0.95   | 2.26   | 0.76   | 0.51   | 2.80   | 1.23   | 0.00  | 1.17  | 0.83                   | 0.29                  |
| SLD00041                                 | 0.16   | -0.09  | 2.48   | 0.84   | 0.77   | 1.98   | 1.13   | 0.17  | 1.57  | 0.75                   | 0.27                  |
| SLD00042                                 | 0.70   | -0.02  | 3.02   | 1.07   | 1.14   | 2.24   | 1.05   | 0.00  | 1.80  | 0.85                   | 0.31                  |
| SLD00043                                 | 0.28   | 2.07   | 2.59   | 0.99   | 1.24   | 2.69   | 1.68   | 0.11  | 1.15  | 0.90                   | 0.31                  |
| SLD00044                                 | 0.13   | 1.65   | 3.46   | 1.03   | 1.06   | 1.16   | 1.33   | 0.00  | 0.90  | 0.98                   | 0.34                  |
| SLD00061                                 | 0.10   | 1.23   | 3.11   | 1.08   | 1.02   | 2.67   | 1.43   | -0.01 | 1.47  | 0.94                   | 0.33                  |
| SLD00062                                 | 0.12   | 1.36   | 2.59   | 1.28   | 1.29   | 1.91   | 1.59   | 0.11  | 0.94  | 0.85                   | 0.30                  |
| SLD00063                                 | 0.15   | 2.12   | 2.11   | 1.03   | 1.01   | 1.61   | 0.70   | -0.02 | 0.74  | 0.64                   | 0.22                  |
| SLD00081                                 | 0.24   | 0.98   | 2.44   | 0.96   | 1.46   | 1.47   | 1.30   | 0.12  | 1.05  | 0.77                   | 0.27                  |
| SLD00082                                 | 0.06   | 1.19   | 2.89   | 1.28   | 2.10   | 1.97   | 1.17   | 0.18  | 1.28  | 0.86                   | 0.30                  |
| SLD00083                                 | 0.20   | 0.98   | 2.33   | 0.88   | 1.60   | 1.94   | 0.69   | 0.11  | 0.59  | 0.65                   | 0.23                  |
| SLD00101                                 | 0.15   | 1.01   | 4.24   | 0.79   | 1.12   | 3.05   | 0.90   | 0.22  | 3.12  | 1.09                   | 0.41                  |
| SLD00102                                 | 0.06   | 1.42   | 3.53   | 0.86   | 1.00   | 3.11   | 1.41   | 0.08  | 2.53  | 1.04                   | 0.38                  |
| SLD00103                                 | 0.08   | 1.30   | 3.08   | 0.81   | 0.54   | 1.46   | 0.92   | 0.05  | 1.69  | 0.83                   | 0.30                  |
| SLD00121                                 | 0.17   | -0.10  | 3.31   | 0.87   | 1.27   | 2.25   | 1.34   | 0.31  | 1.84  | 0.97                   | 0.35                  |
| SLD00122                                 | 0.09   | 0.42   | 2.68   | 0.85   | 1.69   | 1.46   | 0.94   | 0.06  | 1.13  | 0.75                   | 0.26                  |
| SLD00123                                 | 0.23   | 0.25   | 3.51   | 1.02   | 1.23   | 1.33   | 0.94   | 0.06  | 1.17  | 0.93                   | 0.33                  |
| SLD00141                                 | 0.16   | -0.21  | 5.46   | 1.04   | 1.40   | 4.15   | 1.56   | 0.07  | 3.78  | 1.48                   | 0.54                  |
| SLD00142                                 | 0.08   | 0.33   | 5.30   | 1.12   | 1.74   | 3.61   | 1.04   | 0.16  | 3.15  | 1.35                   | 0.49                  |
| SLD00143                                 | 0.19   | 0.02   | 2.33   | 0.96   | 1.50   | 1.45   | 1.02   | 0.05  | 0.93  | 0.69                   | 0.24                  |
| SLD00144                                 | 0.10   | 0.01   | 2.04   | 1.10   | 1.51   | 1.48   | 1.25   | 0.17  | 1.61  | 0.69                   | 0.25                  |
| SLD00161                                 | 0.10   | 0.11   | 1.53   | 0.86   | 1.38   | 1.56   | 1.01   | 0.10  | 1.11  | 0.54                   | 0.19                  |
| SLD00162                                 | 0.04   | 2.01   | 2.07   | 1.04   | 0.73   | 1.35   | 0.86   | 0.12  | 1.00  | 0.64                   | 0.23                  |
| SLD00181                                 | 0.03   | 1.13   | 2.24   | 0.73   | 0.94   | 1.34   | 0.78   | 0.00  | 0.91  | 0.62                   | 0.22                  |
| SLD00201                                 | 0.06   | 1.74   | 2.40   | 0.86   | 1.07   | 1.64   | 1.08   | 0.10  | 1.15  | 0.72                   | 0.26                  |
| SLD00202                                 | -0.10  | 1.73   | 2.67   | 0.97   | 0.88   | 1.62   | 0.78   | 0.05  | 1.11  | 0.75                   | 0.26                  |
| SLD00241                                 | 0.01   | -0.04  | 2.04   | 0.46   | 0.87   | 1.28   | 0.43   | 0.11  | 1.70  | 0.53                   | 0.20                  |
| SLD00242                                 | 0.07   | 0.42   | 2.50   | 0.89   | 0.80   | 1.05   | 0.80   | 0.00  | 0.92  | 0.70                   | 0.24                  |
| SLD00243                                 | 0.03   | 0.31   | 1.91   | 0.65   | 0.84   | 0.96   | 0.90   | 0.08  | 0.86  | 0.59                   | 0.21                  |

Note:

Results are expressed in pCi/g; sum of ratio (SOR) values are unitless.

Negative results are less than the laboratory system's background level.

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**APPENDIX B**  
**FINAL STATUS SURVEY SOIL SAMPLE DATA**

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Table B-1. DT-34 Final Status Survey Soil Data

| Station Name | Sample Name | Easting | Northing | Actinium-227 |        |       | Protactinium-231 |    |        | Radium-226 |      |    | Radium-228 |       |      | Thorium-228 |        |       | Thorium-230 |    |        | Thorium-232 |      |    | Uranium-235 |       |      | Uranium-238 |        |       |      |    |       |      |      |    |      |      |      |
|--------------|-------------|---------|----------|--------------|--------|-------|------------------|----|--------|------------|------|----|------------|-------|------|-------------|--------|-------|-------------|----|--------|-------------|------|----|-------------|-------|------|-------------|--------|-------|------|----|-------|------|------|----|------|------|------|
|              |             |         |          | VQ           | Result | Error | MDC              | VQ | Result | Error      | MDC  | VQ | Result     | Error | MDC  | VQ          | Result | Error | MDC         | VQ | Result | Error       | MDC  | VQ | Result      | Error | MDC  | VQ          | Result | Error | MDC  |    |       |      |      |    |      |      |      |
| HTZ95807     | HTZ95807    | 908877  | 1031312  | UJ           | -0.02  | 0.09  | 0.14             | UJ | 0.14   | 0.25       | 0.39 | =  | 1.08       | 0.27  | 0.03 | J           | 0.22   | 0.03  | 0.04        | J  | 0.92   | 0.49        | 0.28 | =  | 2.15        | 0.82  | 0.15 | J           | 0.43   | 0.33  | 0.28 | UJ | 0.01  | 0.11 | 0.18 | J  | 0.41 | 0.27 | 0.26 |
| HTZ95808     | HTZ95808    | 908899  | 1031220  | UJ           | -0.06  | 0.11  | 0.17             | UJ | 0.16   | 0.29       | 0.44 | =  | 1.28       | 0.33  | 0.04 | =           | 0.56   | 0.04  | 0.05        | J  | 1.02   | 0.52        | 0.36 | =  | 1.65        | 0.68  | 0.14 | J           | 0.37   | 0.29  | 0.14 | UJ | 0.03  | 0.15 | 0.24 | =  | 1.07 | 0.39 | 0.43 |
| HTZ95809     | HTZ95809    | 909182  | 1031335  | UJ           | -0.04  | 0.08  | 0.13             | UJ | 0.04   | 0.25       | 0.38 | =  | 0.91       | 0.24  | 0.03 | J           | 0.21   | 0.03  | 0.04        | J  | 0.32   | 0.25        | 0.26 | J  | 0.47        | 0.30  | 0.12 | J           | 0.52   | 0.31  | 0.12 | UJ | 0.02  | 0.11 | 0.18 | J  | 0.62 | 0.32 | 0.33 |
| HTZ95810     | HTZ95810    | 909074  | 1031796  | UJ           | -0.01  | 0.14  | 0.20             | UJ | -0.04  | 0.36       | 0.52 | =  | 2.37       | 0.60  | 0.05 | =           | 0.76   | 0.06  | 0.06        | =  | 0.98   | 0.48        | 0.25 | =  | 2.22        | 0.80  | 0.13 | J           | 0.78   | 0.42  | 0.25 | U  | 0.30  | 0.18 | 0.30 | =  | 2.12 | 0.56 | 0.50 |
| HTZ95811     | HTZ95811    | 908837  | 1031671  | UJ           | 0.05   | 0.10  | 0.15             | UJ | 0.08   | 0.25       | 0.37 | =  | 1.63       | 0.42  | 0.03 | J           | 0.19   | 0.03  | 0.04        | UJ | 0.21   | 0.21        | 0.27 | =  | 1.84        | 0.68  | 0.27 | UJ          | 0.17   | 0.19  | 0.23 | UJ | 0.03  | 0.13 | 0.21 | =  | 1.34 | 0.41 | 0.36 |
|              | HTZ95812    | 908837  | 1031671  | UJ           | -0.06  | 0.15  | 0.22             | U  | 0.56   | 0.35       | 0.58 | =  | 2.94       | 0.73  | 0.06 | =           | 0.79   | 0.05  | 0.06        | =  | 1.22   | 0.56        | 0.14 | =  | 2.71        | 0.93  | 0.14 | J           | 0.90   | 0.47  | 0.14 | UJ | 0.02  | 0.20 | 0.32 | =  | 2.39 | 0.59 | 0.55 |
| SLD97094     | SLD97094    | 908995  | 1031521  | UJ           | -0.09  | 0.09  | 0.14             | UJ | -0.07  | 0.26       | 0.38 | =  | 0.92       | 0.23  | 0.04 | =           | 0.36   | 0.03  | 0.05        | J  | 0.50   | 0.36        | 0.29 | =  | 1.39        | 0.64  | 0.39 | J           | 0.52   | 0.36  | 0.16 | UJ | 0.03  | 0.11 | 0.18 | J  | 0.53 | 0.27 | 0.25 |
|              | SLD97095    | 908995  | 1031521  | UJ           | -0.03  | 0.13  | 0.21             | UJ | 0.01   | 0.40       | 0.59 | =  | 1.13       | 0.29  | 0.05 | =           | 0.66   | 0.05  | 0.08        | =  | 0.91   | 0.44        | 0.27 | =  | 1.24        | 0.52  | 0.12 | J           | 0.49   | 0.31  | 0.12 | UJ | 0.15  | 0.17 | 0.27 | =  | 1.36 | 0.51 | 0.37 |
| SLD97096     | SLD97096    | 908915  | 1031345  | UJ           | 0.06   | 0.11  | 0.19             | UJ | -0.03  | 0.33       | 0.49 | =  | 0.71       | 0.19  | 0.05 | J           | 0.19   | 0.03  | 0.06        | U  | 0.30   | 0.29        | 0.38 | J  | 0.82        | 0.47  | 0.34 | J           | 0.17   | 0.20  | 0.15 | UJ | 0.04  | 0.15 | 0.24 | UJ | 0.22 | 0.36 | 0.64 |
|              | SLD97097    | 908915  | 1031345  | UJ           | 0.02   | 0.15  | 0.24             | UJ | 0.39   | 0.42       | 0.67 | =  | 1.23       | 0.32  | 0.06 | =           | 0.44   | 0.05  | 0.07        | J  | 0.95   | 0.53        | 0.17 | J  | 1.33        | 0.64  | 0.17 | J           | 0.81   | 0.49  | 0.32 | UJ | 0.03  | 0.19 | 0.30 | J  | 0.95 | 0.73 | 0.78 |
|              | SLD97098    | 908915  | 1031345  | UJ           | -0.12  | 0.18  | 0.27             | UJ | 0.15   | 0.50       | 0.77 | =  | 1.36       | 0.36  | 0.07 | =           | 0.81   | 0.07  | 0.09        | J  | 0.81   | 0.48        | 0.43 | J  | 1.40        | 0.64  | 0.16 | J           | 1.05   | 0.54  | 0.16 | UJ | 0.06  | 0.21 | 0.35 | J  | 2.15 | 1.26 | 0.92 |
|              | SLD97099    | 908915  | 1031345  | UJ           | -0.14  | 0.20  | 0.30             | UJ | 0.02   | 0.59       | 0.88 | =  | 1.35       | 0.36  | 0.08 | =           | 0.95   | 0.08  | 0.12        | =  | 1.11   | 0.50        | 0.24 | J  | 0.99        | 0.48  | 0.31 | =           | 0.89   | 0.44  | 0.13 | UJ | -0.03 | 0.28 | 0.41 | UJ | 0.30 | 0.66 | 1.15 |
| SLD97100     | SLD97100    | 908921  | 1031555  | UJ           | 0.06   | 0.15  | 0.22             | UJ | 0.10   | 0.37       | 0.64 | =  | 1.14       | 0.30  | 0.06 | J           | 0.30   | 0.05  | 0.08        | J  | 0.37   | 0.27        | 0.26 | J  | 1.04        | 0.46  | 0.12 | J           | 0.22   | 0.20  | 0.12 | UJ | -0.01 | 0.18 | 0.29 | J  | 1.06 | 0.65 | 0.68 |
|              | SLD97101    | 908921  | 1031555  | UJ           | 0.06   | 0.19  | 0.30             | UJ | 0.08   | 0.53       | 0.79 | =  | 1.62       | 0.42  | 0.08 | =           | 0.78   | 0.07  | 0.10        | =  | 1.06   | 0.50        | 0.13 | J  | 1.31        | 0.56  | 0.13 | J           | 0.87   | 0.44  | 0.13 | UJ | -0.07 | 0.24 | 0.39 | =  | 2.41 | 0.93 | 0.98 |
| SLD97102     | SLD97102    | 909026  | 1031670  | UJ           | 0.07   | 0.14  | 0.20             | UJ | -0.33  | 0.32       | 0.50 | =  | 1.51       | 0.38  | 0.05 | J           | 0.07   | 0.03  | 0.06        | J  | 0.26   | 0.24        | 0.14 | J  | 1.84        | 0.72  | 0.14 | UJ          | 0.05   | 0.11  | 0.14 | UJ | 0.05  | 0.17 | 0.28 | J  | 1.00 | 0.62 | 0.67 |
|              | SLD97103    | 909026  | 1031670  | UJ           | -0.02  | 0.14  | 0.22             | UJ | 0.03   | 0.35       | 0.60 | =  | 1.33       | 0.34  | 0.05 | =           | 0.34   | 0.05  | 0.06        | J  | 0.80   | 0.42        | 0.13 | J  | 1.36        | 0.57  | 0.13 | J           | 0.27   | 0.24  | 0.24 | UJ | 0.11  | 0.18 | 0.31 | =  | 2.04 | 0.79 | 0.71 |
| SLD97104     | SLD97104    | 909086  | 1031782  | UJ           | 0.03   | 0.14  | 0.22             | UJ | 0.02   | 0.35       | 0.59 | =  | 1.15       | 0.30  | 0.05 | J           | 0.28   | 0.04  | 0.07        | J  | 0.53   | 0.34        | 0.32 | J  | 1.46        | 0.59  | 0.13 | J           | 0.52   | 0.33  | 0.13 | U  | 0.19  | 0.17 | 0.29 | J  | 1.09 | 0.64 | 0.68 |
|              | SLD97105    | 909086  | 1031782  | UJ           | 0.07   | 0.20  | 0.28             | UJ | 0.04   | 0.52       | 0.78 | =  | 1.78       | 0.46  | 0.08 | =           | 0.68   | 0.07  | 0.09        | J  | 0.80   | 0.44        | 0.26 | J  | 1.86        | 0.72  | 0.31 | =           | 1.06   | 0.51  | 0.26 | UJ | 0.32  | 0.32 | 0.41 | =  | 1.70 | 0.72 | 0.99 |
|              | SLD97210    | 909086  | 1031782  | UJ           | 0.05   | 0.14  | 0.22             | UJ | 0.02   | 0.43       | 0.64 | =  | 1.37       | 0.34  | 0.05 | =           | 0.85   | 0.06  | 0.07        | J  | 0.99   | 0.51        | 0.15 | J  | 1.36        | 0.62  | 0.28 | J           | 0.99   | 0.51  | 0.   |    |       |      |      |    |      |      |      |

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## **APPENDIX C**

### **DETERMINATION OF THE MINIMUM NUMBER OF RANDOM SAMPLES**

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## DETERMINATION OF THE MINIMUM NUMBER OF RANDOM SAMPLES

The number of random soil samples estimated for the subject property was based on experience with other properties. The following retrospective analysis confirmed that an adequate number of random soil samples were collected.

To meet the minimum statistical requirements (i.e., WRS test) for each soil SU, MARSSIM provides guidance on determining the minimum number of samples. The necessary parameters for estimating the minimum number of samples and their values are:

- Type I error probability (probability of a false decision that the radionuclide RGs are met when they are actually not met)—set at 0.05 per the FSSP.
- Type II error probability (probability of a false decision that the radionuclide RGs are not met when they actually are met)—typically set at 0.20. FSSP-allowed values are 0.05 to 0.25.
- DCGL—set at  $SOR_N = 1.0$  per the ROD.
- Variability of the contaminant concentration (i.e., standard deviation [ $\sigma$ ])—set based upon engineering estimates for the SU per MARSSIM. Examples include calculating the effective standard deviation ( $\sigma_{eff}$ ) for multiple radionuclides using characterization or screening sample results from the SU, and using a historical effective standard deviation based on samples taken previously from other SUs within the SLDS sites.
- Lower bound of the gray region (LBGR)—set based upon engineering estimates for the SU per MARSSIM. Examples include using the mean  $SOR_N$  calculated from characterization or screening samples in the SU, and using half of the DCGL as an arbitrary, but reasonable, starting point per MARSSIM. The LBGR is the  $SOR_N$  value at which the Type II error is specified, and it is adjustable to achieve the desired relative shift ( $\Delta/\sigma_{eff}$ ) between 1 and 3, with up to 4 being acceptable.

Initially, for this FSSE, the calculation was performed using an assumed LBGR of 0.5 and a calculated effective standard deviation using characterization data. The effective standard deviation represents the variability of the contaminant concentration. This resulted in a minimum number of eight soil samples for SU-1. Because the number of characterization soil samples in the SU that were potentially usable for MARSSIM statistics was more than eight soil samples, valid characterization data could also be used as FSS data. As an additional check to ensure sufficient soil samples were collected, the calculation of the minimum number of soil samples was repeated for the SU with the LBGR set at the mean  $SOR_N$ . This calculation, using SU-1 FSS data, is presented below.

The first step in determining the number of soil samples to support the WRS test was to determine the effective standard deviation. The specific standard deviation values for SU-1 are: Ra-226 = 0.53; Th-230 = 0.39; Th-232 = 0.30; and U-238 = 0.72. Using these values, a conservative effective standard deviation was calculated using surface RGs even though some soil samples were taken below 15 cm (0.5 ft) bcm.

$$\sigma_{eff} = \sqrt{\left(\frac{\sigma_{Ra-226}}{DCGL_{Ra-226}}\right)^2 + \left(\frac{\sigma_{Th-230}}{DCGL_{Th-230}}\right)^2 + \left(\frac{\sigma_{Th-232}}{DCGL_{Th-232}}\right)^2 + \left(\frac{\sigma_{U-238}}{DCGL_{U-238}}\right)^2} = \sqrt{\left(\frac{0.53}{5}\right)^2 + \left(\frac{0.39}{5}\right)^2 + \left(\frac{0.30}{5}\right)^2 + \left(\frac{0.72}{50}\right)^2} = 0.15$$

The next step was to calculate the relative shift,  $\Delta/\sigma$ :

$$\frac{\Delta}{\sigma} = \frac{DCGL - LBGR}{\sigma_{eff}} = \frac{DCGL - SOR_N^{mean}}{\sigma_{eff}} \frac{1.0 - 0.01}{0.15} = 6.6$$

The calculated value for relative shift can be used to obtain the minimum number of samples/measurements necessary to satisfy requirements, using the MARSSIM equation presented below:

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

The calculated value, N, is the combined number of samples/measurements from the reference area and each SU.  $Z_{1-\alpha}$  and  $Z_{1-\beta}$  are critical values that can be found in MARSSIM Table 5.2, and  $P_r$  is a measure of probability available from MARSSIM Table 5.1. Because the calculated value for relative shift is 6.6,  $P_r = 1.0$  will be used to calculate N, per MARSSIM.

Normally,  $N/2$  samples/measurements are conducted in each SU and in the reference area. That is,  $N/2$  samples/measurements are conducted in *each SU and*  $N/2$  samples/measurements are conducted in the reference (background) area. However, the statistical methods are still valid if there are an unequal number of samples/measurements in the SUs and reference areas. A 20 percent increase in this number is recommended to account for lost or unusable samples/measurements. The calculated values apply to each SU.

The number of data points, N, for the WRS test of each combination of reference area and SU is calculated using Equation 5-1 and Table 5.1 in MARSSIM, given 5 percent Type I error and 20 percent Type II error.

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

$$N = \frac{(1.645 + 0.842)^2}{3(1.0 - 0.5)^2} = 8.2 = 9 \text{ Samples}$$

The uncertainty associated with the calculation, N, should be accounted for during survey planning; thus, the number of data points is increased by 20 percent and rounded up. This is in order to ensure there are sufficient data points to allow for any possible lost or unusable data.

$$N = 9 + 0.2(9) = 11 \text{ Samples}$$

The 11 samples include the combined samples/measurements from the reference area and one SU. Therefore, 6 samples/measurements are required in the reference area and 6 in each SU. The actual number of random soil samples collected in SU-1 was greater than 6.

Table C-1 lists the actual number of FSS surface soil samples collected and the minimum number of FSS soil surface samples for each SU. A sufficient number of soil samples were collected from the SU.

**Table C-1. Number of Random Final Status Survey Samples**

| SU   | Class | Minimum Number of Samples per MARSSIM | Number of Random Samples Collected |
|------|-------|---------------------------------------|------------------------------------|
| SU-1 | 3     | 6                                     | 9                                  |

**APPENDIX D**  
**GAMMA RADIATION WALKOVER SURVEY**

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## GAMMA RADIATION WALKOVER SURVEY

Many radioactive contaminants can be identified through field detection methods such as surface gamma radiation scans. (Field detection methods are generally not available for detection of non-radioactive contaminants, which solely rely on laboratory analysis of field soil samples.) While radioactive contaminants that emit gamma radiation can be detected through radiation scans, the contaminants are not the only radioactivity that may be detected. The gamma scans detect radiation from both naturally occurring sources and environmental contamination, and both are present in the GWS results.

A GWS is a qualitative tool that can help locate radioactive contamination. However, elevated GWS readings do not, in and of themselves, provide a definitive indication that the RGs are exceeded. There are no RGs specifying an unacceptable GWS result. Where there are higher levels of naturally occurring radioactivity, higher GWS readings will occur, even though the RGs are met. Such readings can be thought of as false positive results. Representative biased soil samples are collected and analyzed in a radioanalytical laboratory to investigate areas identified during the GWS. These areas are investigated to ensure the RGs are met in those areas. Unlike the GWS, the analytical laboratory can quantitatively identify the COC for comparison to the RGs.

Before starting the GWS, the professional health physics technicians established the relative background radiation level in counts per minute (cpm) for the specific survey area with the survey instrument being used. During the GWS, the technicians assessed the count rates displayed on the instrument and the associated audible click rates to identify locations (by paint or flag) from which representative biased soil samples should be obtained. The identified locations had radiation readings that typically exceeded the relative background radiation levels by 2,000 cpm or higher. Then, professional health physicists reviewed the results of the GWSs and defined locations from which any additional representative biased soil samples were collected.

This review considered count rates, mathematical analysis of the count rates, existing sample information in the area(s) of interest, increased radiation from materials with higher concentrations of naturally occurring radioactivity (such as granite, brick, some concrete, coal or coal ash, and road salt), increased radiation from soil located perpendicular to the surveyed surface (such as the side wall to an excavation or a hill or mound), attempts to duplicate higher count rates, and experience with variations in the radiation readings of soil. As an example of the wide variation of naturally occurring radioactivity in soil, the laboratory results for soil samples collected to establish background levels for the SLDS identified some soil samples with isotopic concentrations that were nearly twice the average.

This process resulted in five biased soil samples being collected based on the GWS. The results from these biased soil samples and all of the other soil samples are provided in Appendix E. *All of the biased soil samples met the RGs.*

The GWS figures were developed using a geographic information system. The GWS results (in count rates) and the location coordinates were translated into maps of colored data points. The range for the colors was calculated using the mean and standard deviation of the count rate from each GWS. The calculation also factors at what count rate a surveyor can distinguish an overall increase in fluctuating readings from the general level of fluctuating readings. The factor is calculated using equations from the *Minimum Detectable Concentrations with Typical Radiation*

*Survey Instruments for Various Contaminants and Field Conditions, U.S. Nuclear Regulatory Commission Regulation (NUREG) 1507 (NRC 1998).*

Because MARSSIM indicates that environmental data does not generally fit a normal distribution and uses non-parametric tests, Chebyshev's Inequality was used for setting the ranges of the colors for the GWS data. The 85<sup>th</sup> and 95<sup>th</sup> percentile of the data were chosen to focus on areas of interest with higher cpm. The 85<sup>th</sup> percentile means that 85 percent of the data have values less than the 85<sup>th</sup> percentile value; the 95<sup>th</sup> percentile is similarly defined. To achieve the 85<sup>th</sup> percentile of the data, a 1.83 factor for the standard deviation was calculated for each GWS file using Chebyshev's Inequality. To achieve the 95<sup>th</sup> percentile of the data, a 3.15 factor for the standard deviation was calculated using Chebyshev's Inequality. The NUREG 1507 factor for fluctuating readings was added to these percentile values to determine the color set points for each GWS file.

The area represented by red on the GWS figure indicates an area of interest. However, not every red data point is sampled. In some cases, a sampled location (soil) is representative of multiple areas of interest based on a professional health physicist review, as previously described. The gamma radiation readings represented on Figure D-1 are within the range of natural background radiation levels.

The following areas on DT-34 (i.e., areas represented by red on the GWS figure) were identified as having elevated counts during the GWS; however, no HTZ samples were collected in the area for the following reasons:

- The area of red/green located between the buildings and on the northern portion of the building in the southwest quadrant of the property was determined to be from the brick building construction.
- The area of red/green near the tank in the southwest quadrant of the property is an exposed concrete aggregate pad (the concrete in this area is from the 1800s and is of a different makeup than that of the surrounding concrete). This pad formerly housed a storage tank.
- The areas of red located on the northwest and northeast corners of the property are due to a granite curb located on these portions of the property.
- The area of red/green located between the buildings on the northern portion of the property was determined to be from the brick building construction.

The global positioning system used for the GWSs has inherent variability in identifying location coordinates. Some of the GWSs and soil samples may be, or may appear to be, outside the subject property or SU boundary due to structural interferences, and/or variance in the global positioning system and/or the geographical information system (GIS). Some sample station coordinates were obtained at a time other than the time the GWS was performed and the sample locations were painted or flagged. Thus, soil samples and their corresponding elevated GWS readings may have different coordinates and may be separated by several feet on the figures when, in reality, they are in the same location.

The GWS instruments and their detection sensitivities are listed in Table D-1, below. Detection sensitivities were determined following the guidance of NUREG 1507, and are derived in the FSSP. The sensitivities presented were derived using typical instrument parameters and are well below the RGs for soil, with the exception of Th-230. Because Ra-226 and Th-230 are

commingled, Ra-226 was used as a surrogate for Th-230. For each SU, the ratio of Ra-226 and Th-230 was confirmed to be high enough for Ra-226 to be a surrogate for Th-230, so Th-230 would be identified at levels below its RG.

Field instrumentation was calibrated annually and source-checked daily during use. In addition, daily field performance checks were conducted in accordance with instrument use procedures. The performance checks were conducted prior to initiating daily field activities, upon completion of daily field activities, and if the instrument response appeared questionable.

**Table D-1. Radiological Field Instrument Detection Sensitivity**

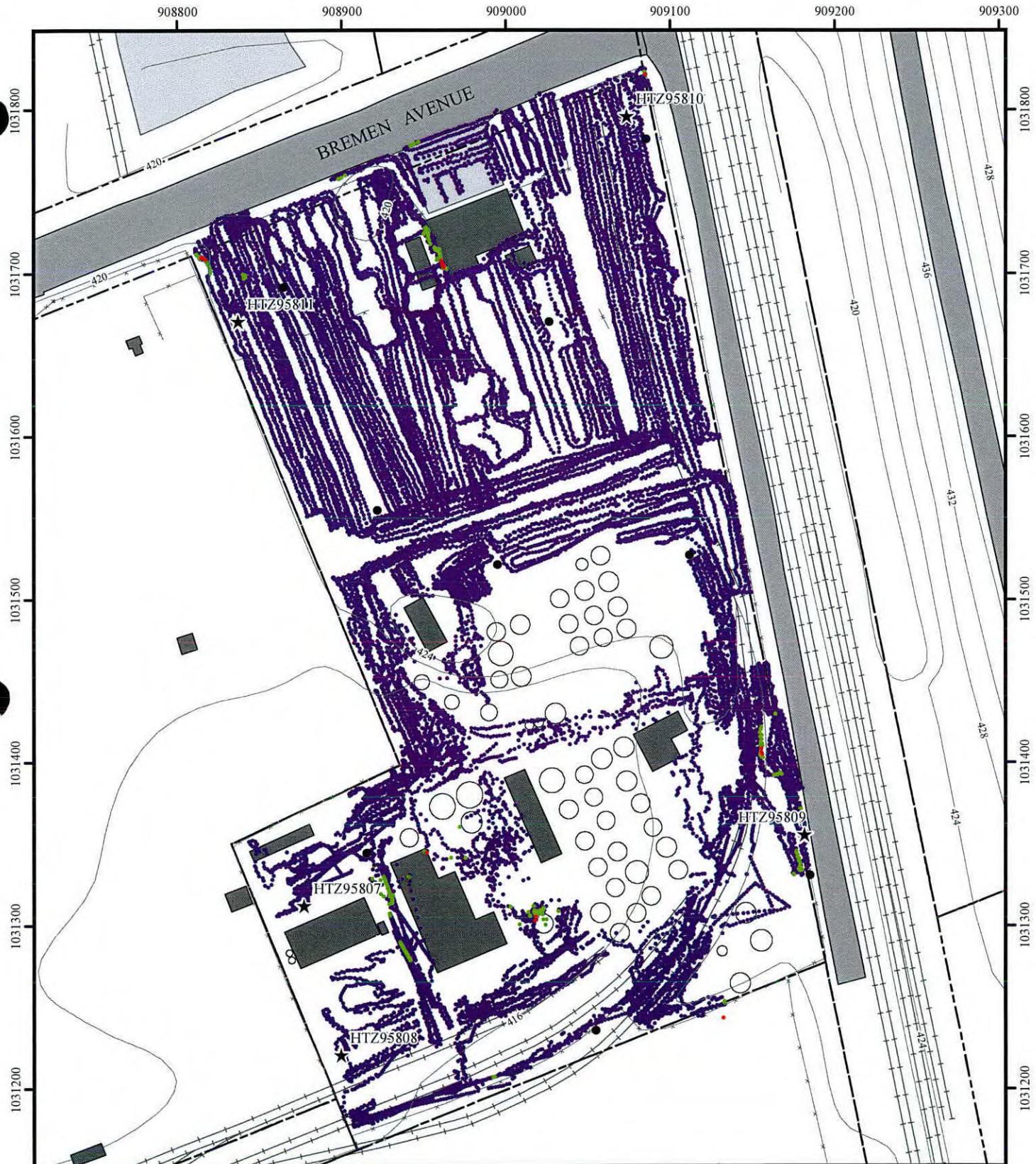
| Description  | Application                                      | Detection Sensitivity         |                                      |
|--|--|-------------------------------|--------------------------------------|
| Ludlum Model 2221 with a Ludlum Model 44-10 (2" x 2" sodium iodide (NaI) gamma scintillation detector) | Gamma scans of ground surface and cover material | Ra-226<br>Th-230<br>U-natural | 1.2 pCi/g<br>1,120 pCi/g<br>40 pCi/g |

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## **APPENDIX D**

### **FIGURE**

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**LEGEND:**

- ★ Biased Sample Locations
  - Class 3 Sample Locations
  - Property Boundary
  - \* Fence
  - Contours
  - + Railroad Track
  - Parking Lot CPM
  - Road
  - Building
  - Tank
  - Below 85th percentile
  - Between 85th and 95th percentile
  - Above 95th percentile
- Investigation warranted through collection of a biased sample from a specific location or biased samples that are representative of an entire area.

0 50 100 Feet

N  
W E S  
MO-East State Plane  
(NAD 83, Feet)

**DT-34**  
St. Louis Downtown Site  
St. Louis, Missouri

**FUSRAP**

|                            |           |                     |
|----------------------------|-----------|---------------------|
| DRAWN BY:<br>TDC, KLP, DLL | REV:<br>1 | DATE:<br>03/17/2011 |
|----------------------------|-----------|---------------------|

Figure D-1. DT-34 Gamma Walkover Survey

**APPENDIX E**  
**GAMMA WALKOVER SURVEY FILES**  
**(On CD-ROM on the Back Cover of this Report)**

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## **APPENDIX F**

### **EVALUATION OF FINAL STATUS SURVEY SOIL SAMPLE DATA**

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**Table F-1. Class 3 SU-1 Random Soil Data Summary**

|                                  |   |                                  |   |              |                      |
|----------------------------------|---|----------------------------------|---|--------------|----------------------|
| <b>Number of Random Samples:</b> | 9 | <b>Number of Biased Samples:</b> | 5 | <b>Area:</b> | 9,841 m <sup>2</sup> |
|----------------------------------|---|----------------------------------|---|--------------|----------------------|

| Statistic         | Type   | Ac-227 | Pa-231 | Ra-226 | Ra-228 | Th-228 | Th-230 | Th-232 | U-235 | U-238 | SOR <sub>G</sub> | SOR <sub>N</sub> |
|-------------------|--------|--------|--------|--------|--------|--------|--------|--------|-------|-------|------------------|------------------|
| Mean              | Random | 0.03   | 0.00   | 1.34   | 0.41   | 0.55   | 1.41   | 0.47   | 0.07  | 1.26  | 0.42             | 0.01             |
| Median            | Random | 0.06   | 0.02   | 1.15   | 0.36   | 0.50   | 1.39   | 0.52   | 0.05  | 1.09  | 0.40             | 0.00             |
| St. Dev.          | Random | 0.07   | 0.16   | 0.53   | 0.28   | 0.26   | 0.39   | 0.30   | 0.06  | 0.72  | 0.16             | 0.01             |
| Number of samples | Random | 9      | 9      | 9      | 9      | 9      | 9      | 9      | 9     | 9     | 9                | 9                |
| Maximum           | All    | 0.13   | 0.19   | 2.37   | 1.02   | 1.02   | 2.22   | 0.93   | 0.30  | 2.63  | 0.69             | 0.07             |
| Range             | All    | 0.13   | 0.19   | 1.67   | 0.95   | 0.82   | 1.75   | 0.88   | 0.30  | 2.41  | 0.48             | 0.07             |

| Sample/<br>Station<br>Name | Biased<br>Area<br>(m <sup>2</sup> ) | Type   | Ac-227 | Pa-231 | Ra-226 | Ra-228 | Th-228 | Th-230 | Th-232 | U-235 | U-238 | SOR <sub>G</sub> | SOR <sub>N</sub> |
|----------------------------|-------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|-------|-------|------------------|------------------|
| SLD97094                   | -                                   | Random | -0.09  | -0.07  | 0.92   | 0.36   | 0.50   | 1.39   | 0.52   | 0.03  | 0.53  | 0.39             | 0.00             |
| SLD97096                   | -                                   | Random | 0.06   | -0.03  | 0.71   | 0.19   | 0.30   | 0.82   | 0.17   | 0.04  | 0.22  | 0.21             | 0.00             |
| SLD97100                   | -                                   | Random | 0.06   | 0.10   | 1.14   | 0.30   | 0.37   | 1.04   | 0.22   | -0.01 | 1.06  | 0.31             | 0.00             |
| SLD97102                   | -                                   | Random | 0.07   | -0.33  | 1.51   | 0.07   | 0.26   | 1.84   | 0.05   | 0.05  | 1.00  | 0.40             | 0.00             |
| SLD97104                   | -                                   | Random | 0.03   | 0.02   | 1.15   | 0.28   | 0.53   | 1.46   | 0.52   | 0.19  | 1.09  | 0.42             | 0.00             |
| SLD97106                   | -                                   | Random | 0.13   | 0.19   | 2.21   | 0.68   | 1.02   | 1.92   | 0.93   | 0.10  | 1.98  | 0.67             | 0.01             |
| SLD97140                   | -                                   | Random | 0.07   | 0.18   | 1.26   | 0.41   | 0.55   | 1.38   | 0.54   | 0.02  | 1.37  | 0.41             | 0.00             |
| SLD97142                   | -                                   | Random | -0.04  | 0.06   | 1.03   | 0.36   | 0.48   | 1.08   | 0.39   | 0.08  | 1.49  | 0.32             | 0.00             |
| SLD97144                   | -                                   | Random | -0.07  | -0.13  | 2.17   | 1.02   | 0.94   | 1.80   | 0.87   | 0.12  | 2.63  | 0.69             | 0.04             |
| HTZ95807                   | 1                                   | Biased | -0.02  | 0.14   | 1.08   | 0.22   | 0.92   | 2.15   | 0.43   | 0.01  | 0.41  | 0.52             | 0.04             |
| HTZ95808                   | 1                                   | Biased | -0.06  | 0.16   | 1.28   | 0.56   | 1.02   | 1.65   | 0.37   | 0.03  | 1.07  | 0.46             | 0.00             |
| HTZ95809                   | 1                                   | Biased | -0.04  | 0.04   | 0.91   | 0.21   | 0.32   | 0.47   | 0.52   | 0.02  | 0.62  | 0.30             | 0.00             |
| HTZ95810                   | 1                                   | Biased | -0.01  | -0.04  | 2.37   | 0.76   | 0.98   | 2.22   | 0.78   | 0.30  | 2.12  | 0.67             | 0.07             |
| HTZ95811                   | 1                                   | Biased | 0.05   | 0.08   | 1.63   | 0.19   | 0.21   | 1.84   | 0.17   | 0.03  | 1.34  | 0.43             | 0.00             |

Notes:

Results are expressed in pCi/g.

SOR values are unitless.

Negative results are less than the laboratory system's background level.

All samples are surface samples, which were collected in the top 0.5 ft of soil.

**Table F-2. DT-34 SU-1 Subsurface Soil Summary**

| Number of Subsurface Samples: |  |  |  |  |  |  |  |  |  | 16 |  |
|-------------------------------|--|--|--|--|--|--|--|--|--|----|--|
|-------------------------------|--|--|--|--|--|--|--|--|--|----|--|

| Statistic         | Ac-227 | Pa-231 | Ra-226 | Ra-228 | Th-228 | Th-230 | Th-232 | U-235 | U-238 | SOR <sub>G</sub> | SOR <sub>N</sub> |
|-------------------|--------|--------|--------|--------|--------|--------|--------|-------|-------|------------------|------------------|
| Mean              | -0.03  | 0.06   | 1.75   | 0.76   | 1.04   | 1.66   | 0.97   | 0.06  | 1.64  | 0.22             | 0.02             |
| Median            | -0.02  | 0.02   | 1.42   | 0.80   | 1.02   | 1.38   | 1.02   | 0.04  | 1.49  | 0.21             | 0.01             |
| St. Dev.          | 0.08   | 0.20   | 0.78   | 0.22   | 0.30   | 0.68   | 0.37   | 0.10  | 0.69  | 0.07             | 0.04             |
| Number of samples | 16     | 16     | 16     | 16     | 16     | 16     | 16     | 16    | 16    | 16               | 16               |
| Maximum           | 0.11   | 0.56   | 4.16   | 1.09   | 1.64   | 3.61   | 1.75   | 0.32  | 3.27  | 0.43             | 0.16             |
| Range             | 0.11   | 0.56   | 3.03   | 0.78   | 1.24   | 2.62   | 1.48   | 0.32  | 2.97  | 0.27             | 0.16             |

| Sample Name | Station Name | Start Depth | End Depth | Ac-227 | Pa-231 | Ra-226 | Ra-228 | Th-228 | Th-230 | Th-232 | U-235 | U-238 | SOR <sub>G</sub> | SOR <sub>N</sub> |
|-------------|--------------|-------------|-----------|--------|--------|--------|--------|--------|--------|--------|-------|-------|------------------|------------------|
| SLD97095    | SLD97094     | 1.5         | 2.0       | -0.03  | 0.01   | 1.13   | 0.66   | 0.91   | 1.24   | 0.49   | 0.15  | 1.36  | 0.15             | 0.00             |
| SLD97097    |              | 1.5         | 2.0       | 0.02   | 0.39   | 1.23   | 0.44   | 0.95   | 1.33   | 0.81   | 0.03  | 0.95  | 0.16             | 0.00             |
| SLD97098    |              | 3.5         | 4.0       | -0.12  | 0.15   | 1.36   | 0.81   | 0.81   | 1.40   | 1.05   | 0.06  | 2.15  | 0.21             | 0.01             |
| SLD97099    |              | 5.5         | 6.0       | -0.14  | 0.02   | 1.35   | 0.95   | 1.11   | 0.99   | 0.89   | -0.03 | 0.30  | 0.16             | 0.00             |
| SLD97101    |              | 1.5         | 2.0       | 0.06   | 0.08   | 1.62   | 0.78   | 1.06   | 1.31   | 0.87   | -0.07 | 2.41  | 0.21             | 0.02             |
| SLD97103    | SLD97102     | 1.5         | 2.0       | -0.02  | 0.03   | 1.33   | 0.34   | 0.80   | 1.36   | 0.27   | 0.11  | 2.04  | 0.15             | 0.01             |
| SLD97105    |              | 1.5         | 2.0       | 0.07   | 0.04   | 1.78   | 0.68   | 0.80   | 1.86   | 1.06   | 0.32  | 1.70  | 0.23             | 0.01             |
| SLD97210    |              | 3.5         | 4.0       | 0.05   | 0.02   | 1.37   | 0.85   | 0.99   | 1.36   | 0.99   | 0.01  | 1.52  | 0.19             | 0.00             |
| SLD97211    |              | 5.5         | 6.0       | 0.02   | 0.22   | 1.76   | 0.89   | 0.84   | 1.23   | 1.19   | 0.11  | 1.35  | 0.22             | 0.01             |
| SLD97107    | SLD97104     | 1.5         | 2.0       | 0.02   | 0.13   | 1.45   | 0.79   | 1.46   | 0.99   | 1.32   | -0.05 | 1.46  | 0.21             | 0.02             |
| SLD97108    |              | 3.5         | 4.0       | -0.18  | 0.01   | 1.90   | 1.09   | 1.64   | 1.60   | 1.75   | 0.18  | 1.23  | 0.27             | 0.04             |
| SLD97109    |              | 5.5         | 6.0       | -0.13  | -0.22  | 1.38   | 0.91   | 1.19   | 1.65   | 1.19   | 0.00  | 1.24  | 0.21             | 0.01             |
| SLD97141    | SLD97140     | 1.5         | 2.0       | 0.11   | -0.13  | 1.25   | 0.31   | 0.40   | 1.98   | 0.44   | -0.03 | 1.32  | 0.19             | 0.00             |
| SLD97143    | SLD97142     | 1.5         | 2.0       | -0.06  | -0.08  | 1.91   | 0.92   | 1.04   | 1.89   | 1.10   | 0.11  | 1.55  | 0.23             | 0.00             |
| SLD97145    | SLD97144     | 1.5         | 2.0       | -0.05  | -0.20  | 4.16   | 0.95   | 1.42   | 3.61   | 1.27   | 0.12  | 3.27  | 0.43             | 0.16             |
| HTZ95812    | HTZ95811     | 0.5         | 1.0       | -0.06  | 0.56   | 2.94   | 0.79   | 1.22   | 2.71   | 0.90   | 0.02  | 2.39  | 0.30             | 0.07             |

Notes:

Depths are in feet.

Results are expressed in pCi/g.

SOR values are unitless.

Negative results are less than the laboratory system's background level.

**APPENDIX G**

**QUALITY CONTROL SUMMARY REPORT**

**(On CD-ROM on the Back Cover of this Report)**

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## **1.0 INTRODUCTION**

### **1.1 PROJECT DESCRIPTION**

This QCSR was performed on the soil samples collected for the FSSE on DT-34.

### **1.2 PROJECT OBJECTIVES**

The intent of the QCSR is to document the usability of the data based on project DQOs, precision, accuracy, representativeness, comparability, completeness, and sensitivity.

### **1.3 PROJECT IMPLEMENTATION**

The sampling was conducted in October 2006. Radiological analyses were conducted by the on-site FUSRAP laboratory at the Hazelwood Interim Storage Site (HISS) with QA split samples being analyzed by Test America (formerly Severn-Trent Laboratories).

### **1.4 PROJECT PURPOSE**

The primary intent of this assessment is to evaluate whether data generated from these samples can withstand scientific scrutiny, are appropriate for their intended purpose, are technically defensible, and are of known and acceptable sensitivity, precision, and accuracy.

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## 2.0    QUALITY ASSURANCE PROGRAM

A Quality Assurance Project Plan (QAPP) was developed for this project and is part of the SAG. The QAPP established requirements for both field and laboratory QC procedures. An analytical laboratory QC duplicate sample, a laboratory control sample (LCS), and a method blank were required for approximately every 20 field soil samples of each matrix.

A primary goal of the QA program is to ensure that the quality of measurements is appropriate for the intended use of the results. To this end, a QAPP and standardized field procedures were compiled to guide the investigation. Through the process of readiness review, training, equipment calibration, QC implementation, and detailed documentation, the project has successfully accomplished the goals set by the QA program.

The resulting "definitive" data, as defined by the USEPA, have been reported, including the following basic information:

- Laboratory case narratives
- Sample analytical data
- Laboratory method blank results
- Laboratory control standard results
- Laboratory duplicate sample results
- Tracer recoveries
- Sample extraction dates
- Sample analysis dates

This information provides the basis for an independent data evaluation relative to accuracy, precision, sensitivity, representativeness, comparability, and completeness, as discussed in the following sections.

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### 3.0 DATA VALIDATION

This project implemented the use of data validation checklists to facilitate laboratory data validation. These checklists were completed by the project-designated validation staff and were reviewed by the project laboratory coordinator. Data validation checklists or verification summaries for each laboratory sample delivery group have been retained with laboratory data deliverables by SAIC.

#### 3.1 LABORATORY DATA VALIDATION

Analytical data generated for this project have been subjected to a process of data verification, validation, and review. The SAG and the following documents establish the criteria against which the data are compared and from which a judgment is rendered regarding the acceptance and qualification of the data:

- *Department of Defense Quality Systems Manual for Environmental Laboratories* (DOD 2006).
- *USACE Kansas City and St. Louis District Radionuclide Data Quality Evaluation Guidance for Alpha and Gamma Spectroscopy* (USACE 2002b).
- *Data Validation Technical Procedures* (SAIC 2006).

Upon receipt of field and analytical data, verification staff performed a systematic examination of the reports to ensure the content, presentation, and administrative validity of the data. In conjunction with data package verification, laboratory electronic data deliverables were available. These data deliverables were subjected to review and verification against the hardcopy deliverable. Both a structural and technical assessment of the laboratory-delivered electronic reports were performed. The structural evaluation verified that required data had been reported and contract-specified requirements were met (i.e., analytical holding times, contractual turnaround times, etc.).

During the validation phase of the review and evaluation process, data were subjected to a systematic technical review by examining the field results, analytical QC results, and laboratory documentation, following appropriate guidelines provided in the previously referenced documents. These data validation guidelines define the technical review criteria, methods for evaluation of the criteria, and actions to be taken resulting from the review of these criteria. The primary objective of this phase was to assess and summarize the quality and reliability of the data for the intended use and to document factors that may affect the usability of the data. Data verification/validation included, but was not necessarily limited to, the following parameters for radiological methods, as appropriate:

- Holding time information and methods requested
- Discussion of laboratory analysis, including any laboratory problems
- Sample analytical data
- Initial calibration
- Efficiency check
- Background determinations
- Spike recovery results
- Internal standard results (tracers or carriers)
- Duplicate sample analytical results
- Self-absorption factor (for alpha and beta radioactivity)

- Cross-talk factor (during simultaneous detection of alpha and beta radioactivity)
- LCSs
- Run log

As an end result of this phase of the review, the data were qualified based on the technical assessment of the validation criteria. Validation qualifiers (VQs) were applied to each analytical result to indicate the usability of the data for its intended purpose, with a reason code to explain the retention or the qualifier.

### **3.2 DEFINITIONS OF DATA QUALIFIERS**

During the data validation process, all laboratory data were assigned appropriate data VQs and reason codes, as follows:

- “=” Positive result was obtained.
- “U” The material was analyzed for a COC, but it was not detected above the level of the associated value.
- “J” The associated value is an estimated quantity, indicating a decreased knowledge of the accuracy or precision of the reported value.
- “UJ” The analyte was analyzed for, but it was not detected above the minimum detectable value, and the reported value is an estimate, indicating a decreased knowledge of the accuracy or precision of the reported value.
- “R” The analyte value reported is unusable. The integrity of the analyte’s identification, accuracy, precision, or sensitivity has raised significant question as to the reliability of the information presented.

A positive result is flagged with a “J” qualifier, and a non-detect result is flagged “UJ” when data quality is suspect due to QC issues, either blank contamination or analytical interference. None of the laboratory data were assigned an “R” code. SAIC VQs, reason codes, copies of validation checklists, and qualified data forms are filed with the analytical hard copy deliverable.

## 4.0 DATA EVALUATION

The data evaluation process considers precision, accuracy, representativeness, completeness, comparability, and sensitivity. The following subsections will provide detail to the particular parameters and how the data were evaluated for each, with discussion and tables to present the associated data.

Accuracy and precision can be measured by the relative percent difference (RPD) for radiological analyses or the normalized absolute difference (NAD) for radiological analyses using the following equations:

$$RPD = \left( \frac{|S - D|}{\frac{S + D}{2}} \right) * 100$$

$$NAD = \frac{|S - D|}{\sqrt{U_S^2 + U_D^2}}$$

Where:  
 $S$  = Parent Sample Result  
 $D$  = Field Split/Duplicate Parent Sample Result  
 $U_S$  = Parent Sample Uncertainty  
 $U_D$  = Field Split/Duplicate Parent Sample Uncertainty

The RPD is calculated for all radiological sample-duplicate/split pairs, if a detectable result is reported for both the parent and the QA field split or field duplicate. For radiological samples, when the RPD is greater than 50 percent, the NAD is used to determine the precision of the method. NAD accounts for uncertainty in the results, RPD does not. The NAD should be equal to or less than a value of 1.96. Neither equation is used when the analyte in one or both of the samples is not detected. In cases where neither equation can be used, the comparison is counted as acceptable in the overall number of comparisons.

The USACE memorandum *SAG Implementation Guidance for Interpretation of QA Split Program* (USACE 2005b) states that a QA split sample should be collected and analyzed at a frequency of approximately 1 every 20 samples (5 percent). For radiological analyses, 3 split samples and 3 field duplicate samples were analyzed using both gamma and alpha spectrometry. These represent approximately 10 percent of the 30 systematic/random, biased, and their associated subsurface samples.

### 4.1 ACCURACY

Accuracy provides a gauge or measure of the agreement between an observed result and the true value for an analysis. For this report, accuracy is measured through the use of the field split samples through a comparison of the prime laboratory results versus the results of an independent laboratory.

#### 4.1.1 Radiological Parameters

Individual sample chemical yields and LCS recoveries were within the 25 percent criterion for the verification samples, as stated in the SAG. Therefore, the data can be used for their intended purpose.

#### 4.1.2 Inter-Laboratory Accuracy

As previously discussed, RPD and NAD were used to measure the analytical accuracy of split sample pairs for two radiological analytical groups (i.e., alpha spectroscopy and gamma spectroscopy). The split sample pairs were analyzed by the FUSRAP laboratory at the HISS and by an independent contract laboratory, Test America (formerly Severn Trent Laboratory). The ability to compare the results from the laboratories is subject to several factors, such as sample homogeneity, analytical methods, volume of sample, and, for radiological samples, the size of the uncertainty (reported as error) relative to the result (e.g., a low result near the detection limit may have an uncertainty close to or even higher than the result itself). Accuracy is affected by the size of the relative uncertainty in the result. Typically, as the result gets closer to the MDC, the relative uncertainty gets larger. Many of the sample results discussed in this report are close to the MDC.

The analytical accuracy between laboratories met the FSS goal of ensuring that 90 percent of the verification samples met the DQOs. For radiological analyses, the sample results comparison must be less than the 50 percent criteria for RPD, or be less than or equal to 1.96 for NAD, to meet the DQOs. For radiological analyses, 3 sample pairs were compared for 12 analytes, for a total of 36 comparisons. One comparison, or 2.8 percent, exceeded the criteria, as demonstrated in Tables G-1 and G-2, yielding 97.2 percent acceptance. This meets the SAG goal of 90 percent acceptance. The data are acceptable.

**Table G-1. Split Sample Accuracy Among Alpha Spectroscopy Analyses**

| Sample Name           | Thorium-228 |      | Thorium-230 |     | Thorium-232 |     |
|-----------------------|-------------|------|-------------|-----|-------------|-----|
|                       | RPD         | NAD  | RPD         | NAD | RPD         | NAD |
| SLD97097 / SLD97097-2 | 73.29       | 0.93 | 1.49        | NA  | 43.14       | NA  |
| SLD97141 / SLD97141-2 | 15.72       | NA   | 1.02        | NA  | 6.83        | NA  |
| SLD97142 / SLD97142-2 | 10.15       | NA   | 6.70        | NA  | 12.30       | NA  |

Notes:

NAD — Calculated for additional information when RPD greater than 50 percent.

Boldface — Values for RPD/NAD pairs exceed the control limits. Values not in boldface – pair meets the acceptance criteria.

NA — Not applicable; see other calculated value.

**Table G-2. Split Sample Accuracy Among Gamma Spectroscopy Analyses**

| Sample Name           | Actinium-227 |     | Americium-241 |     | Cesium-137 |     | Potassium-40 |             | Protactinium-231 |     | Radium-226 |     | Radium-228 |     | Uranium-235 |     | Uranium-238 |      |
|-----------------------|--------------|-----|---------------|-----|------------|-----|--------------|-------------|------------------|-----|------------|-----|------------|-----|-------------|-----|-------------|------|
|                       | RPD          | NAD | RPD           | NAD | RPD        | NAD | RPD          | NAD         | RPD              | NAD | RPD        | NAD | RPD        | NAD | RPD         | NAD | RPD         | NAD  |
| SLD97097 / SLD97097-2 | NC           | NC  | NC            | NC  | NC         | NC  | 23.20        | NA          | NC               | NC  | 14.85      | NA  | 16.89      | NA  | NC          | NC  | 23.46       | NA   |
| SLD97141 / SLD97141-2 | NC           | NC  | NC            | NC  | NC         | NC  | <b>50.05</b> | <b>2.19</b> | NC               | NC  | 47.52      | NA  | NC         | NC  | NC          | NC  | 38.91       | NA   |
| SLD97142 / SLD97142-2 | NC           | NC  | NC            | NC  | NC         | NC  | 43.64        | NA          | NC               | NC  | 48.19      | NA  | NC         | NC  | NC          | NC  | 60.26       | 1.04 |

Notes:

NAD — Calculated for additional information when RPD greater than 50 percent.

Boldface — Values for RPD/NAD pairs exceed the control limits. Values not in boldface – pair meets the acceptance criteria.

NC — Value cannot be calculated because the radionuclide was not detected in one or both of the samples.

NA — Not applicable; see other calculated value.

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## 4.2 PRECISION

### 4.2.1 Analytical Precision

Precision is a measure of mutual agreement among individual measurements performed under the same laboratory controls. To evaluate precision, a field duplicate sample is submitted to the HISS laboratory along with the original sample. Both samples are analyzed under the same laboratory conditions. If any bias was introduced at the laboratory, that bias would affect both samples equally.

Field duplicate samples were employed at a frequency of approximately 1 duplicate sample per 20 samples. As a measure of analytical precision, the RPDs for these field duplicate sample pairs for the two radiological analytical groups (i.e., alpha spectroscopy and gamma spectroscopy) were calculated at the time of verification and validation. RPD (and/or NAD) values for all analytes were within the 50 percent window (or less than or equal to 1.96) of acceptance for the verification samples, except where noted.

### 4.2.2 System Precision

Field duplicate samples were collected to ascertain the contribution to variability (i.e., precision) due to the combination of environmental media, sampling consistency, and analytical precision that contribute to the precision for the entire system of collecting and analyzing samples. The field duplicate samples were collected from the same spatial and temporal conditions as the primary environmental sample. Soil samples were collected from the same sampling device, after homogenization for all analytes.

For the 3 duplicate samples taken for the verification activities, the NAD and RPD values indicated acceptable precision for the data. For radiological analyses, 12 analytes were compared for 3 duplicate pairs, for a total of 36 comparisons. All comparisons were within the criteria, as demonstrated in Tables G-3 and G-4, yielding 100 percent acceptance. This meets the SAG goal of 90 percent acceptance. The data are acceptable.

**Table G-3. Duplicate Precision Among Alpha Spectroscopy Analyses**

| Sample Name           | Thorium-228 |     | Thorium-230 |      | Thorium-232 |      |
|-----------------------|-------------|-----|-------------|------|-------------|------|
|                       | RPD         | NAD | RPD         | NAD  | RPD         | NAD  |
| SLD97097 / SLD97097-1 | 48.92       | NA  | 10.28       | NA   | 60.42       | 0.65 |
| SLD97141 / SLD97141-1 | 9.47        | NA  | 26.29       | NA   | NC          | NC   |
| SLD97142 / SLD97142-1 | 16.57       | NA  | 50.52       | 0.90 | 43.30       | NA   |

Notes:

NAD calculated for additional information when RPD greater than 50 percent.

Boldface – Values for RPD/NAD pairs exceed the control limits. Values not in boldface – pair meets the acceptance criteria.

NC – Value not calculated because the radionuclide was not detected in one or both of the samples.

NA – Not applicable; see other calculated value.

**Table G-4. Duplicate Precision Among Gamma Spectroscopy Analyses**

| Sample Name           | Actinium-227 |     | Americium-241 |     | Cesium-137 |     | Potassium-40 |     | Protactinium-231 |     | Radium-226 |     | Radium-228 |     | Uranium-235 |     | Uranium-238 |     |
|-----------------------|--------------|-----|---------------|-----|------------|-----|--------------|-----|------------------|-----|------------|-----|------------|-----|-------------|-----|-------------|-----|
|                       | RPD          | NAD | RPD           | NAD | RPD        | NAD | RPD          | NAD | RPD              | NAD | RPD        | NAD | RPD        | NAD | RPD         | NAD | RPD         | NAD |
| SLD97097 / SLD97097-1 | NC           | NC  | NC            | NC  | NC         | NC  | 12.02        | NA  | NC               | NC  | 7.06       | NA  | 4.45       | NA  | NC          | NC  | 1.59        | NA  |
| SLD97141 / SLD97141-1 | NC           | NC  | NC            | NC  | 38.87      | NA  | 23.64        | NA  | NC               | NC  | 3.25       | NA  | 5.90       | NA  | NC          | NC  | 32.80       | NA  |
| SLD97142 / SLD97142-1 | NC           | NC  | NC            | NC  | 16.07      | NA  | 11.19        | NA  | NC               | NC  | 1.96       | NA  | 4.01       | NA  | NC          | NC  | 25.76       | NA  |

Notes:

NAD calculated for additional information when RPD greater than 50 percent.

Boldface – Values for RPD/NAD pairs exceed the control limits. Values not in boldface – pair meets the acceptance criteria.

NC – Value not calculated because the radionuclide was not detected in one or both of the samples.

NA — Not applicable; see other calculated value.

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### **4.3 SENSITIVITY**

Determination of MDC values allows the investigation to assess the relative confidence that can be placed in a value in comparison to the magnitude or level of analyte concentration observed. The closer a measured value comes to the MDC, the less confidence and more variation the measurement will have. Project sensitivity goals were expressed as quantitation level goals in the FSSP. These levels were achieved or exceeded throughout the analytical process.

The MDC is reported for each result obtained by laboratory analysis. These very low MDCs are achieved through the use of gamma spectroscopy for all radionuclides of concern, with additional analyses from alpha spectroscopy for thorium. Variations in MDCs for the same radiological analyte reflect variability in the detection efficiencies and conversion factors due to factors such as individual sample aliquot, sample density, and variations in analyte background radioactivity for gamma and alpha spectroscopy, at the laboratory. In order to complete the Data Evaluation (i.e. precision, accuracy, representativeness, and comparability), analytical results are desired that exceed the MDC of the analyte.

### **4.4 REPRESENTATIVENESS AND COMPARABILITY**

Representativeness expresses the degree to which data accurately reflect the analyte or parameter of interest for an environmental site and is the qualitative term most concerned with the proper design of a sampling program. Factors that affect the representativeness of analytical data include proper preservation, holding times, use of standard sampling and analytical methods, and determination of matrix or analyte interferences. Sample preservation, analytical methodologies, and soil sampling methodologies were documented to be adequate and consistently applied.

Comparability, like representativeness, is a qualitative term relative to a project data set as an individual. These investigations employed appropriate sampling methodologies, site surveillance, use of standard sampling devices, uniform training, documentation of sampling, standard analytical protocols/procedures, QC checks with standard control limits, and universally accepted data reporting units to ensure comparability to other data sets. Through the proper implementation and documentation of these standard practices, the project has established the confidence that the data will be comparable to other project and programmatic information.

Tables G-5 and G-6 present the duplicate and split results used in comparison with associated parent sample results for alpha spectroscopy and gamma spectroscopy, respectively. In Table G-6, the Ra-226 results reported by the FUSRAP laboratory automatically include an upward adjustment factor of 1.5 for all samples analyzed after February 20, 2002. The adjustment is necessary to conservatively account for Ra-226 in-growth and to provide proper comparability with the independent laboratory.

### **4.5 COMPLETENESS**

Acceptable results are defined as those data that pass individual scrutiny during the verification and validation process and are accepted for unrestricted use. The DQO of achieving 90 percent completeness, as defined in the FSSP, was satisfied, with the project producing valid results for 100 percent of the sample analyses performed and successfully collected.

A total of 9 systematic/random, 5 biased, and 16 subsurface soil samples were collected, with approximately 360 discrete analyses being obtained, reviewed, and integrated into the assessment. The project produced acceptable results for 100 percent of the sample analyses performed.

**Table G-5. Alpha Spectroscopy Results for Parent Samples and Associated Split and Duplicate Samples**

| Sample Name | Thorium-228 |       |      |    | Thorium-230 |       |      |    | Thorium-232 |       |      |    |
|-------------|-------------|-------|------|----|-------------|-------|------|----|-------------|-------|------|----|
|             | Result      | Error | MDC  | VQ | Result      | Error | MDC  | VQ | Result      | Error | MDC  | VQ |
| SLD97097    | 0.95        | 0.53  | 0.17 | J  | 1.33        | 0.64  | 0.17 | J  | 0.81        | 0.49  | 0.32 | J  |
| SLD97097-1  | 0.58        | 0.35  | 0.13 | J  | 1.20        | 0.53  | 0.13 | =  | 0.43        | 0.30  | 0.13 | J  |
| SLD97097-2  | 0.44        | 0.14  | 0.07 | =  | 1.35        | 0.29  | 0.05 | =  | 0.52        | 0.16  | 0.06 | =  |
| SLD97141    | 0.40        | 0.33  | 0.37 | J  | 1.98        | 0.77  | 0.15 | =  | 0.44        | 0.32  | 0.15 | J  |
| SLD97141-1  | 0.36        | 0.28  | 0.24 | J  | 1.52        | 0.62  | 0.28 | =  | 0.04        | 0.10  | 0.24 | UJ |
| SLD97141-2  | 0.34        | 0.15  | 0.12 | =  | 1.96        | 0.40  | 0.07 | =  | 0.41        | 0.15  | 0.05 | =  |
| SLD97142    | 0.48        | 0.30  | 0.12 | J  | 1.08        | 0.48  | 0.12 | =  | 0.39        | 0.27  | 0.12 | J  |
| SLD97142-1  | 0.56        | 0.33  | 0.12 | J  | 1.81        | 0.66  | 0.22 | =  | 0.60        | 0.34  | 0.12 | J  |
| SLD97142-2  | 0.43        | 0.18  | 0.17 | =  | 1.01        | 0.24  | 0.06 | =  | 0.44        | 0.15  | 0.05 | =  |

Notes:

Results are expressed in pCi/g.

Samples ending in “-1” are duplicate samples.

Samples ending in “-2” are split samples.

**Table G-6. Gamma Spectroscopy Results for Parent Samples and Associated Split and Duplicate Samples**

| Sample Name | Actinium-227 |       |      |    | Americium-241 |       |      |    | Cesium-137 |       |      |    | Potassium-40 |       |      |    | Protactinium-231 |       |      |    | Radium-226 |       |      |    | Radium-228 |       |      |    | Uranium-235 |       |      |    | Uranium-238 |      |      |   |
|-------------|--------------|-------|------|----|---------------|-------|------|----|------------|-------|------|----|--------------|-------|------|----|------------------|-------|------|----|------------|-------|------|----|------------|-------|------|----|-------------|-------|------|----|-------------|------|------|---|
|             | Result       | Error | MDC  | VQ | Result        | Error | MDC  | VQ | Result     | Error | MDC  | VQ | Result       | Error | MDC  | VQ | Result           | Error | MDC  | VQ | Result     | Error | MDC  | VQ | Result     | Error | MDC  | VQ | Result      | Error | MDC  | VQ |             |      |      |   |
| SLD97097    | 0.02         | 0.15  | 0.24 | UJ | 0.01          | 0.06  | 0.09 | UJ | 0.00       | 0.01  | 0.03 | UJ | 6.02         | 0.59  | 0.18 | =  | 0.39             | 0.42  | 0.67 | UJ | 1.23       | 0.32  | 0.06 | =  | 0.44       | 0.05  | 0.07 | =  | 0.03        | 0.19  | 0.30 | UJ | 0.95        | 0.73 | 0.78 | J |
| SLD97097-1  | 0.02         | 0.10  | 0.16 | UJ | 0.01          | 0.03  | 0.04 | UJ | 0.01       | 0.01  | 0.01 | UJ | 6.79         | 0.53  | 0.12 | =  | -0.15            | 0.29  | 0.41 | UJ | 1.32       | 0.34  | 0.04 | =  | 0.46       | 0.04  | 0.05 | =  | 0.02        | 0.14  | 0.22 | UJ | 0.93        | 0.46 | 0.39 | = |
| SLD97097-2  | -0.02        | 0.29  | 0.43 | UJ | 0.06          | 0.10  | 0.17 | UJ | 0.03       | 0.05  | 0.10 | UJ | 7.60         | 1.70  | 0.90 | =  | -0.40            | 1.00  | 1.70 | UJ | 1.06       | 0.20  | 0.16 | =  | 0.52       | 0.19  | 0.33 | =  | 0.04        | 0.22  | 0.40 | UJ | 1.20        | 0.56 | 1.10 | = |
| SLD97141    | 0.11         | 0.12  | 0.17 | UJ | 0.00          | 0.03  | 0.04 | UJ | 0.08       | 0.01  | 0.01 | =  | 6.67         | 0.53  | 0.11 | =  | -0.13            | 0.30  | 0.43 | UJ | 1.25       | 0.32  | 0.04 | =  | 0.31       | 0.04  | 0.05 | =  | -0.03       | 0.15  | 0.24 | UJ | 1.32        | 0.37 | 0.40 | = |
| SLD97141-1  | 0.08         | 0.10  | 0.17 | UJ | 0.02          | 0.03  | 0.04 | UJ | 0.05       | 0.01  | 0.01 | =  | 5.26         | 0.46  | 0.11 | =  | 0.01             | 0.29  | 0.43 | UJ | 1.21       | 0.31  | 0.04 | =  | 0.30       | 0.03  | 0.05 | =  | 0.01        | 0.14  | 0.23 | UJ | 0.95        | 0.38 | 0.40 | = |
| SLD97141-2  | 0.01         | 0.20  | 0.31 | UJ | -0.02         | 0.08  | 0.12 | UJ | -0.01      | 0.05  | 0.09 | UJ | 4.00         | 1.10  | 0.60 | =  | -0.55            | 0.79  | 1.30 | UJ | 0.77       | 0.16  | 0.12 | =  | 0.10       | 0.19  | 0.38 | UJ | 0.07        | 0.17  | 0.31 | UJ | 0.89        | 0.29 | 0.66 | = |
| SLD97142    | -0.04        | 0.10  | 0.16 | UJ | 0.01          | 0.03  | 0.04 | UJ | 0.09       | 0.02  | 0.01 | =  | 6.70         | 0.55  | 0.12 | =  | 0.06             | 0.31  | 0.47 | UJ | 1.03       | 0.27  | 0.04 | =  | 0.36       | 0.04  | 0.05 | =  | 0.08        | 0.14  | 0.24 | UJ | 1.49        | 0.41 | 0.37 | = |
| SLD97142-1  | -0.07        | 0.09  | 0.14 | UJ | 0.00          | 0.03  | 0.04 | UJ | 0.08       | 0.01  | 0.01 | =  | 5.99         | 0.49  | 0.12 | =  | -0.08            | 0.27  | 0.39 | UJ | 1.01       | 0.27  | 0.03 | =  | 0.34       | 0.03  | 0.04 | =  | 0.05        | 0.13  | 0.21 | UJ | 1.15        | 0.37 | 0.36 | = |
| SLD97142-2  | -0.39        | 0.25  | 0.29 | UJ | -0.07         | 0.05  | 0.08 | UJ | 0.03       | 0.05  | 0.09 | UJ | 4.30         | 1.10  | 0.80 | =  | 0.15             | 0.83  | 1.50 | UJ | 0.63       | 0.15  | 0.14 | =  | 0.36       | 0.20  | 0.45 | U  | -0.05       | 0.14  | 0.25 | UJ | 0.80        | 0.52 | 0.75 | J |

Notes:

Results are expressed in pCi/g.

Negative results are less than the laboratory system's background level.

Samples ending in "-1" are duplicate samples.

Samples ending in "-2" are split samples.

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## 5.0 DATA QUALITY ASSESSMENT SUMMARY

The overall quality of this data meets or exceeds the established project objectives. Through proper implementation of the project data verification, validation, and assessment process, project information has been determined to be acceptable for use.

Sample data, as presented, have been qualified as usable, but estimated when necessary. Data that have been estimated have concentrations/activities that are below the quantitation limit or are indicative of accuracy, precision, or sensitivity being less than desired but adequate for interpretation. Comparisons that have exceeded the requirements have bolded type in associated tables. There are numerous possibilities for these anomalies:

- Dilution of a sample due to high analyte concentration(s) that exceed analytical calibration(s);
- Excessive dilution for sample turbidity or other matrix issues that was deemed necessary for a laboratory analysis;
- Incomplete sample homogenization, either at the laboratory or during the field sampling;
- Matrix interferences within the sample itself that caused inadequate analytical quantitation;
- Different preparation methods for associated split samples at different laboratories;
- Different analytical methods for associated split samples at different laboratories; and
- Concentration of an analyte being below the calibration range or near the method detection limit for that analyte; etc.

Further analysis of the data can display trends or even randomness within the data set that could be explained with one or more of the previously mentioned contributors to anomalies. For instance, a single split sample pair analyzed at two different laboratories for which the RPD was not met for any analyte could be an indicator of incomplete homogenization in the field, matrix effects in the sample, use of different preparation methods, dilutions that were required to overcome sample concentration, or analyte concentrations approaching the method detection limit. Precision and/or accuracy anomalies occurring for some analytes, but not for others, could be the result of a simple matrix effect causing poor quantitation of a sample, or perhaps low concentrations of those analytes. When considering split sample data, if a laboratory has numerous "out of specification" data for a certain analyte(s) versus the corresponding data produced by another laboratory, differences in sample preparation by the laboratories in question, or perhaps differences in instrument calibrations, could be considered as potential causes for differences in data quality for the specific analyte(s) in question. Exceedance by one laboratory of the RPD acceptance criterion for an analyte measured in a duplicate sample pair, for which the same duplicate analysis at another laboratory produced results for which the RPD was within the same acceptance limit, could be attributed to randomness of quantitation within the analysis.

The *Department of Defense Quality Systems Manual for Environmental Laboratories (DOD QSM)* (DOD 2006) defines allowable marginal exceedances as 10 percent of the total analysis for random anomalies that occur during regular laboratory analysis. As presented in this report, there are 72 total comparisons with 1 exceedance, resulting in a marginal exceedance rate of 1.39 percent. This is well within the *DOD QSM* 10 percent allowance for marginal exceedances. The

allowable marginal exceedance requirements for the project have been met, with more than 90 percent of the data being within acceptance limits, while allowing for some noticeable trends and randomness of anomalous exceedances between laboratories.

Data evaluated by this QCSR demonstrate that they can withstand scientific scrutiny, are appropriate for their intended purpose, are technically defensible, and are of known and acceptable sensitivity, precision, and accuracy. Data integrity has been documented through proper implementation of QA/QC measures. The environmental information presented has an established confidence, which allows utilization for the project objectives and provides data for future needs.

**APPENDIX H**  
**RISK AND DOSE ASSESSMENT**

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## RISK AND DOSE ASSESSMENT

### RISK AND DOSE ASSESSMENT MODEL

RESRAD (RESidual RADioactivity) is a computer model developed by the Argonne National Laboratory (ANL) for the DOE. RESRAD calculates site-specific risk and dose to various future hypothetical on-site receptors at sites that are contaminated with residual radioactive materials. The use of RESRAD codes for modeling risk and dose has become an acceptable industry practice among prominent federal agencies. For example:

- The USEPA used RESRAD in its “Reassessment of Radium and Thorium Soil Concentrations and Annual Dose Rates” (USEPA 1996), which demonstrated the protectiveness of the Uranium Mill Tailing Radiation Control Act soil criteria, and in its rulemaking for cleanup of sites contaminated with radioactivity.
- Seven U.S. Cabinet-level agencies, including the USEPA, DOE, NRC, and DOD, functioning as the Interagency Steering Committee on Radiation Standards, formally accepted RESRAD-BIOTA.
- The USEPA was also a signatory to the ROD, which used RESRAD in its development. The USEPA has participated in many other CERCLA actions involving RESRAD.

Version 6.3 was used to calculate potential risk and dose to the scenario receptor. Residual risk and dose assessments for the ROD were performed using RESRAD Version 5.62. RESRAD 5.62 incorporates the morbidity slope factors from the *Health Effects Assessment Summary Tables (HEAST)*, Table 4 (USEPA 1995), whereas RESRAD 6.3 incorporates morbidity slope factors from the *Cancer Risk Coefficients for Environmental Exposure to Radionuclides* (USEPA 1999) that are pathway specific.

### RECEPTOR SCENARIO

The input parameters selected for the utility and industrial worker scenarios are those defined in the FS. The exposure parameters selected for the on-site residential receptor scenario are those defined for the on-site residential receptor in the *Post-Remedial Action Report for the Accessible Soils within the St. Louis Downtown Site Plant 2 Property* (USACE 2002c). Input parameters for the hydrological data (site soil and water properties) for all scenarios were selected or determined from the *Baseline Risk Assessment for Exposure to Contaminants at the St. Louis Site* (DOE 1993), the FS, and RESRAD guidance.

Each receptor scenario is summarized as follows:

- Industrial Worker: The industrial worker is modeled as a typical site worker who spends most of the time indoors. The worker is at the property for 250 days per year for 25 years. During a standard year, the industrial worker is assumed to spend 1,600 hours indoors and 400 hours outdoors, plus 125 hours (0.5 hour per day) indoors to account for the possibility of eating lunch on site, early daily arrival, and late daily departure.
- Utility Worker: The utility worker may participate in utility work or other intrusive outdoor activities at the property. It is assumed that the utility worker is exposed in a single event that takes place over an 80-hour period.

- On-Site Residential Receptor: The on-site residential receptor is modeled as a potential future receptor in case the current land use areas being assessed change to residential. From the *Risk Assessment Guidance for Superfund: Volume 1—Human Health Evaluation Manual* (USEPA 1989), the residential receptor is assumed to live on site for 350 days per year for 30 years. The resident is assumed to spend 16.4 hours indoors and 2.0 hours outdoors each day, per the *Exposure Factors Handbook, Volumes I, II, and III* (USEPA 1997b). Among outdoor activities, the resident is assumed to spend 0.2 hours each day gardening.

The exposure pathways applicable to the radiological risk and dose assessment are external gamma, inhalation, and soil ingestion for the three scenarios, with plant ingestion added for the on-site resident scenario. Because ground water is not a potential source of drinking water for the SLDS, the drinking water pathway is not considered a potential pathway for the property (USACE 1998a). The non-default RESRAD input parameters for the receptor scenarios are presented in Table H-1.

**Table H-1. RESRAD Non-Default Input Parameters**

| Category                                | Parameter   | Values               |                     |                   |
|---|---|----------------------|---------------------|-------------------|
| Physical Parameters                     | Area of Contaminated Zone ( $m^2$ )                   | Non-HTZ Area         | 9,841               |                   |
|   |   | HTZ Area             | 5                   |                   |
|   |   | Combined Area        | 9,846               |                   |
| Cover Parameters                        | Thickness of the Contaminated Zone (m)                |                      | 2                   |                   |
|   | Cover Depth (m)                                       |                      | 0                   |                   |
|   | Density of the Cover Material ( $g/cm^3$ )            |                      | Not Applicable      |                   |
| Hydrological Data for Contaminated Zone | Cover Erosion Rate (m per year)                       |                      | Not Applicable      |                   |
|   | Density of Contaminated Zone ( $g/cm^3$ )             |                      | 1.28 (Clay Loam)    |                   |
|   | Contaminated Zone Total Porosity (unitless)           |                      | 0.42 (Clay Soil)    |                   |
|   | Contaminated Zone Field Capacity (unitless)           |                      | 0.36                |                   |
|   | Contaminated Zone Hydraulic Conductivity (m per year) |                      | 3.048               |                   |
|   | Contaminated Zone b parameter (unitless)              |                      | 10.4                |                   |
|   | Wind Speed (m per second)                             |                      | 4.17                |                   |
|   | Precipitation (m per year)                            |                      | 0.92                |                   |
|   | Irrigation (m per year)                               |                      | 0                   |                   |
|   | Run-off Coefficient (unitless)                        |                      | 0.8 (Built-Up Area) |                   |
|   | Contaminated Zone Erosion Rate (m per year)           |                      | 0.00006             |                   |
| Exposure Parameters                     |   | On-Site Resident     | Utility Worker      | Industrial Worker |
|   | Inhalation Rate ( $m^3/yr$ )                          | 8,400                | 10,550              | 10,550            |
|   | Mass Loading for Inhalation ( $g/m^3$ )               | $5.9 \times 10^{-6}$ | 0.0002              | 0.0002            |
|   | Exposure Duration (year)                              | 30                   | 1                   | 25                |
|   | Indoor Dust Filtration Factor (unitless)              | 0.5                  | 0.5                 | 0.5               |
|   | External Gamma Shielding Factor                       | 0.7                  | 0.7                 | 0.7               |
|   | Indoor Time Fraction <sup>a</sup> (unitless)          | 0.655                | 0                   | 0.1969            |
|   | Outdoor Time Fraction <sup>b</sup> (unitless)         | 0.0799               | 0.0091              | 0.04566           |
|   | Fruit, Vegetable, and Grain Consumption (kg per year) | 42.7                 | Not Applicable      | Not Applicable    |
|   | Leafy Vegetable Consumption (kg per year)             | 4.66                 | Not Applicable      | Not Applicable    |
|   | Soil Ingestion (g per year)                           | 43.8                 | 175.2               | 49.64             |

<sup>a</sup> Fraction of Time Indoor per year (On-Site Resident) = (16.4 hours/day \* 350 days/year) / (24 hours/day \* 365 days/year) = 0.655

<sup>b</sup> Fraction of Time Outdoor per year (On-Site Resident) = (2 hours/day \* 350 days/year) / (24 hours/day \* 365 days/year) = 0.0799

Notes:  $g/cm^3$  – gram(s) per cubic centimeter;  $g/m^3$  – gram(s) per cubic meter; kg – kilogram(s).

## DETERMINATION OF EXPOSURE POINT CONCENTRATIONS

Risk and dose for this property are determined by developing a source term and applying that source term to the three receptor scenarios using RESRAD. For this property, the source term is based upon exposure point concentrations (EPCs). EPCs for applicable COCs were independently calculated for both 'non-HTZ' soil samples and 'HTZ' soil samples (surface and subsurface soils are combined for each type of soil sample). For this analysis, 'HTZ' soil samples are those samples taken based on increased readings identified during GWSs that may be due to environmental contamination in the soil or due to higher amounts of naturally occurring radioactivity in the soil. 'HTZ' soil samples are assigned areas, in square meters, based on the estimated area exhibiting increased readings. (Biased soil samples for bounding purposes may have 'HTZ' in the sample identification, but no area is assigned, because they are not associated with the GWS; these samples are treated as 'non-HTZ' soil samples.) Area weighting of the sample analytical data was conducted to ensure that 'HTZ' sampling did not cause the true average concentration term to be misrepresented (USEPA 1989). The following discussion summarizes the process for calculating each COC's EPC.

- The 'non-HTZ' soil sample results for each radionuclide COC were inserted into the USEPA-designed software ProUCL (Version 4.0) to calculate the 95 percent upper confidence limit of the arithmetic mean ( $UCL_{95}$ ).
- The 'HTZ' soil sample results for each radionuclide COC were inserted into ProUCL to calculate the  $UCL_{95}$ .
- The areas represented by the 'HTZ' soil sample results were summed. The total area represented by the 'non-HTZ' soil samples was calculated by subtracting the total biased soil sample area from the total area of all the SUs. Next, these areas were used to provide a weighted average of the two  $UCL_{95}$  values.

The EPCs for each radionuclide COC were calculated by subtracting the average background concentration from the smaller of its  $UCL_{95}$  result or its maximum detection concentration. Because the soil sample results did not include lead (Pb)-210 or U-234, which are COCs having negligible contributions, the EPCs for these radionuclides were estimated from established ratios to other radionuclides for which an EPC was calculated. From Table 2.15 of the *Baseline Risk Assessment for Exposure to Contaminants at the St. Louis Site* (DOE 1993), the ratio of Pb-210 to Ra-226 is 1.3, and the ratio of U-234 to U-238 is 1.0.

For each data set, Table H-2 presents the summary statistics, EPC results for HTZ and non-HTZ soil samples, EPC results for the entire property being assessed, and current radionuclide-specific background concentrations for the SLDS. In addition, the EPCs for the unavailable radionuclides (Pb-210 and U-234) were determined based on the relationship previously discussed. All statistics are based upon the representative area concentration values used to determine  $UCL_{95}$  values for the SU.

**Table H-2. Exposure Point Concentrations**

|                            | Area<br>(m <sup>2</sup> ) | Statistic                      | Radionuclide Concentration (pCi/g) |        |                     |        |        |        |        |        |                    |       |       |
|----------------------------|---------------------------|--------------------------------|------------------------------------|--------|---------------------|--------|--------|--------|--------|--------|--------------------|-------|-------|
|                            |                           |                                | Ac-227                             | Pa-231 | Pb-210 <sup>a</sup> | Ra-226 | Ra-228 | Th-228 | Th-230 | Th-232 | U-234 <sup>a</sup> | U-235 | U-238 |
| Non-HTZ<br>Soil<br>Samples | 9,841                     | Background <sup>b</sup>        | 0.14                               | 0.90   | -                   | 2.78   | 0.95   | 1.16   | 1.94   | 1.09   | -                  | 0.08  | 1.44  |
|                            |                           | Maximum                        | 0.13                               | 0.39   | -                   | 4.16   | 1.09   | 1.64   | 3.61   | 1.75   | -                  | 0.32  | 3.27  |
|                            |                           | Distribution                   | N                                  | N      | -                   | G      | N      | N      | G      | N      | -                  | N     | N     |
|                            |                           | UCL <sub>95</sub> <sup>a</sup> | 0.02                               | 0.07   | -                   | 1.77   | 0.73   | 0.98   | 1.71   | 0.94   | -                  | 0.10  | 1.71  |
|                            |                           | EPC                            | 0.00                               | 0.00   | -                   | 0.00   | 0.00   | 0.00   | 0.00   | 0.00   | -                  | 0.02  | 0.27  |
| HTZ Soil<br>Samples        | 5                         | Background <sup>b</sup>        | 0.14                               | 0.90   | -                   | 2.78   | 0.95   | 1.16   | 1.94   | 1.09   | -                  | 0.08  | 1.44  |
|                            |                           | Maximum                        | 0.05                               | 0.56   | -                   | 2.94   | 0.79   | 1.22   | 2.71   | 0.90   | -                  | 0.30  | 2.39  |
|                            |                           | Distribution                   | N                                  | N      | -                   | N      | N      | N      | N      | N      | -                  | L     | N     |
|                            |                           | UCL <sub>95</sub>              | 0.01                               | 0.33   | -                   | 2.36   | 0.69   | 1.12   | 2.47   | 0.75   | -                  | 0.27  | 1.98  |
|                            |                           | EPC                            | 0.00                               | 0.00   | -                   | 0.00   | 0.00   | 0.00   | 0.53   | 0.00   | -                  | 0.19  | 0.54  |
| Combined<br>Area           | 9,846                     | EPC                            | 0.00                               | 0.00   | 0.00                | 0.00   | 0.00   | 0.00   | 0.00   | 0.00   | 0.27               | 0.02  | 0.27  |

<sup>a</sup> EPC was determined based table 2.15 of the *Baseline Risk Assessment for Exposure to Contaminants at the St. Louis Site* (DOE 1993).

<sup>b</sup> Background values were taken from Table 3-2 of the *Background Soils Characterization Report for the St. Louis Downtown Site* (USACE 1999).

Note: G=Gamma, L=Lognormal, N=Normal

## RISK AND DOSE ASSESSMENT RESULTS

Table H-3 summarizes the highest radiological risk and dose in a 1,000-year period to each of the three receptors from exposure to the residual radionuclides present at DT-34 for each scenario.

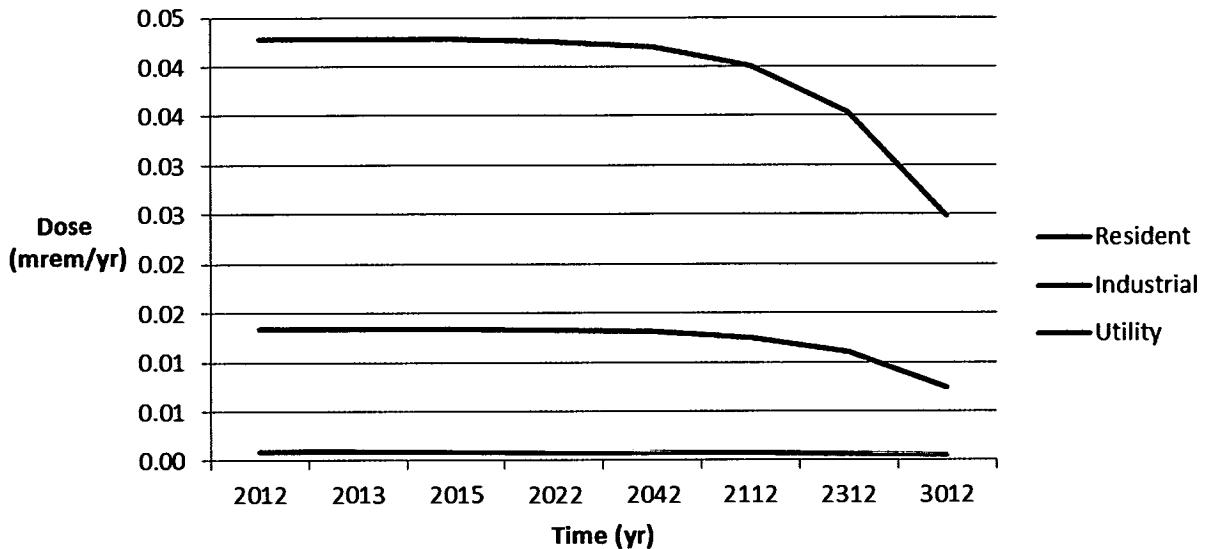
**Table H-3. Highest Risk and Dose for DT-34 Property to Different Receptors**

| Industrial Worker |         | Utility Worker |         | Onsite Resident |         |
|-------------------|---------|----------------|---------|-----------------|---------|
| Dose (mrem/yr)    | Risk    | Dose (mrem/yr) | Risk    | Dose (mrem/yr)  | Risk    |
| 1.3E-02           | 2.1E-07 | 8.4E-04        | 5.3E-10 | 4.3E-02         | 8.3E-07 |

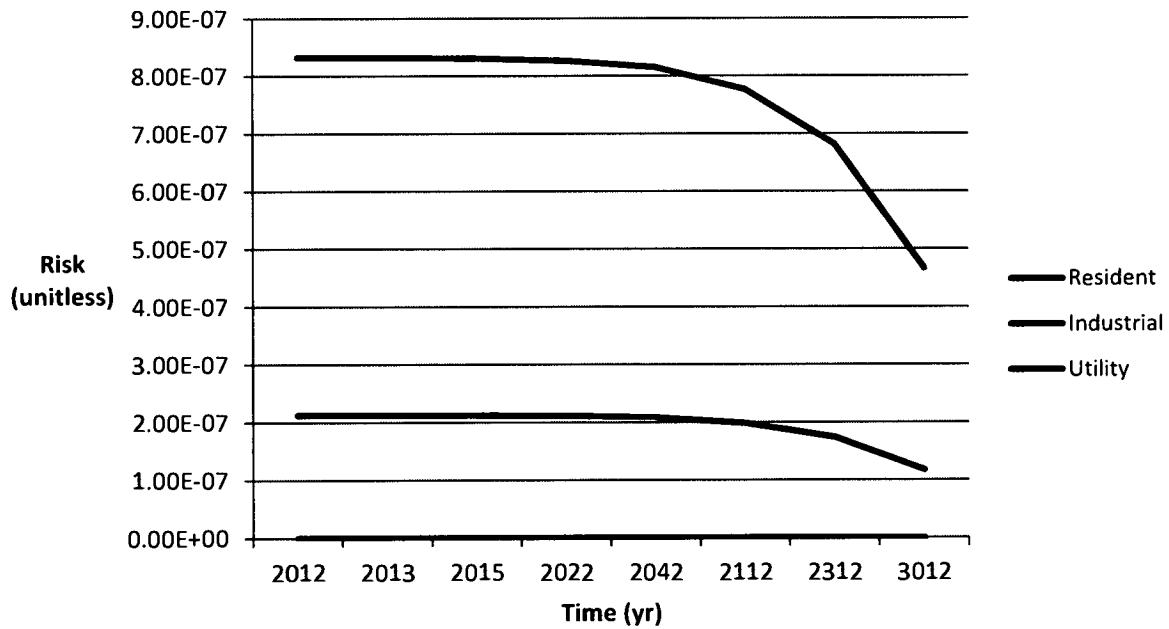
For the scenarios assessed, the highest residential risk and dose were  $8.3 \times 10^{-7}$  and  $4.3 \times 10^{-2}$  mrem/yr, respectively. The dose for all receptors is below 25 mrem/yr. These results met the CERCLA risk range and were below the dose criteria of 25 mrem/yr. EPC calculations (including Pro-UCL output files) and RESRAD output files are included in this report as Attachments H-1 and H-2, respectively.

The graphs below illustrate the radiological risk and dose for a 1,000-year period for the on-site resident and the industrial and utility worker receptors.

### Dose: On-Site Resident and Industrial and Utility Worker Receptors vs. Time



### Risk: On-Site Resident and Industrial and Utility Worker Receptors vs. Time



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**ATTACHMENT H-1**  
**EPC CALCULATIONS (PRO-UCL OUTPUT FILES)**  
**(On CD-ROM on the Back Cover of this Report)**

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DT-34  
Non-HTZ Pro-UCL Output

| General UCL Statistics for Full Data Sets |               |
|---|---------------|
| User Selected Options                     |               |
| From File                                 | WorkSheet.wst |
| Full Precision                            | OFF           |
| Confidence Coefficient                    | 95%           |
| Number of Bootstrap Operations            | 2000          |

Ac-227

| General Statistics  |   |
|---|---|
| Number of Valid Observations  | 24  |
| Number of Distinct Observations   | 24  |
| Raw Statistics  | Log-transformed Statistics                  |
| Minimum   | -0.184                                      |
| Maximum   | 0.129                                       |
| Mean  | -0.00683                                    |
| Median  | 0.0164                                      |
| SD  | 0.0845                                      |
| Coefficient of Variation  | 12.39                                       |
| Skewness  | -0.452                                      |
| Relevant UCL Statistics   |   |
| Normal Distribution Test  | Lognormal Distribution Test                 |
| Shapiro Wilk Test Statistic   | 0.954                                       |
| Shapiro Wilk Critical Value   | 0.916                                       |
| Data appear Normal at 5% Significance Level   |   |
| Assuming Normal Distribution  | Assuming Lognormal Distribution             |
| 95% Student's-t UCL   | 0.0227                                      |
|   | 95% H-UCL N/A                               |
| Assuming Normal Distribution  | 95% UCLs (Adjusted for Skewness)            |
| 95% Student's-t UCL   | 0.0227                                      |
|   | 95% Adjusted-CLT UCL (Chen 1995) 0.0199     |
|   | 95% Modified-t UCL (Johnson-1978) 0.0225    |
| Gamma Distribution Test   | Data Distribution                           |
| Gamma Statistics Not Available  | Data appear Normal at 5% Significance Level |
| Potential UCL to Use  |   |
| Use 95% Student's-t UCL   | 0.0227                                      |
|   | 95% CLT UCL 0.0216                          |
|   | 95% Jackknife UCL 0.0227                    |
|   | 95% Standard Bootstrap UCL 0.0211           |
|   | 95% Bootstrap-t UCL 0.0199                  |
|   | 95% Hall's Bootstrap UCL 0.0197             |
|   | 95% Percentile Bootstrap UCL 0.0205         |
|   | 95% BCA Bootstrap UCL 0.0172                |
|   | 95% Chebyshev(Mean, Sd) UCL 0.0684          |
|   | 97.5% Chebyshev(Mean, Sd) UCL 0.101         |
|   | 99% Chebyshev(Mean, Sd) UCL 0.165           |
| Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.  |   |
| These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). For additional insight, the user may want to consult a statistician. |   |

Pa-231

#### General Statistics

|                              |    |                                 |    |
|------------------------------|----|---------------------------------|----|
| Number of Valid Observations | 24 | Number of Distinct Observations | 24 |
|------------------------------|----|---------------------------------|----|

#### Raw Statistics

#### Log-transformed Statistics

Minimum -0.333

Log Statistics Not Available

Maximum 0.385

Mean 0.0193

Median 0.023

SD 0.156

Coefficient of Variation 8.094

Skewness -0.0688

#### Relevant UCL Statistics

##### Normal Distribution Test

##### Lognormal Distribution Test

Shapiro Wilk Test Statistic 0.983

Not Available

Shapiro Wilk Critical Value 0.916

Data appear Normal at 5% Significance Level

##### Assuming Normal Distribution

##### Assuming Lognormal Distribution

95% Student's-t UCL 0.0738

95% H-UCL N/A

##### Assuming Normal Distribution

##### 95% UCLs (Adjusted for Skewness)

95% Student's-t UCL 0.0738

95% Adjusted-CLT UCL (Chen 1995) 0.0712

##### Gamma Distribution Test

##### Data Distribution

Gamma Statistics Not Available

Data appear Normal at 5% Significance Level

##### Potential UCL to Use

Use 95% Student's-t UCL 0.0738

95% CLT UCL 0.0716

95% Jackknife UCL 0.0738

95% Standard Bootstrap UCL 0.0724

95% Bootstrap-t UCL 0.0747

95% Hall's Bootstrap UCL 0.0759

95% Percentile Bootstrap UCL 0.0697

95% BCA Bootstrap UCL 0.0717

95% Chebyshev(Mean, Sd) UCL 0.158

97.5% Chebyshev(Mean, Sd) UCL 0.218

99% Chebyshev(Mean, Sd) UCL 0.336

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)

and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

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**General Statistics**

|                              |    |                                 |    |
|------------------------------|----|---------------------------------|----|
| Number of Valid Observations | 24 | Number of Distinct Observations | 24 |
|------------------------------|----|---------------------------------|----|

**Raw Statistics****Log-transformed Statistics**

|                          |       |                     |       |
|--------------------------|-------|---------------------|-------|
| Minimum                  | 0.705 | Minimum of Log Data | -0.35 |
| Maximum                  | 4.16  | Maximum of Log Data | 1.426 |
| Mean                     | 1.545 | Mean of log Data    | 0.37  |
| Median                   | 1.365 | SD of log Data      | 0.349 |
| SD                       | 0.671 |                     |       |
| Coefficient of Variation | 0.434 |                     |       |
| Skewness                 | 2.714 |                     |       |

**Relevant UCL Statistics****Normal Distribution Test****Lognormal Distribution Test**

|                             |       |                             |       |
|-----------------------------|-------|-----------------------------|-------|
| Shapiro Wilk Test Statistic | 0.743 | Shapiro Wilk Test Statistic | 0.936 |
| Shapiro Wilk Critical Value | 0.916 | Shapiro Wilk Critical Value | 0.916 |

Data not Normal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

**Assuming Normal Distribution****Assuming Lognormal Distribution**

|                                   |       |                            |       |
|-----------------------------------|-------|----------------------------|-------|
| 95% Student's-t UCL               | 1.779 | 95% H-UCL                  | 1.761 |
| 95% UCLs (Adjusted for Skewness)  |       | 95% Chebyshev (MVUE) UCL   | 2.02  |
| 95% Adjusted-CLT UCL (Chen-1995)  | 1.851 | 97.5% Chebyshev (MVUE) UCL | 2.23  |
| 95% Modified-t UCL (Johnson-1978) | 1.792 | 99% Chebyshev (MVUE) UCL   | 2.643 |

**Gamma Distribution Test****Data Distribution**

|                           |       |   |  |
|---------------------------|-------|---|--|
| k star (bias corrected)   | 6.877 | Data Follow Appr. Gamma Distribution at 5% Significance Level |  |
| Theta Star                | 0.225 |   |  |
| MLE of Mean               | 1.545 |   |  |
| MLE of Standard Deviation | 0.589 |   |  |
| nu star                   | 330.1 |   |  |

Approximate Chi Square Value (.05)

**Nonparametric Statistics**

|                                      |        |                              |       |
|--------------------------------------|--------|------------------------------|-------|
| Adjusted Level of Significance       | 0.0392 | 95% CLT UCL                  | 1.77  |
| Adjusted Chi Square Value            | 286.3  | 95% Jackknife UCL            | 1.779 |
|                                      |        | 95% Standard Bootstrap UCL   | 1.765 |
| Anderson-Darling Test Statistic      | 0.775  | 95% Bootstrap-t UCL          | 1.921 |
| Anderson-Darling 5% Critical Value   | 0.745  | 95% Hall's Bootstrap UCL     | 2.827 |
| Kolmogorov-Smirnov Test Statistic    | 0.158  | 95% Percentile Bootstrap UCL | 1.789 |
| Kolmogorov-Smirnov 5% Critical Value | 0.178  | 95% BCA Bootstrap UCL        | 1.859 |

Data follow Appr. Gamma Distribution at 5% Significance Level

95% Chebyshev(Mean, Sd) UCL 2.142

97.5% Chebyshev(Mean, Sd) UCL 2.4

**Assuming Gamma Distribution**

99% Chebyshev(Mean, Sd) UCL 2.907

95% Approximate Gamma UCL 1.765

95% Adjusted Gamma UCL 1.781

**Potential UCL to Use**

Use 95% Approximate Gamma UCL 1.765

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

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**General Statistics**

|                              |    |                                 |    |
|------------------------------|----|---------------------------------|----|
| Number of Valid Observations | 24 | Number of Distinct Observations | 24 |
|------------------------------|----|---------------------------------|----|

**Raw Statistics****Log-transformed Statistics**

|                          |        |                     |        |
|--------------------------|--------|---------------------|--------|
| Minimum                  | 0.073  | Minimum of Log Data | -2.617 |
| Maximum                  | 1.09   | Maximum of Log Data | 0.0862 |
| Mean                     | 0.626  | Mean of log Data    | -0.63  |
| Median                   | 0.68   | SD of log Data      | 0.659  |
| SD                       | 0.301  |                     |        |
| Coefficient of Variation | 0.481  |                     |        |
| Skewness                 | -0.206 |                     |        |

**Relevant UCL Statistics****Normal Distribution Test****Lognormal Distribution Test**

|                             |       |                             |       |
|-----------------------------|-------|-----------------------------|-------|
| Shapiro Wilk Test Statistic | 0.926 | Shapiro Wilk Test Statistic | 0.86  |
| Shapiro Wilk Critical Value | 0.916 | Shapiro Wilk Critical Value | 0.916 |

Data appear Normal at 5% Significance Level

Data not Lognormal at 5% Significance Level

**Assuming Normal Distribution****Assuming Lognormal Distribution**

|                                   |       |                            |       |
|-----------------------------------|-------|----------------------------|-------|
| 95% Student's-t UCL               | 0.732 | 95% H-UCL                  | 0.887 |
| 95% UCLs (Adjusted for Skewness)  |       | 95% Chebyshev (MVUE) UCL   | 1.064 |
| 95% Adjusted-CLT UCL (Chen-1995)  | 0.725 | 97.5% Chebyshev (MVUE) UCL | 1.241 |
| 95% Modified-t UCL (Johnson-1978) | 0.731 | 99% Chebyshev (MVUE) UCL   | 1.589 |

**Gamma Distribution Test****Data Distribution**

k star (bias corrected)

2.865

Data appear Normal at 5% Significance Level

Theta Star

0.219

MLE of Mean

0.626

MLE of Standard Deviation

0.37

nu star

137.5

Approximate Chi Square Value (.05)

111.4

**Nonparametric Statistics**

Adjusted Level of Significance

0.0392

95% CLT UCL

0.728

Adjusted Chi Square Value

109.8

95% Jackknife UCL

0.732

95% Standard Bootstrap UCL

0.725

Anderson-Darling Test Statistic

0.926

95% Bootstrap-t UCL

0.73

Anderson-Darling 5% Critical Value

0.751

95% Hall's Bootstrap UCL

0.718

Kolmogorov-Smirnov Test Statistic

0.192

95% Percentile Bootstrap UCL

0.72

Kolmogorov-Smirnov 5% Critical Value

0.179

95% BCA Bootstrap UCL

0.727

Data not Gamma Distributed at 5% Significance Level

95% Chebyshev(Mean, Sd) UCL

0.895

97.5% Chebyshev(Mean, Sd) UCL

1.011

Assuming Gamma Distribution

99% Chebyshev(Mean, Sd) UCL

1.238

95% Approximate Gamma UCL

0.773

95% Adjusted Gamma UCL

0.785

**Potential UCL to Use**

Use 95% Student's-t UCL

0.732

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)

and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

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**General Statistics**

|                              |    |                                 |    |
|------------------------------|----|---------------------------------|----|
| Number of Valid Observations | 24 | Number of Distinct Observations | 24 |
|------------------------------|----|---------------------------------|----|

**Raw Statistics****Log-transformed Statistics**

|                          |       |                     |        |
|--------------------------|-------|---------------------|--------|
| Minimum                  | 0.263 | Minimum of Log Data | -1.336 |
| Maximum                  | 1.64  | Maximum of Log Data | 0.495  |
| Mean                     | 0.848 | Mean of log Data    | -0.274 |
| Median                   | 0.874 | SD of log Data      | 0.504  |
| SD                       | 0.373 |                     |        |
| Coefficient of Variation | 0.44  |                     |        |
| Skewness                 | 0.248 |                     |        |

**Relevant UCL Statistics****Normal Distribution Test****Lognormal Distribution Test**

|                             |       |                             |       |
|-----------------------------|-------|-----------------------------|-------|
| Shapiro Wilk Test Statistic | 0.961 | Shapiro Wilk Test Statistic | 0.935 |
| Shapiro Wilk Critical Value | 0.916 | Shapiro Wilk Critical Value | 0.916 |

Data appear Normal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

**Assuming Normal Distribution****Assuming Lognormal Distribution**

|                                   |       |                            |       |
|-----------------------------------|-------|----------------------------|-------|
| 95% Student's-t UCL               | 0.979 | 95% H-UCL                  | 1.064 |
| 95% UCLs (Adjusted for Skewness)  |       | 95% Chebyshev (MVUE) UCL   | 1.259 |
| 95% Adjusted-CLT UCL (Chen-1995)  | 0.978 | 97.5% Chebyshev (MVUE) UCL | 1.433 |
| 95% Modified-t UCL (Johnson-1978) | 0.98  | 99% Chebyshev (MVUE) UCL   | 1.774 |

**Gamma Distribution Test****Data Distribution**

k star (bias corrected)

Theta Star

MLE of Mean

MLE of Standard Deviation

nu star

Approximate Chi Square Value (.05)

Adjusted Level of Significance

Adjusted Chi Square Value

Anderson-Darling Test Statistic

Anderson-Darling 5% Critical Value

Kolmogorov-Smirnov Test Statistic

Kolmogorov-Smirnov 5% Critical Value

Data appear Gamma Distributed at 5% Significance Level

**Nonparametric Statistics**

95% CLT UCL

95% Jackknife UCL

95% Standard Bootstrap UCL

95% Bootstrap-t UCL

95% Hall's Bootstrap UCL

95% Percentile Bootstrap UCL

95% BCA Bootstrap UCL

95% Chebyshev(Mean, Sd) UCL

97.5% Chebyshev(Mean, Sd) UCL

99% Chebyshev(Mean, Sd) UCL

**Assuming Gamma Distribution**

95% Approximate Gamma UCL

95% Adjusted Gamma UCL

Potential UCL to Use

Use 95% Student's-t UCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)

and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Th-230

### General Statistics

|                              |    |                                 |    |
|------------------------------|----|---------------------------------|----|
| Number of Valid Observations | 24 | Number of Distinct Observations | 23 |
|------------------------------|----|---------------------------------|----|

### Raw Statistics

|                          | Log-transformed Statistics |                     |        |
|--------------------------|----------------------------|---------------------|--------|
| Minimum                  | 0.823                      | Minimum of Log Data | -0.195 |
| Maximum                  | 3.61                       | Maximum of Log Data | 1.284  |
| Mean                     | 1.522                      | Mean of log Data    | 0.371  |
| Median                   | 1.385                      | SD of log Data      | 0.307  |
| SD                       | 0.552                      |                     |        |
| Coefficient of Variation | 0.363                      |                     |        |
| Skewness                 | 2.387                      |                     |        |

### Relevant UCL Statistics

#### Normal Distribution Test

#### Lognormal Distribution Test

|                             |       |                             |       |
|-----------------------------|-------|-----------------------------|-------|
| Shapiro Wilk Test Statistic | 0.783 | Shapiro Wilk Test Statistic | 0.938 |
| Shapiro Wilk Critical Value | 0.916 | Shapiro Wilk Critical Value | 0.916 |

Data not Normal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

#### Assuming Normal Distribution

#### Assuming Lognormal Distribution

|                                   |       |                            |       |
|-----------------------------------|-------|----------------------------|-------|
| 95% Student's-t UCL               | 1.715 | 95% H-UCL                  | 1.708 |
| 95% UCLs (Adjusted for Skewness)  |       | 95% Chebyshev (MVUE) UCL   | 1.936 |
| 95% Adjusted-CLT UCL (Chen-1995)  | 1.766 | 97.5% Chebyshev (MVUE) UCL | 2.118 |
| 95% Modified-t UCL (Johnson-1978) | 1.725 | 99% Chebyshev (MVUE) UCL   | 2.475 |

#### Gamma Distribution Test

#### Data Distribution

|                           |       |
|---------------------------|-------|
| k star (bias corrected)   | 9.069 |
| Theta Star                | 0.168 |
| MLE of Mean               | 1.522 |
| MLE of Standard Deviation | 0.505 |
| nu star                   | 435.3 |

|                                    |       |
|------------------------------------|-------|
| Approximate Chi Square Value (.05) | 387.9 |
|------------------------------------|-------|

#### Nonparametric Statistics

|                                      |        |                              |       |
|--------------------------------------|--------|------------------------------|-------|
| Adjusted Level of Significance       | 0.0392 | 95% CLT UCL                  | 1.708 |
| Adjusted Chi Square Value            | 384.8  | 95% Jackknife UCL            | 1.715 |
|                                      |        | 95% Standard Bootstrap UCL   | 1.703 |
| Anderson-Darling Test Statistic      | 0.615  | 95% Bootstrap-t UCL          | 1.808 |
| Anderson-Darling 5% Critical Value   | 0.744  | 95% Hall's Bootstrap UCL     | 2.625 |
| Kolmogorov-Smirnov Test Statistic    | 0.147  | 95% Percentile Bootstrap UCL | 1.715 |
| Kolmogorov-Smirnov 5% Critical Value | 0.178  | 95% BCA Bootstrap UCL        | 1.791 |

Data appear Gamma Distributed at 5% Significance Level

95% Chebyshev(Mean, Sd) UCL

97.5% Chebyshev(Mean, Sd) UCL

#### Assuming Gamma Distribution

99% Chebyshev(Mean, Sd) UCL

|                           |       |
|---------------------------|-------|
| 95% Approximate Gamma UCL | 1.708 |
| 95% Adjusted Gamma UCL    | 1.722 |
|                           |       |

#### Potential UCL to Use

Use 95% Approximate Gamma UCL

1.708

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)

and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

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**General Statistics**

|                              |    |                                 |    |
|------------------------------|----|---------------------------------|----|
| Number of Valid Observations | 24 | Number of Distinct Observations | 22 |
|------------------------------|----|---------------------------------|----|

**Raw Statistics****Log-transformed Statistics**

|                          |        |                     |        |
|--------------------------|--------|---------------------|--------|
| Minimum                  | 0.0526 | Minimum of Log Data | -2.945 |
| Maximum                  | 1.75   | Maximum of Log Data | 0.56   |
| Mean                     | 0.786  | Mean of log Data    | -0.461 |
| Median                   | 0.87   | SD of log Data      | 0.801  |
| SD                       | 0.427  |                     |        |
| Coefficient of Variation | 0.543  |                     |        |
| Skewness                 | 0.144  |                     |        |

**Relevant UCL Statistics****Normal Distribution Test****Lognormal Distribution Test**

|                             |       |                             |       |
|-----------------------------|-------|-----------------------------|-------|
| Shapiro Wilk Test Statistic | 0.969 | Shapiro Wilk Test Statistic | 0.864 |
| Shapiro Wilk Critical Value | 0.916 | Shapiro Wilk Critical Value | 0.916 |

Data appear Normal at 5% Significance Level

Data not Lognormal at 5% Significance Level

**Assuming Normal Distribution****Assuming Lognormal Distribution**

|                                   |       |                            |       |
|-----------------------------------|-------|----------------------------|-------|
| 95% Student's-t UCL               | 0.936 | 95% H-UCL                  | 1.275 |
| 95% UCLs (Adjusted for Skewness)  |       | 95% Chebyshev (MVUE) UCL   | 1.52  |
| 95% Adjusted-CLT UCL (Chen-1995)  | 0.932 | 97.5% Chebyshev (MVUE) UCL | 1.809 |
| 95% Modified-t UCL (Johnson-1978) | 0.936 | 99% Chebyshev (MVUE) UCL   | 2.375 |

**Gamma Distribution Test****Data Distribution**

|                           |       |
|---------------------------|-------|
| k star (bias corrected)   | 2.144 |
| Theta Star                | 0.367 |
| MLE of Mean               | 0.786 |
| MLE of Standard Deviation | 0.537 |
| nu star                   | 102.9 |

|                                    |      |
|------------------------------------|------|
| Approximate Chi Square Value (.05) | 80.5 |
|------------------------------------|------|

**Nonparametric Statistics**

|                                      |        |                              |       |
|--------------------------------------|--------|------------------------------|-------|
| Adjusted Level of Significance       | 0.0392 | 95% CLT UCL                  | 0.93  |
| Adjusted Chi Square Value            | 79.1   | 95% Jackknife UCL            | 0.936 |
|                                      |        | 95% Standard Bootstrap UCL   | 0.923 |
| Anderson-Darling Test Statistic      | 0.659  | 95% Bootstrap-t UCL          | 0.941 |
| Anderson-Darling 5% Critical Value   | 0.753  | 95% Hall's Bootstrap UCL     | 0.94  |
| Kolmogorov-Smirnov Test Statistic    | 0.188  | 95% Percentile Bootstrap UCL | 0.928 |
| Kolmogorov-Smirnov 5% Critical Value | 0.18   | 95% BCA Bootstrap UCL        | 0.923 |

Data follow Appr. Gamma Distribution at 5% Significance Level

|                               |       |
|-------------------------------|-------|
| 95% Chebyshev(Mean, Sd) UCL   | 1.166 |
| 97.5% Chebyshev(Mean, Sd) UCL | 1.33  |

**Assuming Gamma Distribution**

|                             |       |
|-----------------------------|-------|
| 99% Chebyshev(Mean, Sd) UCL | 1.653 |
|-----------------------------|-------|

|                           |       |
|---------------------------|-------|
| 95% Approximate Gamma UCL | 1.005 |
| 95% Adjusted Gamma UCL    | 1.023 |

**Potential UCL to Use**

|                         |       |
|-------------------------|-------|
| Use 95% Student's-t UCL | 0.936 |
|-------------------------|-------|

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)

and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

U-235

**General Statistics**

|                              |    |                                 |    |
|------------------------------|----|---------------------------------|----|
| Number of Valid Observations | 24 | Number of Distinct Observations | 24 |
|------------------------------|----|---------------------------------|----|

**Raw Statistics****Log-transformed Statistics**

Minimum -0.0705

Log Statistics Not Available

Maximum 0.315

Mean 0.0677

Median 0.0547

SD 0.0885

Coefficient of Variation 1.307

Skewness 0.851

**Relevant UCL Statistics****Normal Distribution Test****Lognormal Distribution Test**

Shapiro Wilk Test Statistic 0.953

Not Available

Shapiro Wilk Critical Value 0.916

Data appear Normal at 5% Significance Level

**Assuming Normal Distribution****Assuming Lognormal Distribution**

95% Student's-t UCL 0.0986

95% H-UCL N/A

**Assuming Normal Distribution****95% UCLs (Adjusted for Skewness)**

95% Student's-t UCL 0.0986

95% Adjusted-CLT UCL (Chen 1995) 0.101

95% Modified-t UCL (Johnson-1978) 0.0992

**Gamma Distribution Test****Data Distribution**

Gamma Statistics Not Available

Data appear Normal at 5% Significance Level

**Potential UCL to Use**

Use 95% Student's-t UCL 0.0986

95% CLT UCL 0.0974

95% Jackknife UCL 0.0986

95% Standard Bootstrap UCL 0.0972

95% Bootstrap-t UCL 0.103

95% Hall's Bootstrap UCL 0.105

95% Percentile Bootstrap UCL 0.096

95% BCA Bootstrap UCL 0.101

95% Chebyshev(Mean, Sd) UCL 0.146

97.5% Chebyshev(Mean, Sd) UCL 0.18

99% Chebyshev(Mean, Sd) UCL 0.247

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)

and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

U-238

**General Statistics**

|                              |    |                                 |    |
|------------------------------|----|---------------------------------|----|
| Number of Valid Observations | 24 | Number of Distinct Observations | 24 |
|------------------------------|----|---------------------------------|----|

**Raw Statistics****Log-transformed Statistics**

|                          |       |                     |        |
|--------------------------|-------|---------------------|--------|
| Minimum                  | 0.222 | Minimum of Log Data | -1.505 |
| Maximum                  | 3.27  | Maximum of Log Data | 1.185  |
| Mean                     | 1.467 | Mean of log Data    | 0.238  |
| Median                   | 1.365 | SD of log Data      | 0.62   |
| SD                       | 0.703 |                     |        |
| Coefficient of Variation | 0.479 |                     |        |
| Skewness                 | 0.57  |                     |        |

**Relevant UCL Statistics****Normal Distribution Test****Lognormal Distribution Test**

|                             |       |                             |       |
|-----------------------------|-------|-----------------------------|-------|
| Shapiro Wilk Test Statistic | 0.957 | Shapiro Wilk Test Statistic | 0.868 |
| Shapiro Wilk Critical Value | 0.916 | Shapiro Wilk Critical Value | 0.916 |

Data appear Normal at 5% Significance Level

Data not Lognormal at 5% Significance Level

**Assuming Normal Distribution****Assuming Lognormal Distribution**

|                                   |       |                            |       |
|-----------------------------------|-------|----------------------------|-------|
| 95% Student's-t UCL               | 1.713 | 95% H-UCL                  | 2.017 |
| 95% UCLs (Adjusted for Skewness)  |       | 95% Chebyshev (MVUE) UCL   | 2.416 |
| 95% Adjusted-CLT UCL (Chen-1995)  | 1.721 | 97.5% Chebyshev (MVUE) UCL | 2.802 |
| 95% Modified-t UCL (Johnson-1978) | 1.716 | 99% Chebyshev (MVUE) UCL   | 3.56  |

**Gamma Distribution Test****Data Distribution**

|                           |       |   |
|---------------------------|-------|---|
| k star (bias corrected)   | 3.182 | Data appear Normal at 5% Significance Level |
| Theta Star                | 0.461 |   |
| MLE of Mean               | 1.467 |   |
| MLE of Standard Deviation | 0.823 |   |
| nu star                   | 152.8 |   |

Approximate Chi Square Value (.05)

**Nonparametric Statistics**

|                                      |        |                              |       |
|--------------------------------------|--------|------------------------------|-------|
| Adjusted Level of Significance       | 0.0392 | 95% CLT UCL                  | 1.703 |
| Adjusted Chi Square Value            | 123.4  | 95% Jackknife UCL            | 1.713 |
|                                      |        | 95% Standard Bootstrap UCL   | 1.699 |
| Anderson-Darling Test Statistic      | 0.674  | 95% Bootstrap-t UCL          | 1.74  |
| Anderson-Darling 5% Critical Value   | 0.75   | 95% Hall's Bootstrap UCL     | 1.773 |
| Kolmogorov-Smirnov Test Statistic    | 0.152  | 95% Percentile Bootstrap UCL | 1.709 |
| Kolmogorov-Smirnov 5% Critical Value | 0.179  | 95% BCA Bootstrap UCL        | 1.704 |

Data appear Gamma Distributed at 5% Significance Level

95% Chebyshev(Mean, Sd) UCL 2.093

97.5% Chebyshev(Mean, Sd) UCL 2.364

**Assuming Gamma Distribution**

99% Chebyshev(Mean, Sd) UCL 2.895

95% Approximate Gamma UCL 1.791

95% Adjusted Gamma UCL 1.816

**Potential UCL to Use**

Use 95% Student's-t UCL 1.713

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

DT-34  
HTZ Pro-UCL Output

| General UCL Statistics for Full Data Sets |  |
|---|--|
| User Selected Options                     |  |
| From File                                 | P:\Task 10 - Safety & HP (Hansen)\Dose and Risk\SLDSIDT-34\NEW DT-34 PRAR 2011\BD Pro-UCL input_DT-34 PRAR.wst |
| Full Precision                            | OFF  |
| Confidence Coefficient                    | 95%  |
| Number of Bootstrap Operations            | 2000   |

Ac-227

| General Statistics           |         |                                   |
|------------------------------|---------|-----------------------------------|
| Number of Valid Observations | 6       | Number of Distinct Observations   |
| <b>Raw Statistics</b>        |         | <b>Log-transformed Statistics</b> |
| Minimum                      | -0.0642 | Log Statistics Not Available      |
| Maximum                      | 0.045   |                                   |
| Mean                         | -0.0235 |                                   |
| Median                       | -0.0292 |                                   |
| SD                           | 0.0404  |                                   |
| Coefficient of Variation     | -1.721  |                                   |
| Skewness                     | 0.976   |                                   |

Warning: A sample size of 'n' = 6 may not adequate enough to compute meaningful and reliable test statistics and estimates!

It is suggested to collect at least 8 to 10 observations using these statistical methods!

If possible compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

Warning: There are only 6 Values in this data

Note: It should be noted that even though bootstrap methods may be performed on this data set,  
the resulting calculations may not be reliable enough to draw conclusions

The literature suggests to use bootstrap methods on data sets having more than 10-15 observations.

| Relevant UCL Statistics  |  |   |
|--|--|---|
| <b>Normal Distribution Test</b>  |  | <b>Lognormal Distribution Test</b>          |
| Shapiro Wilk Test Statistic  |  | Not Available                               |
| Shapiro Wilk Critical Value  |  |   |
| Data appear Normal at 5% Significance Level  |  |   |
| <b>Assuming Normal Distribution</b>  |  | <b>Assuming Lognormal Distribution</b>      |
| 95% Student's-t UCL  |  | 95% H-UCL N/A                               |
| Assuming Normal Distribution   |  | 95% UCLs (Adjusted for Skewness)            |
| 95% Student's-t UCL  |  | 95% Adjusted-CLT UCL (Chen 1995) 0.0107     |
|  |  | 95% Modified-t UCL (Johnson-1978) 0.0108    |
| <b>Gamma Distribution Test</b>   |  | <b>Data Distribution</b>                    |
| Gamma Statistics Not Available   |  | Data appear Normal at 5% Significance Level |
| <b>Potential UCL to Use</b>  |  |   |
| Use 95% Student's-t UCL  |  | 95% CLT UCL 0.00365                         |
|  |  | 95% Jackknife UCL 0.00975                   |
|  |  | 95% Standard Bootstrap UCL 0.00151          |
|  |  | 95% Bootstrap-t UCL 0.0234                  |
|  |  | 95% Hall's Bootstrap UCL 0.0326             |
|  |  | 95% Percentile Bootstrap UCL 0.00312        |
|  |  | 95% BCA Bootstrap UCL 0.00653               |
|  |  | 95% Chebyshev(Mean, Sd) UCL 0.0484          |
|  |  | 97.5% Chebyshev(Mean, Sd) UCL 0.0795        |
|  |  | 99% Chebyshev(Mean, Sd) UCL 0.141           |
| Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. |  |   |
| These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)       |  |   |
| and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.                             |  |   |

**General Statistics**

|                              |   |                                 |   |
|------------------------------|---|---------------------------------|---|
| Number of Valid Observations | 6 | Number of Distinct Observations | 6 |
|------------------------------|---|---------------------------------|---|

**Raw Statistics****Log-transformed Statistics**

|                          |         |                              |
|--------------------------|---------|------------------------------|
| Minimum                  | -0.0351 | Log Statistics Not Available |
| Maximum                  | 0.564   |                              |
| Mean                     | 0.159   |                              |
| Median                   | 0.109   |                              |
| SD                       | 0.211   |                              |
| Coefficient of Variation | 1.325   |                              |
| Skewness                 | 1.836   |                              |

**Warning:** A sample size of 'n' = 6 may not be adequate enough to compute meaningful and reliable test statistics and estimates!

It is suggested to collect at least 8 to 10 observations using these statistical methods!

If possible compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

**Warning:** There are only 6 Values in this data

**Note:** It should be noted that even though bootstrap methods may be performed on this data set,  
the resulting calculations may not be reliable enough to draw conclusions

The literature suggests to use bootstrap methods on data sets having more than 10-15 observations.

**Relevant UCL Statistics****Normal Distribution Test**

Shapiro Wilk Test Statistic | 0.809

Shapiro Wilk Critical Value | 0.788

**Lognormal Distribution Test**

Not Available

Data appear Normal at 5% Significance Level

**Assuming Normal Distribution**

95% Student's-t UCL | 0.332

**Assuming Lognormal Distribution**

95% H-UCL | N/A

**Assuming Normal Distribution**

95% Student's-t UCL | 0.332

**95% UCLs (Adjusted for Skewness)**

95% Adjusted-CLT UCL (Chen 1995) | 0.369

95% Modified-t UCL (Johnson-1978) | 0.343

**Gamma Distribution Test****Data Distribution**

Gamma Statistics Not Available

Data appear Normal at 5% Significance Level

**Potential UCL to Use**

Use 95% Student's-t UCL | 0.332

95% CLT UCL | 0.3

95% Jackknife UCL | 0.332

95% Standard Bootstrap UCL | 0.287

95% Bootstrap-t UCL | 0.509

95% Hall's Bootstrap UCL | 0.945

95% Percentile Bootstrap UCL | 0.312

95% BCA Bootstrap UCL | 0.335

95% Chebyshev(Mean, Sd) UCL | 0.534

97.5% Chebyshev(Mean, Sd) UCL | 0.696

99% Chebyshev(Mean, Sd) UCL | 1.014

**Note:** Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)

and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

| General Statistics           |       |                                 |         |
|------------------------------|-------|---------------------------------|---------|
| Raw Statistics               |       | Log-transformed Statistics      |         |
| Number of Valid Observations | 6     | Number of Distinct Observations | 6       |
| Minimum                      | 0.907 | Minimum of Log Data             | -0.0976 |
| Maximum                      | 2.94  | Maximum of Log Data             | 1.078   |
| Mean                         | 1.701 | Mean of log Data                | 0.443   |
| Median                       | 1.455 | SD of log Data                  | 0.458   |
| SD                           | 0.798 |                                 |         |
| Coefficient of Variation     | 0.469 |                                 |         |
| Skewness                     | 0.819 |                                 |         |

Warning: A sample size of 'n' = 6 may not adequate enough to compute meaningful and reliable test statistics and estimates!

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If possible compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

Warning: There are only 6 Values in this data

Note: It should be noted that even though bootstrap methods may be performed on this data set,  
the resulting calculations may not be reliable enough to draw conclusions

The literature suggests to use bootstrap methods on data sets having more than 10-15 observations.

| Relevant UCL Statistics  |        |  |       |
|--|--------|--|-------|
| Normal Distribution Test   |        | Lognormal Distribution Test                    |       |
| Shapiro Wilk Test Statistic  | 0.909  | Shapiro Wilk Test Statistic                    | 0.951 |
| Shapiro Wilk Critical Value  | 0.788  | Shapiro Wilk Critical Value                    | 0.788 |
| Data appear Normal at 5% Significance Level  |        | Data appear Lognormal at 5% Significance Level |       |
| Assuming Normal Distribution   |        | Assuming Lognormal Distribution                |       |
| 95% Student's-t UCL  | 2.357  | 95% H-UCL                                      | 2.907 |
| 95% UCLs (Adjusted for Skewness)   |        | 95% Chebyshev (MVUE) UCL                       |       |
| 95% Adjusted-CLT UCL (Chen-1995)   | 2.353  | 97.5% Chebyshev (MVUE) UCL                     | 3.675 |
| 95% Modified-t UCL (Johnson-1978)  | 2.375  | 99% Chebyshev (MVUE) UCL                       | 4.848 |
| Gamma Distribution Test  |        | Data Distribution                              |       |
| k star (bias corrected)  | 3.013  | Data appear Normal at 5% Significance Level    |       |
| Theta Star   | 0.565  |  |       |
| MLE of Mean  | 1.701  |  |       |
| MLE of Standard Deviation  | 0.98   |  |       |
| nu star  | 36.15  |  |       |
| Approximate Chi Square Value (.05)   | 23.39  | Nonparametric Statistics                       |       |
| Adjusted Level of Significance   | 0.0122 | 95% CLT UCL                                    | 2.237 |
| Adjusted Chi Square Value  | 19.77  | 95% Jackknife UCL                              | 2.357 |
|  |        | 95% Standard Bootstrap UCL                     | 2.193 |
| Anderson-Darling Test Statistic  | 0.278  | 95% Bootstrap-t UCL                            | 2.89  |
| Anderson-Darling 5% Critical Value   | 0.698  | 95% Hall's Bootstrap UCL                       | 3.779 |
| Kolmogorov-Smirnov Test Statistic  | 0.196  | 95% Percentile Bootstrap UCL                   | 2.222 |
| Kolmogorov-Smirnov 5% Critical Value   | 0.333  | 95% BCA Bootstrap UCL                          | 2.288 |
| Data appear Gamma Distributed at 5% Significance Level   |        | 95% Chebyshev(Mean, Sd) UCL                    | 3.121 |
|  |        | 97.5% Chebyshev(Mean, Sd) UCL                  | 3.735 |
| Assuming Gamma Distribution  |        | 99% Chebyshev(Mean, Sd) UCL                    |       |
| 95% Approximate Gamma UCL  | 2.629  |  |       |
| 95% Adjusted Gamma UCL   | 3.111  |  |       |
| Potential UCL to Use   |        | Use 95% Student's-t UCL                        | 2.357 |
| Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. |        |  |       |
| These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)       |        |  |       |
| and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.                             |        |  |       |

**General Statistics**

|                              |   |                                 |   |
|------------------------------|---|---------------------------------|---|
| Number of Valid Observations | 6 | Number of Distinct Observations | 6 |
|------------------------------|---|---------------------------------|---|

**Raw Statistics**

|                          |       | <b>Log-transformed Statistics</b> |        |
|--------------------------|-------|-----------------------------------|--------|
| Minimum                  | 0.189 | Minimum of Log Data               | -1.666 |
| Maximum                  | 0.794 | Maximum of Log Data               | -0.231 |
| Mean                     | 0.456 | Mean of log Data                  | -0.968 |
| Median                   | 0.391 | SD of log Data                    | 0.677  |
| SD                       | 0.284 |                                   |        |
| Coefficient of Variation | 0.623 |                                   |        |
| Skewness                 | 0.283 |                                   |        |

**Warning:** A sample size of 'n' = 6 may not adequate enough to compute meaningful and reliable test statistics and estimates!

It is suggested to collect at least 8 to 10 observations using these statistical methods!

If possible compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

**Warning:** There are only 6 Values in this data

**Note:** It should be noted that even though bootstrap methods may be performed on this data set,  
the resulting calculations may not be reliable enough to draw conclusions

The literature suggests to use bootstrap methods on data sets having more than 10-15 observations.

**Relevant UCL Statistics**

| <b>Normal Distribution Test</b>                        |        | <b>Lognormal Distribution Test</b>             |       |
|--|--------|--|-------|
| Shapiro Wilk Test Statistic                            | 0.814  | Shapiro Wilk Test Statistic                    | 0.812 |
| Shapiro Wilk Critical Value                            | 0.788  | Shapiro Wilk Critical Value                    | 0.788 |
| Data appear Normal at 5% Significance Level            |        | Data appear Lognormal at 5% Significance Level |       |
| <b>Assuming Normal Distribution</b>                    |        | <b>Assuming Lognormal Distribution</b>         |       |
| 95% Student's-t UCL                                    | 0.69   | 95% H-UCL                                      | 1.223 |
| 95% UCLs (Adjusted for Skewness)                       |        | 95% Chebyshev (MVUE) UCL                       | 1.006 |
| 95% Adjusted-CLT UCL (Chen-1995)                       | 0.661  | 97.5% Chebyshev (MVUE) UCL                     | 1.243 |
| 95% Modified-t UCL (Johnson-1978)                      | 0.692  | 99% Chebyshev (MVUE) UCL                       | 1.71  |
| <b>Gamma Distribution Test</b>                         |        | <b>Data Distribution</b>                       |       |
| k star (bias corrected)                                | 1.555  | Data appear Normal at 5% Significance Level    |       |
| Theta Star   | 0.293  |  |       |
| MLE of Mean  | 0.456  |  |       |
| MLE of Standard Deviation                              | 0.366  |  |       |
| nu star  | 18.66  |  |       |
| Approximate Chi Square Value (.05)                     | 9.867  | <b>Nonparametric Statistics</b>                |       |
| Adjusted Level of Significance                         | 0.0122 | 95% CLT UCL                                    | 0.647 |
| Adjusted Chi Square Value                              | 7.67   | 95% Jackknife UCL                              | 0.69  |
|  |        | 95% Standard Bootstrap UCL                     | 0.629 |
| Anderson-Darling Test Statistic                        | 0.64   | 95% Bootstrap-t UCL                            | 0.666 |
| Anderson-Darling 5% Critical Value                     | 0.702  | 95% Hall's Bootstrap UCL                       | 0.571 |
| Kolmogorov-Smirnov Test Statistic                      | 0.309  | 95% Percentile Bootstrap UCL                   | 0.641 |
| Kolmogorov-Smirnov 5% Critical Value                   | 0.335  | 95% BCA Bootstrap UCL                          | 0.643 |
| Data appear Gamma Distributed at 5% Significance Level |        | 95% Chebyshev(Mean, Sd) UCL                    | 0.961 |
|  |        | 97.5% Chebyshev(Mean, Sd) UCL                  | 1.18  |
| Assuming Gamma Distribution                            |        | 99% Chebyshev(Mean, Sd) UCL                    | 1.61  |
| 95% Approximate Gamma UCL                              | 0.862  |  |       |
| 95% Adjusted Gamma UCL                                 | 1.109  |  |       |
| <b>Potential UCL to Use</b>                            |        | <b>Use 95% Student's-t UCL</b>                 |       |
|  |        |  | 0.69  |

**Note:** Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)

and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

**General Statistics**

|                              |   |                                 |   |
|------------------------------|---|---------------------------------|---|
| Number of Valid Observations | 6 | Number of Distinct Observations | 6 |
|------------------------------|---|---------------------------------|---|

**Raw Statistics****Log-transformed Statistics**

|                          |        |                     |        |
|--------------------------|--------|---------------------|--------|
| Minimum                  | 0.205  | Minimum of Log Data | -1.585 |
| Maximum                  | 1.22   | Maximum of Log Data | 0.199  |
| Mean                     | 0.778  | Mean of log Data    | -0.433 |
| Median                   | 0.95   | SD of log Data      | 0.736  |
| SD                       | 0.412  |                     |        |
| Coefficient of Variation | 0.53   |                     |        |
| Skewness                 | -0.731 |                     |        |

**Warning:** A sample size of 'n' = 6 may not adequate enough to compute meaningful and reliable test statistics and estimates!

It is suggested to collect at least 8 to 10 observations using these statistical methods!

If possible compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

**Warning:** There are only 6 Values in this data

**Note:** It should be noted that even though bootstrap methods may be performed on this data set,  
the resulting calculations may not be reliable enough to draw conclusions

The literature suggests to use bootstrap methods on data sets having more than 10-15 observations.

**Relevant UCL Statistics****Normal Distribution Test****Lognormal Distribution Test**

|                             |       |                             |       |
|-----------------------------|-------|-----------------------------|-------|
| Shapiro Wilk Test Statistic | 0.856 | Shapiro Wilk Test Statistic | 0.803 |
| Shapiro Wilk Critical Value | 0.788 | Shapiro Wilk Critical Value | 0.788 |

Data appear Normal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

**Assuming Normal Distribution****Assuming Lognormal Distribution**

|                                  |       |                            |       |
|----------------------------------|-------|----------------------------|-------|
| 95% Student's-t UCL              | 1.117 | 95% H-UCL                  | 2.501 |
| 95% UCLs (Adjusted for Skewness) |       | 95% Chebyshev (MVUE) UCL   | 1.858 |
| 95% Adjusted-CLT UCL (Chen-1995) | 1.001 | 97.5% Chebyshev (MVUE) UCL | 2.312 |

95% Modified-t UCL (Johnson-1978)

1.109

99% Chebyshev (MVUE) UCL

3.205

**Gamma Distribution Test****Data Distribution**

k star (bias corrected)

1.561

Data appear Normal at 5% Significance Level

Theta Star

0.498

MLE of Mean

0.778

MLE of Standard Deviation

0.623

nu star

18.74

Approximate Chi Square Value (.05)

9.925

**Nonparametric Statistics**

Adjusted Level of Significance

0.0122

95% CLT UCL

1.055

Adjusted Chi Square Value

7.72

95% Jackknife UCL

1.117

Anderson-Darling Test Statistic

0.679

95% Standard Bootstrap UCL

1.027

Anderson-Darling 5% Critical Value

0.702

95% Bootstrap-t UCL

1.087

Kolmogorov-Smirnov Test Statistic

0.357

95% Hall's Bootstrap UCL

0.943

Kolmogorov-Smirnov 5% Critical Value

0.335

95% Percentile Bootstrap UCL

1.023

Data follow Appr. Gamma Distribution at 5% Significance Level

95% BCA Bootstrap UCL

1.006

95% Chebyshev(Mean, Sd) UCL

1.511

97.5% Chebyshev(Mean, Sd) UCL

1.829

**Assuming Gamma Distribution**

99% Chebyshev(Mean, Sd) UCL

2.452

95% Approximate Gamma UCL

1.468

95% Adjusted Gamma UCL

1.888

**Potential UCL to Use**

Use 95% Student's-t UCL

1.117

**Note:** Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)

and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

**General Statistics**

|                              |   |                                 |   |
|------------------------------|---|---------------------------------|---|
| Number of Valid Observations | 6 | Number of Distinct Observations | 6 |
|------------------------------|---|---------------------------------|---|

**Raw Statistics****Log-transformed Statistics**

|                          |        |                     |        |
|--------------------------|--------|---------------------|--------|
| Minimum                  | 0.474  | Minimum of Log Data | -0.747 |
| Maximum                  | 2.71   | Maximum of Log Data | 0.997  |
| Mean                     | 1.841  | Mean of log Data    | 0.487  |
| Median                   | 1.995  | SD of log Data      | 0.628  |
| SD                       | 0.762  |                     |        |
| Coefficient of Variation | 0.414  |                     |        |
| Skewness                 | -1.235 |                     |        |

**Warning:** A sample size of 'n' = 6 may not adequate enough to compute meaningful and reliable test statistics and estimates!

**It is suggested to collect at least 8 to 10 observations using these statistical methods!**

If possible compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

**Warning:** There are only 6 Values in this data

**Note:** It should be noted that even though bootstrap methods may be performed on this data set,  
the resulting calculations may not be reliable enough to draw conclusions

The literature suggests to use bootstrap methods on data sets having more than 10-15 observations.

**Relevant UCL Statistics****Normal Distribution Test****Lognormal Distribution Test**

|                             |       |                             |       |
|-----------------------------|-------|-----------------------------|-------|
| Shapiro Wilk Test Statistic | 0.911 | Shapiro Wilk Test Statistic | 0.753 |
| Shapiro Wilk Critical Value | 0.788 | Shapiro Wilk Critical Value | 0.788 |

Data appear Normal at 5% Significance Level

Data not Lognormal at 5% Significance Level

**Assuming Normal Distribution****Assuming Lognormal Distribution**

|                                   |       |                            |       |
|-----------------------------------|-------|----------------------------|-------|
| 95% Student's-t UCL               | 2.467 | 95% H-UCL                  | 4.561 |
| 95% UCLs (Adjusted for Skewness)  |       | 95% Chebyshev (MVUE) UCL   | 4.04  |
| 95% Adjusted-CLT UCL (Chen-1995)  | 2.184 | 97.5% Chebyshev (MVUE) UCL | 4.961 |
| 95% Modified-t UCL (Johnson-1978) | 2.441 | 99% Chebyshev (MVUE) UCL   | 6.771 |

**Gamma Distribution Test****Data Distribution**

k star (bias corrected) 2.227 Data appear Normal at 5% Significance Level

Theta Star 0.827

MLE of Mean 1.841

MLE of Standard Deviation 1.234

nu star 26.72

Approximate Chi Square Value (.05) 15.93

**Nonparametric Statistics**

Adjusted Level of Significance 0.0122

95% CLT UCL 2.352

Adjusted Chi Square Value 13.02

95% Jackknife UCL 2.467

95% Standard Bootstrap UCL 2.303

Anderson-Darling Test Statistic 0.654

95% Bootstrap-t UCL 2.29

Anderson-Darling 5% Critical Value 0.7

95% Hall's Bootstrap UCL 2.23

Kolmogorov-Smirnov Test Statistic 0.311

95% Percentile Bootstrap UCL 2.277

Kolmogorov-Smirnov 5% Critical Value 0.333

95% BCA Bootstrap UCL 2.207

Data appear Gamma Distributed at 5% Significance Level

95% Chebyshev(Mean, Sd) UCL 3.196

97.5% Chebyshev(Mean, Sd) UCL 3.782

**Assuming Gamma Distribution**

99% Chebyshev(Mean, Sd) UCL 4.934

95% Approximate Gamma UCL 3.087

95% Adjusted Gamma UCL 3.776

**Potential UCL to Use**

Use 95% Student's-t UCL 2.467

**Note:** Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)

and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

| General Statistics  |        |   |  |        |   |
|---|--------|---|--|--------|---|
| Number of Valid Observations  |        | 6 | Number of Distinct Observations                |        | 6 |
| Raw Statistics  |        |   | Log-transformed Statistics                     |        |   |
| Minimum   | 0.17   |   | Minimum of Log Data                            | -1.772 |   |
| Maximum   | 0.9    |   | Maximum of Log Data                            | -0.105 |   |
| Mean  | 0.527  |   | Mean of log Data                               | -0.772 |   |
| Median  | 0.472  |   | SD of log Data                                 | 0.597  |   |
| SD  | 0.27   |   |  |        |   |
| Coefficient of Variation  | 0.511  |   |  |        |   |
| Skewness  | 0.265  |   |  |        |   |
| <br>Warning: A sample size of 'n' = 6 may not adequate enough to compute meaningful and reliable test statistics and estimates!   |        |   |  |        |   |
| It is suggested to collect at least 8 to 10 observations using these statistical methods!   |        |   |  |        |   |
| If possible compute and collect Data Quality Objectives (DQO) based sample size and analytical results.   |        |   |  |        |   |
| <br>Warning: There are only 6 Values in this data   |        |   |  |        |   |
| Note: It should be noted that even though bootstrap methods may be performed on this data set,<br>the resulting calculations may not be reliable enough to draw conclusions |        |   |  |        |   |
| <br>The literature suggests to use bootstrap methods on data sets having more than 10-15 observations.  |        |   |  |        |   |
| Relevant UCL Statistics   |        |   |  |        |   |
| Normal Distribution Test  |        |   | Lognormal Distribution Test                    |        |   |
| Shapiro Wilk Test Statistic   | 0.961  |   | Shapiro Wilk Test Statistic                    | 0.942  |   |
| Shapiro Wilk Critical Value   | 0.788  |   | Shapiro Wilk Critical Value                    | 0.788  |   |
| Data appear Normal at 5% Significance Level   |        |   | Data appear Lognormal at 5% Significance Level |        |   |
| Assuming Normal Distribution  |        |   | Assuming Lognormal Distribution                |        |   |
| 95% Student's-t UCL   | 0.749  |   | 95% H-UCL                                      | 1.192  |   |
| 95% UCLs (Adjusted for Skewness)  |        |   | 95% Chebyshev (MVUE) UCL                       |        |   |
| 95% Adjusted-CLT UCL (Chen-1995)  | 0.721  |   | 97.5% Chebyshev (MVUE) UCL                     | 1.345  |   |
| 95% Modified-t UCL (Johnson-1978)   | 0.751  |   | 99% Chebyshev (MVUE) UCL                       | 1.826  |   |
| Gamma Distribution Test   |        |   | Data Distribution                              |        |   |
| k star (bias corrected)   | 2.095  |   | Data appear Normal at 5% Significance Level    |        |   |
| Theta Star  | 0.252  |   |  |        |   |
| MLE of Mean   | 0.527  |   |  |        |   |
| MLE of Standard Deviation   | 0.364  |   |  |        |   |
| nu star   | 25.14  |   |  |        |   |
| Approximate Chi Square Value (.05)  | 14.72  |   | Nonparametric Statistics                       |        |   |
| Adjusted Level of Significance  | 0.0122 |   | 95% CLT UCL                                    | 0.708  |   |
| Adjusted Chi Square Value   | 11.94  |   | 95% Jackknife UCL                              | 0.749  |   |
|   |        |   | 95% Standard Bootstrap UCL                     | 0.699  |   |
| Anderson-Darling Test Statistic   | 0.222  |   | 95% Bootstrap-t UCL                            | 0.854  |   |
| Anderson-Darling 5% Critical Value  | 0.7    |   | 95% Hall's Bootstrap UCL                       | 0.912  |   |
| Kolmogorov-Smirnov Test Statistic   | 0.172  |   | 95% Percentile Bootstrap UCL                   | 0.707  |   |
| Kolmogorov-Smirnov 5% Critical Value  | 0.334  |   | 95% BCA Bootstrap UCL                          | 0.701  |   |
| Data appear Gamma Distributed at 5% Significance Level  |        |   | 95% Chebyshev(Mean, Sd) UCL                    | 1.007  |   |
|   |        |   | 97.5% Chebyshev(Mean, Sd) UCL                  | 1.214  |   |
| Assuming Gamma Distribution   |        |   | 99% Chebyshev(Mean, Sd) UCL                    | 1.622  |   |
| 95% Approximate Gamma UCL   | 0.9    |   |  |        |   |
| 95% Adjusted Gamma UCL  | 1.11   |   |  |        |   |
| Potential UCL to Use  |        |   | Use 95% Student's-t UCL                        |        |   |
|   |        |   | 0.749  |        |   |
| <br>Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.  |        |   |  |        |   |
| These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)  |        |   |  |        |   |
| and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.  |        |   |  |        |   |

**General Statistics**

|                              |   |                                 |   |
|------------------------------|---|---------------------------------|---|
| Number of Valid Observations | 6 | Number of Distinct Observations | 6 |
|------------------------------|---|---------------------------------|---|

**Raw Statistics****Log-transformed Statistics**

|                          |        |                     |        |
|--------------------------|--------|---------------------|--------|
| Minimum                  | 0.006  | Minimum of Log Data | -5.116 |
| Maximum                  | 0.297  | Maximum of Log Data | -1.214 |
| Mean                     | 0.0669 | Mean of log Data    | -3.555 |
| Median                   | 0.0251 | SD of log Data      | 1.298  |
| SD                       | 0.113  |                     |        |
| Coefficient of Variation | 1.692  |                     |        |
| Skewness                 | 2.409  |                     |        |

**Warning:** A sample size of 'n' = 6 may not adequate enough to compute meaningful and reliable test statistics and estimates!

It is suggested to collect at least 8 to 10 observations using these statistical methods!

If possible compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

**Warning:** There are only 6 Values in this data

**Note:** It should be noted that even though bootstrap methods may be performed on this data set,  
the resulting calculations may not be reliable enough to draw conclusions

The literature suggests to use bootstrap methods on data sets having more than 10-15 observations.

**Relevant UCL Statistics****Normal Distribution Test****Lognormal Distribution Test**

|                             |       |                             |       |
|-----------------------------|-------|-----------------------------|-------|
| Shapiro Wilk Test Statistic | 0.58  | Shapiro Wilk Test Statistic | 0.895 |
| Shapiro Wilk Critical Value | 0.788 | Shapiro Wilk Critical Value | 0.788 |

Data not Normal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

**Assuming Normal Distribution****Assuming Lognormal Distribution**

|                                  |       |                            |       |
|----------------------------------|-------|----------------------------|-------|
| 95% Student's-t UCL              | 0.16  | 95% H-UCL                  | 1.324 |
| 95% UCLs (Adjusted for Skewness) |       | 95% Chebyshev (MVUE) UCL   | 0.175 |
| 95% Adjusted-CLT UCL (Chen-1995) | 0.191 | 97.5% Chebyshev (MVUE) UCL | 0.227 |

95% Modified-t UCL (Johnson-1978)

0.168

99% Chebyshev (MVUE) UCL

0.33

**Gamma Distribution Test****Data Distribution**

k star (bias corrected)

Data appear Lognormal at 5% Significance Level

Theta Star

MLE of Mean

MLE of Standard Deviation

nu star

Approximate Chi Square Value (.05)

1.435

**Nonparametric Statistics**

Adjusted Level of Significance

0.0122

95% CLT UCL

0.143

Adjusted Chi Square Value

0.808

95% Jackknife UCL

0.16

Anderson-Darling Test Statistic

0.767

95% Standard Bootstrap UCL

0.138

Anderson-Darling 5% Critical Value

0.723

95% Bootstrap-t UCL

0.766

Kolmogorov-Smirnov Test Statistic

0.386

95% Hall's Bootstrap UCL

0.745

Kolmogorov-Smirnov 5% Critical Value

0.344

95% Percentile Bootstrap UCL

0.158

Data not Gamma Distributed at 5% Significance Level

95% Chebyshev (Mean, Sd) UCL

0.268

97.5% Chebyshev (Mean, Sd) UCL

0.355

**Assuming Gamma Distribution**

99% Chebyshev (Mean, Sd) UCL

0.527

95% Approximate Gamma UCL

0.261

95% Adjusted Gamma UCL

0.463

Use 95% Chebyshev (Mean, Sd) UCL

0.268

**Potential UCL to Use**

**Note:** Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)

and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

| General Statistics           |       |                                 |        |
|------------------------------|-------|---------------------------------|--------|
| Number of Valid Observations | 6     | Number of Distinct Observations | 6      |
| Raw Statistics               |       | Log-transformed Statistics      |        |
| Minimum                      | 0.408 | Minimum of Log Data             | -0.896 |
| Maximum                      | 2.39  | Maximum of Log Data             | 0.871  |
| Mean                         | 1.324 | Mean of log Data                | 0.101  |
| Median                       | 1.205 | SD of log Data                  | 0.691  |
| SD                           | 0.797 |                                 |        |
| Coefficient of Variation     | 0.602 |                                 |        |
| Skewness                     | 0.342 |                                 |        |

Warning: A sample size of 'n' = 6 may not adequate enough to compute meaningful and reliable test statistics and estimates!

It is suggested to collect at least 8 to 10 observations using these statistical methods!  
If possible compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

Warning: There are only 6 Values in this data

Note: It should be noted that even though bootstrap methods may be performed on this data set,  
the resulting calculations may not be reliable enough to draw conclusions

The literature suggests to use bootstrap methods on data sets having more than 10-15 observations.

| Relevant UCL Statistics  |        |  |       |
|--|--------|--|-------|
| Normal Distribution Test   |        | Lognormal Distribution Test                    |       |
| Shapiro Wilk Test Statistic  | 0.932  | Shapiro Wilk Test Statistic                    | 0.945 |
| Shapiro Wilk Critical Value  | 0.788  | Shapiro Wilk Critical Value                    | 0.788 |
| Data appear Normal at 5% Significance Level  |        | Data appear Lognormal at 5% Significance Level |       |
| Assuming Normal Distribution   |        | Assuming Lognormal Distribution                |       |
| 95% Student's-t UCL  | 1.98   | 95% H-UCL                                      | 3.716 |
| 95% UCLs (Adjusted for Skewness)   |        | 95% Chebyshev (MVUE) UCL                       | 2.986 |
| 95% Adjusted-d-CLT UCL (Chen-1995)   | 1.908  | 97.5% Chebyshev (MVUE) UCL                     | 3.698 |
| 95% Modified-t UCL (Johnson-1978)  | 1.987  | 99% Chebyshev (MVUE) UCL                       | 5.095 |
| Gamma Distribution Test  |        | Data Distribution                              |       |
| k star (bias corrected)  | 1.577  | Data appear Normal at 5% Significance Level    |       |
| Theta Star   | 0.84   |  |       |
| MLE of Mean  | 1.324  |  |       |
| MLE of Standard Deviation  | 1.055  |  |       |
| nu star  | 18.92  |  |       |
| Approximate Chi Square Value (.05)   | 10.06  | Nonparametric Statistics                       |       |
| Adjusted Level of Significance   | 0.0122 | 95% CLT UCL                                    | 1.859 |
| Adjusted Chi Square Value  | 7.837  | 95% Jackknife UCL                              | 1.98  |
|  |        | 95% Standard Bootstrap UCL                     | 1.815 |
| Anderson-Darling Test Statistic  | 0.238  | 95% Bootstrap-t UCL                            | 2.156 |
| Anderson-Darling 5% Critical Value   | 0.702  | 95% Hall's Bootstrap UCL                       | 2.169 |
| Kolmogorov-Smirnov Test Statistic  | 0.189  | 95% Percentile Bootstrap UCL                   | 1.83  |
| Kolmogorov-Smirnov 5% Critical Value   | 0.335  | 95% BCA Bootstrap UCL                          | 1.86  |
| Data appear Gamma Distributed at 5% Significance Level   |        | 95% Chebyshev(Means, Sd) UCL                   | 2.742 |
|  |        | 97.5% Chebyshev(Means, Sd) UCL                 | 3.355 |
| Assuming Gamma Distribution  |        | 99% Chebyshev(Means, Sd) UCL                   | 4.56  |
| 95% Approximate Gamma UCL  | 2.491  |  |       |
| 95% Adjusted Gamma UCL   | 3.197  |  |       |
| Potential UCL to Use   |        | Use 95% Student's-t UCL                        |       |
|  |        |  | 1.98  |
| Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. |        |  |       |
| These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)       |        |  |       |
| and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.                             |        |  |       |

**ATTACHMENT H-2**

**RESRAD OUTPUT SUMMARY REPORTS**

**(On CD-ROM on the Back Cover of this Report)**

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DT-34 Resident  
RESRAD Dose Summary

1RESRAD, Version 6.5      T<sub>1/2</sub> Limit = 180 days      03/16/2011 10:17 Page 1  
Summary : DT-34-Onsite Resident  
File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\DT-34-ONSITE RESIDENT 2011.RAD

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Summary : DT-34-Onsite Resident

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\DT-34-ONSITE RESIDENT 2011.RAD

Dose Conversion Factor (and Related) Parameter Summary  
Dose Library: FGR 12 & FGR 11

| 0<br>Menu | Parameter  | Current<br>Value# | Base<br>Case* | Parameter<br>Name |
|-----------|--|-------------------|---------------|-------------------|
| A-1       | DCF's for external ground radiation, (mrem/yr)/(pCi/g) |                   |               |                   |
| A-1       | Ac-227 (Source: FGR 12)                                | 4.951E-04         | 4.951E-04     | DCF1( 1)          |
| A-1       | At-218 (Source: FGR 12)                                | 5.847E-03         | 5.847E-03     | DCF1( 2)          |
| A-1       | Bi-210 (Source: FGR 12)                                | 3.606E-03         | 3.606E-03     | DCF1( 3)          |
| A-1       | Bi-211 (Source: FGR 12)                                | 2.559E-01         | 2.559E-01     | DCF1( 4)          |
| A-1       | Bi-214 (Source: FGR 12)                                | 9.808E+00         | 9.808E+00     | DCF1( 5)          |
| A-1       | Fr-223 (Source: FGR 12)                                | 1.980E-01         | 1.980E-01     | DCF1( 6)          |
| A-1       | Pa-231 (Source: FGR 12)                                | 1.906E-01         | 1.906E-01     | DCF1( 7)          |
| A-1       | Pa-234 (Source: FGR 12)                                | 1.155E+01         | 1.155E+01     | DCF1( 8)          |
| A-1       | Pa-234m (Source: FGR 12)                               | 8.967E-02         | 8.967E-02     | DCF1( 9)          |
| A-1       | Pb-210 (Source: FGR 12)                                | 2.447E-03         | 2.447E-03     | DCF1( 10)         |
| A-1       | Pb-211 (Source: FGR 12)                                | 3.064E-01         | 3.064E-01     | DCF1( 11)         |
| A-1       | Pb-214 (Source: FGR 12)                                | 1.341E+00         | 1.341E+00     | DCF1( 12)         |
| A-1       | Po-210 (Source: FGR 12)                                | 5.231E-05         | 5.231E-05     | DCF1( 13)         |
| A-1       | Po-211 (Source: FGR 12)                                | 4.764E-02         | 4.764E-02     | DCF1( 14)         |
| A-1       | Po-214 (Source: FGR 12)                                | 5.138E-04         | 5.138E-04     | DCF1( 15)         |
| A-1       | Po-215 (Source: FGR 12)                                | 1.016E-03         | 1.016E-03     | DCF1( 16)         |
| A-1       | Po-218 (Source: FGR 12)                                | 5.642E-05         | 5.642E-05     | DCF1( 17)         |
| A-1       | Ra-223 (Source: FGR 12)                                | 6.034E-01         | 6.034E-01     | DCF1( 18)         |
| A-1       | Ra-226 (Source: FGR 12)                                | 3.176E-02         | 3.176E-02     | DCF1( 19)         |
| A-1       | Rn-219 (Source: FGR 12)                                | 3.083E-01         | 3.083E-01     | DCF1( 20)         |
| A-1       | Rn-222 (Source: FGR 12)                                | 2.354E-03         | 2.354E-03     | DCF1( 21)         |
| A-1       | Th-227 (Source: FGR 12)                                | 5.212E-01         | 5.212E-01     | DCF1( 22)         |
| A-1       | Th-230 (Source: FGR 12)                                | 1.209E-03         | 1.209E-03     | DCF1( 23)         |
| A-1       | Th-231 (Source: FGR 12)                                | 3.643E-02         | 3.643E-02     | DCF1( 24)         |
| A-1       | Th-234 (Source: FGR 12)                                | 2.410E-02         | 2.410E-02     | DCF1( 25)         |
| A-1       | Tl-207 (Source: FGR 12)                                | 1.980E-02         | 1.980E-02     | DCF1( 26)         |
| A-1       | Tl-210 (Source: no data)                               | 0.000E+00         | -2.000E+00    | DCF1( 27)         |
| A-1       | U-234 (Source: FGR 12)                                 | 4.017E-04         | 4.017E-04     | DCF1( 28)         |
| A-1       | U-235 (Source: FGR 12)                                 | 7.211E-01         | 7.211E-01     | DCF1( 29)         |
| A-1       | U-238 (Source: FGR 12)                                 | 1.031E-04         | 1.031E-04     | DCF1( 30)         |
| B-1       | Dose conversion factors for inhalation, mrem/pCi:      |                   |               |                   |
| B-1       | Ac-227+D   | 6.724E+00         | 6.700E+00     | DCF2( 1)          |
| B-1       | Pa-231   | 1.280E+00         | 1.280E+00     | DCF2( 2)          |
| B-1       | Pb-210+D   | 2.320E-02         | 1.360E-02     | DCF2( 3)          |
| B-1       | Ra-226+D   | 8.594E-03         | 8.580E-03     | DCF2( 4)          |
| B-1       | Th-230   | 3.260E-01         | 3.260E-01     | DCF2( 5)          |
| B-1       | U-234  | 1.320E-01         | 1.320E-01     | DCF2( 6)          |
| B-1       | U-235+D  | 1.230E-01         | 1.230E-01     | DCF2( 7)          |
| B-1       | U-238  | 1.180E-01         | 1.180E-01     | DCF2( 8)          |
| B-1       | U-238+D  | 1.180E-01         | 1.180E-01     | DCF2( 9)          |
| D-1       | Dose conversion factors for ingestion, mrem/pCi:       |                   |               |                   |
| D-1       | Ac-227+D   | 1.480E-02         | 1.410E-02     | DCF3( 1)          |
| D-1       | Pa-231   | 1.060E-02         | 1.060E-02     | DCF3( 2)          |
| D-1       | Pb-210+D   | 7.276E-03         | 5.370E-03     | DCF3( 3)          |
| D-1       | Ra-226+D   | 1.321E-03         | 1.320E-03     | DCF3( 4)          |
| D-1       | Th-230   | 5.480E-04         | 5.480E-04     | DCF3( 5)          |
| D-1       | U-234  | 2.830E-04         | 2.830E-04     | DCF3( 6)          |

Dose Conversion Factor (and Related) Parameter Summary (continued)  
Dose Library: FGR 12 & FGR 11

| 0<br>Menu | Parameter  | Current<br>Value# | Base<br>Case* | Parameter<br>Name |
|-----------|--|-------------------|---------------|-------------------|
| D-1       | U-235+D  | 2.673E-04         | 2.660E-04     | DCF3( 7)          |
| D-1       | U-238  | 2.550E-04         | 2.550E-04     | DCF3( 8)          |
| D-1       | U-238+D  | 2.687E-04         | 2.550E-04     | DCF3( 9)          |
| D-34      | Food transfer factors:                                   |                   |               |                   |
| D-34      | Ac-227+D , plant/soil concentration ratio, dimensionless | 2.500E-03         | 2.500E-03     | RTF( 1,1)         |
| D-34      | Ac-227+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d) | 2.000E-05         | 2.000E-05     | RTF( 1,2)         |
| D-34      | Ac-227+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)  | 2.000E-05         | 2.000E-05     | RTF( 1,3)         |
| D-34      | Pa-231 , plant/soil concentration ratio, dimensionless   | 1.000E-02         | 1.000E-02     | RTF( 2,1)         |
| D-34      | Pa-231 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)   | 5.000E-03         | 5.000E-03     | RTF( 2,2)         |
| D-34      | Pa-231 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)    | 5.000E-06         | 5.000E-06     | RTF( 2,3)         |
| D-34      | Pb-210+D , plant/soil concentration ratio, dimensionless | 1.000E-02         | 1.000E-02     | RTF( 3,1)         |
| D-34      | Pb-210+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d) | 8.000E-04         | 8.000E-04     | RTF( 3,2)         |
| D-34      | Pb-210+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)  | 3.000E-04         | 3.000E-04     | RTF( 3,3)         |
| D-34      | Ra-226+D , plant/soil concentration ratio, dimensionless | 4.000E-02         | 4.000E-02     | RTF( 4,1)         |
| D-34      | Ra-226+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d) | 1.000E-03         | 1.000E-03     | RTF( 4,2)         |
| D-34      | Ra-226+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)  | 1.000E-03         | 1.000E-03     | RTF( 4,3)         |
| D-34      | Th-230 , plant/soil concentration ratio, dimensionless   | 1.000E-03         | 1.000E-03     | RTF( 5,1)         |
| D-34      | Th-230 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)   | 1.000E-04         | 1.000E-04     | RTF( 5,2)         |
| D-34      | Th-230 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)    | 5.000E-06         | 5.000E-06     | RTF( 5,3)         |
| D-34      | U-234 , plant/soil concentration ratio, dimensionless    | 2.500E-03         | 2.500E-03     | RTF( 6,1)         |
| D-34      | U-234 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)    | 3.400E-04         | 3.400E-04     | RTF( 6,2)         |
| D-34      | U-234 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)     | 6.000E-04         | 6.000E-04     | RTF( 6,3)         |
| D-34      | U-235+D , plant/soil concentration ratio, dimensionless  | 2.500E-03         | 2.500E-03     | RTF( 7,1)         |
| D-34      | U-235+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)  | 3.400E-04         | 3.400E-04     | RTF( 7,2)         |
| D-34      | U-235+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)   | 6.000E-04         | 6.000E-04     | RTF( 7,3)         |
| D-34      | U-238 , plant/soil concentration ratio, dimensionless    | 2.500E-03         | 2.500E-03     | RTF( 8,1)         |
| D-34      | U-238 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)    | 3.400E-04         | 3.400E-04     | RTF( 8,2)         |
| D-34      | U-238 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)     | 6.000E-04         | 6.000E-04     | RTF( 8,3)         |
| D-34      | U-238+D , plant/soil concentration ratio, dimensionless  | 2.500E-03         | 2.500E-03     | RTF( 9,1)         |
| D-34      | U-238+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)  | 3.400E-04         | 3.400E-04     | RTF( 9,2)         |
| D-34      | U-238+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)   | 6.000E-04         | 6.000E-04     | RTF( 9,3)         |
| D-5       | Bioaccumulation factors, fresh water, L/kg:              |                   |               |                   |
| D-5       | Ac-227+D , fish  | 1.500E+01         | 1.500E+01     | BIOFAC( 1,1)      |
| D-5       | Ac-227+D , crustacea and mollusks                        | 1.000E+03         | 1.000E+03     | BIOFAC( 1,2)      |
| D-5       | Pa-231 , fish  | 1.000E+01         | 1.000E+01     | BIOFAC( 2,1)      |
| D-5       | Pa-231 , crustacea and mollusks                          | 1.100E+02         | 1.100E+02     | BIOFAC( 2,2)      |
| D-5       | Pb-210+D , fish  | 3.000E+02         | 3.000E+02     | BIOFAC( 3,1)      |
| D-5       | Pb-210+D , crustacea and mollusks                        | 1.000E+02         | 1.000E+02     | BIOFAC( 3,2)      |

1RESRAD, Version 6.5

T<sub>1/2</sub> Limit = 180 days

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Summary : DT-34-Onsite Resident

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\DT-34-ONSITE RESIDENT 2011.RAD

## Dose Conversion Factor (and Related) Parameter Summary (continued)

Dose Library: FGR 12 &amp; FGR 11

| 0<br>Menu | Parameter                         | Current<br>Value# | Base<br>Case* | Parameter<br>Name |
|-----------|-----------------------------------|-------------------|---------------|-------------------|
| D-5       | Ra-226+D , fish                   | 5.000E+01         | 5.000E+01     | BIOFAC( 4,1)      |
| D-5       | Ra-226+D , crustacea and mollusks | 2.500E+02         | 2.500E+02     | BIOFAC( 4,2)      |
| D-5       |                                   |                   |               |                   |
| D-5       | Th-230 , fish                     | 1.000E+02         | 1.000E+02     | BIOFAC( 5,1)      |
| D-5       | Th-230 , crustacea and mollusks   | 5.000E+02         | 5.000E+02     | BIOFAC( 5,2)      |
| D-5       |                                   |                   |               |                   |
| D-5       | U-234 , fish                      | 1.000E+01         | 1.000E+01     | BIOFAC( 6,1)      |
| D-5       | U-234 , crustacea and mollusks    | 6.000E+01         | 6.000E+01     | BIOFAC( 6,2)      |
| D-5       |                                   |                   |               |                   |
| D-5       | U-235+D , fish                    | 1.000E+01         | 1.000E+01     | BIOFAC( 7,1)      |
| D-5       | U-235+D , crustacea and mollusks  | 6.000E+01         | 6.000E+01     | BIOFAC( 7,2)      |
| D-5       |                                   |                   |               |                   |
| D-5       | U-238 , fish                      | 1.000E+01         | 1.000E+01     | BIOFAC( 8,1)      |
| D-5       | U-238 , crustacea and mollusks    | 6.000E+01         | 6.000E+01     | BIOFAC( 8,2)      |
| D-5       |                                   |                   |               |                   |
| D-5       | U-238+D , fish                    | 1.000E+01         | 1.000E+01     | BIOFAC( 9,1)      |
| D-5       | U-238+D , crustacea and mollusks  | 6.000E+01         | 6.000E+01     | BIOFAC( 9,2)      |

#For DCF1(xxx) only, factors are for infinite depth &amp; area. See ETFG table in Ground Pathway of Detailed Report.

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

## Site-Specific Parameter Summary

| 0<br>Menu | Parameter                                       | User<br>Input | Default   | Used by RESRAD<br>(If different from user input) | Parameter<br>Name |
|-----------|---|---------------|-----------|--|-------------------|
| R011      | Area of contaminated zone (m**2)                | 9.846E+03     | 1.000E+04 | ---  | AREA              |
| R011      | Thickness of contaminated zone (m)              | 2.000E+00     | 2.000E+00 | ---  | THICK0            |
| R011      | Fraction of contamination that is submerged     | 0.000E+00     | 0.000E+00 | ---  | SUBMFRACT         |
| R011      | Length parallel to aquifer flow (m)             | 1.000E+02     | 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                |
| 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): U-234   | 2.700E-01     | 0.000E+00 | ---  | S1(6)             |
| R012      | Initial principal radionuclide (pCi/g): U-235   | 2.000E-02     | 0.000E+00 | ---  | S1(7)             |
| R012      | Initial principal radionuclide (pCi/g): U-238   | 2.700E-01     | 0.000E+00 | ---  | S1(8)             |
| R012      | Concentration in groundwater (pCi/L): U-234     | not used      | 0.000E+00 | ---  | W1( 6)            |
| R012      | Concentration in groundwater (pCi/L): U-235     | not used      | 0.000E+00 | ---  | W1( 7)            |
| R012      | Concentration in groundwater (pCi/L): U-238     | not used      | 0.000E+00 | ---  | W1( 8)            |
| 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)          | 1.280E+00     | 1.500E+00 | ---  | DENSCZ            |
| R013      | Contaminated zone erosion rate (m/yr)           | 6.000E-05     | 1.000E-03 | ---  | VCZ               |
| R013      | Contaminated zone total porosity                | 4.200E-01     | 4.000E-01 | ---  | TPCZ              |
| R013      | Contaminated zone field capacity                | 3.600E-01     | 2.000E-01 | ---  | FCCZ              |
| R013      | Contaminated zone hydraulic conductivity (m/yr) | 3.048E+00     | 1.000E+01 | ---  | HCCZ              |
| R013      | Contaminated zone b parameter                   | 1.040E+01     | 5.300E+00 | ---  | BCZ               |
| R013      | Average annual wind speed (m/sec)               | 4.170E+00     | 2.000E+00 | ---  | WIND              |
| R013      | Humidity in air (g/m**3)                        | not used      | 8.000E+00 | ---  | HUMID             |
| R013      | Evapotranspiration coefficient                  | 5.000E-01     | 5.000E-01 | ---  | EVAPTR            |
| R013      | Precipitation (m/yr)                            | 9.200E-01     | 1.000E+00 | ---  | PRECIP            |
| R013      | Irrigation (m/yr)                               | 0.000E+00     | 2.000E-01 | ---  | RI                |
| R013      | Irrigation mode                                 | overhead      | overhead  | ---  | IDITCH            |
| R013      | Runoff coefficient                              | 8.000E-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)             | 1.500E+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              |
| R014      | Saturated zone field capacity                   | 2.000E-01     | 2.000E-01 | ---  | FCSZ              |
| R014      | Saturated zone hydraulic conductivity (m/yr)    | 1.000E-02     | 1.000E+02 | ---  | HCSZ              |
| R014      | Saturated zone hydraulic gradient               | 2.000E-02     | 2.000E-02 | ---  | HGWT              |
| R014      | Saturated zone b parameter                      | 5.300E+00     | 5.300E+00 | ---  | BSZ               |
| R014      | Water table drop rate (m/yr)                    | 1.000E-03     | 1.000E-03 | ---  | VWT               |

## Site-Specific Parameter Summary (continued)

| 0<br>Menu | Parameter                                      | User<br>Input | Default   | Used by RESRAD<br>(If different from user input) | Parameter<br>Name |
|-----------|--|---------------|-----------|--|-------------------|
| R014      | Well pump intake depth (m below water table)   | 1.000E+01     | 1.000E+01 | ---  | DWIBWT            |
| R014      | Model: Nondispersion (ND) or Mass-Balance (MB) | ND            | ND        | ---  | MODEL             |
| R014      | Well pumping rate (m**3/yr)                    | 2.500E+02     | 2.500E+02 | ---  | UW                |
| R015      | Number of unsaturated zone strata              | 1             | 1         | ---  | NS                |
| R015      | Unsat. zone 1, thickness (m)                   | 4.000E+00     | 4.000E+00 | ---  | H(1)              |
| R015      | Unsat. zone 1, soil density (g/cm**3)          | 1.500E+00     | 1.500E+00 | ---  | DENSUZ(1)         |
| R015      | Unsat. zone 1, total porosity                  | 4.000E-01     | 4.000E-01 | ---  | TPUZ(1)           |
| R015      | Unsat. zone 1, effective porosity              | 2.000E-01     | 2.000E-01 | ---  | EPUZ(1)           |
| R015      | Unsat. zone 1, field capacity                  | 2.000E-01     | 2.000E-01 | ---  | FCUZ(1)           |
| R015      | Unsat. zone 1, soil-specific b parameter       | 5.300E+00     | 5.300E+00 | ---  | BUZ(1)            |
| R015      | Unsat. zone 1, hydraulic conductivity (m/yr)   | 1.000E+01     | 1.000E+01 | ---  | HCUZ(1)           |
| R016      | Distribution coefficients for U-234            |               |           |  |                   |
| R016      | Contaminated zone (cm**3/g)                    | 5.000E+01     | 5.000E+01 | ---  | DCNUCC( 6)        |
| R016      | Unsaturated zone 1 (cm**3/g)                   | 5.000E+01     | 5.000E+01 | ---  | DCNUCU( 6,1)      |
| R016      | Saturated zone (cm**3/g)                       | 5.000E+01     | 5.000E+01 | ---  | DCNUCS( 6)        |
| R016      | Leach rate (/yr)                               | 0.000E+00     | 0.000E+00 | 7.147E-04  | ALEACH( 6)        |
| R016      | Solubility constant                            | 0.000E+00     | 0.000E+00 | not used   | SOLUBK( 6)        |
| R016      | Distribution coefficients for U-235            |               |           |  |                   |
| R016      | Contaminated zone (cm**3/g)                    | 5.000E+01     | 5.000E+01 | ---  | DCNUCC( 7)        |
| R016      | Unsaturated zone 1 (cm**3/g)                   | 5.000E+01     | 5.000E+01 | ---  | DCNUCU( 7,1)      |
| R016      | Saturated zone (cm**3/g)                       | 5.000E+01     | 5.000E+01 | ---  | DCNUCS( 7)        |
| R016      | Leach rate (/yr)                               | 0.000E+00     | 0.000E+00 | 7.147E-04  | ALEACH( 7)        |
| R016      | Solubility constant                            | 0.000E+00     | 0.000E+00 | not used   | SOLUBK( 7)        |
| R016      | Distribution coefficients for U-238            |               |           |  |                   |
| R016      | Contaminated zone (cm**3/g)                    | 5.000E+01     | 5.000E+01 | ---  | DCNUCC( 8)        |
| R016      | Unsaturated zone 1 (cm**3/g)                   | 5.000E+01     | 5.000E+01 | ---  | DCNUCU( 8,1)      |
| R016      | Saturated zone (cm**3/g)                       | 5.000E+01     | 5.000E+01 | ---  | DCNUCS( 8)        |
| R016      | Leach rate (/yr)                               | 0.000E+00     | 0.000E+00 | 7.147E-04  | ALEACH( 8)        |
| R016      | Solubility constant                            | 0.000E+00     | 0.000E+00 | not used   | SOLUBK( 8)        |
| R016      | Distribution coefficients for daughter Ac-227  |               |           |  |                   |
| R016      | Contaminated zone (cm**3/g)                    | 2.000E+01     | 2.000E+01 | ---  | DCNUCC( 1)        |
| R016      | Unsaturated zone 1 (cm**3/g)                   | 2.000E+01     | 2.000E+01 | ---  | DCNUCU( 1,1)      |
| R016      | Saturated zone (cm**3/g)                       | 2.000E+01     | 2.000E+01 | ---  | DCNUCS( 1)        |
| R016      | Leach rate (/yr)                               | 0.000E+00     | 0.000E+00 | 1.772E-03  | ALEACH( 1)        |
| R016      | Solubility constant                            | 0.000E+00     | 0.000E+00 | not used   | SOLUBK( 1)        |
| R016      | Distribution coefficients for daughter Pa-231  |               |           |  |                   |
| R016      | Contaminated zone (cm**3/g)                    | 5.000E+01     | 5.000E+01 | ---  | DCNUCC( 2)        |
| R016      | Unsaturated zone 1 (cm**3/g)                   | 5.000E+01     | 5.000E+01 | ---  | DCNUCU( 2,1)      |
| R016      | Saturated zone (cm**3/g)                       | 5.000E+01     | 5.000E+01 | ---  | DCNUCS( 2)        |
| R016      | Leach rate (/yr)                               | 0.000E+00     | 0.000E+00 | 7.147E-04  | ALEACH( 2)        |
| R016      | Solubility constant                            | 0.000E+00     | 0.000E+00 | not used   | SOLUBK( 2)        |

## Site-Specific Parameter Summary (continued)

| 0<br>Menu | Parameter                                      | User<br>Input | Default   | Used by RESRAD<br>(If different from user input) | Parameter<br>Name |
|-----------|--|---------------|-----------|--|-------------------|
| R016      | Distribution coefficients for daughter Pb-210  |               |           |  |                   |
| R016      | Contaminated zone (cm**3/g)                    | 1.000E+02     | 1.000E+02 | ---  | DCNUCC( 3)        |
| R016      | Unsaturated zone 1 (cm**3/g)                   | 1.000E+02     | 1.000E+02 | ---  | DCNUCU( 3,1)      |
| R016      | Saturated zone (cm**3/g)                       | 1.000E+02     | 1.000E+02 | ---  | DCNUCS( 3)        |
| R016      | Leach rate (/yr)                               | 0.000E+00     | 0.000E+00 | 3.584E-04  | ALEACH( 3)        |
| R016      | Solubility constant                            | 0.000E+00     | 0.000E+00 | not used   | SOLUBK( 3)        |
| R016      | Distribution coefficients for daughter Ra-226  |               |           |  |                   |
| R016      | Contaminated zone (cm**3/g)                    | 7.000E+01     | 7.000E+01 | ---  | DCNUCC( 4)        |
| R016      | Unsaturated zone 1 (cm**3/g)                   | 7.000E+01     | 7.000E+01 | ---  | DCNUCU( 4,1)      |
| R016      | Saturated zone (cm**3/g)                       | 7.000E+01     | 7.000E+01 | ---  | DCNUCS( 4)        |
| R016      | Leach rate (/yr)                               | 0.000E+00     | 0.000E+00 | 5.113E-04  | ALEACH( 4)        |
| R016      | Solubility constant                            | 0.000E+00     | 0.000E+00 | not used   | SOLUBK( 4)        |
| R016      | Distribution coefficients for daughter Th-230  |               |           |  |                   |
| R016      | Contaminated zone (cm**3/g)                    | 6.000E+04     | 6.000E+04 | ---  | DCNUCC( 5)        |
| R016      | Unsaturated zone 1 (cm**3/g)                   | 6.000E+04     | 6.000E+04 | ---  | DCNUCU( 5,1)      |
| R016      | Saturated zone (cm**3/g)                       | 6.000E+04     | 6.000E+04 | ---  | DCNUCS( 5)        |
| R016      | Leach rate (/yr)                               | 0.000E+00     | 0.000E+00 | 5.990E-07  | ALEACH( 5)        |
| R016      | Solubility constant                            | 0.000E+00     | 0.000E+00 | not used   | SOLUBK( 5)        |
| R017      | Inhalation rate (m**3/yr)                      | 8.400E+03     | 8.400E+03 | ---  | INHALR            |
| R017      | Mass loading for inhalation (g/m**3)           | 5.900E-06     | 1.000E-04 | ---  | MLINH             |
| R017      | Exposure duration                              | 3.000E+01     | 3.000E+01 | ---  | ED                |
| R017      | Shielding factor, inhalation                   | 5.000E-01     | 4.000E-01 | ---  | SHF3              |
| R017      | Shielding factor, external gamma               | 7.000E-01     | 7.000E-01 | ---  | SHF1              |
| R017      | Fraction of time spent indoors                 | 6.550E-01     | 5.000E-01 | ---  | FIND              |
| R017      | Fraction of time spent outdoors (on site)      | 7.990E-02     | 2.500E-01 | ---  | FOTD              |
| R017      | Shape factor flag, external gamma              | 1.000E+00     | 1.000E+00 | >0 shows circular AREA.                          | FS                |
| R017      | Radii of shape factor array (used if FS = -1): |               |           |  |                   |
| R017      | Outer annular radius (m), ring 1:              | not used      | 5.000E+01 | ---  | RAD_SHAPE( 1)     |
| R017      | Outer annular radius (m), ring 2:              | not used      | 7.071E+01 | ---  | RAD_SHAPE( 2)     |
| R017      | Outer annular radius (m), ring 3:              | not used      | 0.000E+00 | ---  | RAD_SHAPE( 3)     |
| R017      | Outer annular radius (m), ring 4:              | not used      | 0.000E+00 | ---  | RAD_SHAPE( 4)     |
| R017      | Outer annular radius (m), ring 5:              | not used      | 0.000E+00 | ---  | RAD_SHAPE( 5)     |
| R017      | Outer annular radius (m), ring 6:              | not used      | 0.000E+00 | ---  | RAD_SHAPE( 6)     |
| R017      | Outer annular radius (m), ring 7:              | not used      | 0.000E+00 | ---  | RAD_SHAPE( 7)     |
| R017      | Outer annular radius (m), ring 8:              | not used      | 0.000E+00 | ---  | RAD_SHAPE( 8)     |
| R017      | Outer annular radius (m), ring 9:              | not used      | 0.000E+00 | ---  | RAD_SHAPE( 9)     |
| R017      | Outer annular radius (m), ring 10:             | not used      | 0.000E+00 | ---  | RAD_SHAPE(10)     |
| R017      | Outer annular radius (m), ring 11:             | not used      | 0.000E+00 | ---  | RAD_SHAPE(11)     |
| R017      | Outer annular radius (m), ring 12:             | not used      | 0.000E+00 | ---  | RAD_SHAPE(12)     |

## Site-Specific Parameter Summary (continued)

| 0<br>Menu | Parameter  | User<br>Input | Default   | Used by RESRAD<br>(If different from user input) | Parameter<br>Name |
|-----------|--|---------------|-----------|--|-------------------|
| R017      | Fractions of annular areas within AREA:          |               |           |  |                   |
| R017      | Ring 1   | not used      | 1.000E+00 | ---  | FRACA( 1)         |
| R017      | Ring 2   | not used      | 2.732E-01 | ---  | FRACA( 2)         |
| R017      | Ring 3   | not used      | 0.000E+00 | ---  | FRACA( 3)         |
| R017      | Ring 4   | not used      | 0.000E+00 | ---  | FRACA( 4)         |
| R017      | Ring 5   | not used      | 0.000E+00 | ---  | FRACA( 5)         |
| R017      | Ring 6   | not used      | 0.000E+00 | ---  | FRACA( 6)         |
| R017      | Ring 7   | not used      | 0.000E+00 | ---  | FRACA( 7)         |
| R017      | Ring 8   | not used      | 0.000E+00 | ---  | FRACA( 8)         |
| R017      | Ring 9   | not used      | 0.000E+00 | ---  | FRACA( 9)         |
| R017      | Ring 10  | not used      | 0.000E+00 | ---  | FRACA(10)         |
| R017      | Ring 11  | not used      | 0.000E+00 | ---  | FRACA(11)         |
| R017      | Ring 12  | not used      | 0.000E+00 | ---  | FRACA(12)         |
| R018      | Fruits, vegetables and grain consumption (kg/yr) | 4.270E+01     | 1.600E+02 | ---  | DIET(1)           |
| R018      | Leafy vegetable consumption (kg/yr)              | 4.660E+00     | 1.400E+01 | ---  | DIET(2)           |
| R018      | Milk consumption (L/yr)                          | not used      | 9.200E+01 | ---  | DIET(3)           |
| R018      | Meat and poultry consumption (kg/yr)             | not used      | 6.300E+01 | ---  | DIET(4)           |
| R018      | Fish consumption (kg/yr)                         | not used      | 5.400E+00 | ---  | DIET(5)           |
| R018      | Other seafood consumption (kg/yr)                | not used      | 9.000E-01 | ---  | DIET(6)           |
| R018      | Soil ingestion rate (g/yr)                       | 4.380E+01     | 3.650E+01 | ---  | SOIL              |
| R018      | Drinking water intake (L/yr)                     | not used      | 5.100E+02 | ---  | DWI               |
| R018      | Contamination fraction of drinking water         | not used      | 1.000E+00 | ---  | FDW               |
| R018      | Contamination fraction of household water        | not used      | 1.000E+00 | ---  | FHHW              |
| R018      | Contamination fraction of livestock water        | not used      | 1.000E+00 | ---  | FLW               |
| R018      | Contamination fraction of irrigation water       | 1.000E+00     | 1.000E+00 | ---  | FIRW              |
| R018      | Contamination fraction of aquatic food           | not used      | 5.000E-01 | ---  | FR9               |
| R018      | Contamination fraction of plant food             | -1            | -1        | 0.500E+00  | FPLANT            |
| R018      | Contamination fraction of meat                   | not used      | -1        | ---  | FMEAT             |
| R018      | Contamination fraction of milk                   | not used      | -1        | ---  | FMILK             |
| R019      | Livestock fodder intake for meat (kg/day)        | not used      | 6.800E+01 | ---  | LFI5              |
| R019      | Livestock fodder intake for milk (kg/day)        | not used      | 5.500E+01 | ---  | LFI6              |
| R019      | Livestock water intake for meat (L/day)          | not used      | 5.000E+01 | ---  | LWI5              |
| R019      | Livestock water intake for milk (L/day)          | not used      | 1.600E+02 | ---  | LWI6              |
| R019      | Livestock soil intake (kg/day)                   | not used      | 5.000E-01 | ---  | LSI               |
| 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                |
| R019      | Depth of roots (m)                               | 9.000E-01     | 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            | 1.000E+00     | 1.000E+00 | ---  | FGWIR             |
| R19B      | Wet weight crop yield for Non-Leafy (kg/m**2)    | 7.000E-01     | 7.000E-01 | ---  | YV(1)             |
| R19B      | Wet weight crop yield for Leafy (kg/m**2)        | 1.500E+00     | 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)             | 1.700E-01     | 1.700E-01 | ---  | TE(1)             |
| R19B      | Growing Season for Leafy (years)                 | 2.500E-01     | 2.500E-01 | ---  | TE(2)             |
| R19B      | Growing Season for Fodder (years)                | not used      | 8.000E-02 | ---  | TE(3)             |

Site-Specific Parameter Summary (continued)

| 0<br>Menu | Parameter  | User<br>Input | Default    | Used by RESRAD<br>(If different from user input) | Parameter<br>Name |
|-----------|--|---------------|------------|--|-------------------|
| R19B      | Translocation Factor for Non-Leafy               | 1.000E-01     | 1.000E-01  | ---  | TIV(1)            |
| R19B      | Translocation Factor for Leafy                   | 1.000E+00     | 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   | 2.500E-01     | 2.500E-01  | ---  | RDRY(1)           |
| R19B      | Dry Foliar Interception Fraction for Leafy       | 2.500E-01     | 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   | 2.500E-01     | 2.500E-01  | ---  | RWET(1)           |
| R19B      | Wet Foliar Interception Fraction for Leafy       | 2.500E-01     | 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       | 2.000E+01     | 2.000E+01  | ---  | WLAM              |
| C14       | C-12 concentration in water (g/cm**3)            | not used      | 2.000E-05  | ---  | C12WTR            |
| C14       | C-12 concentration in contaminated soil (g/g)    | not used      | 3.000E-02  | ---  | C12CZ             |
| C14       | Fraction of vegetation carbon from soil          | not used      | 2.000E-02  | ---  | CSOIL             |
| C14       | Fraction of vegetation carbon from air           | not used      | 9.800E-01  | ---  | CAIR              |
| C14       | C-14 evasion layer thickness in soil (m)         | not used      | 3.000E-01  | ---  | DMC               |
| C14       | C-14 evasion flux rate from soil (1/sec)         | not used      | 7.000E-07  | ---  | EVSN              |
| C14       | C-12 evasion flux rate from soil (1/sec)         | not used      | 1.000E-10  | ---  | REVSN             |
| C14       | Fraction of grain in beef cattle feed            | not used      | 8.000E-01  | ---  | AVFG4             |
| C14       | Fraction of grain in milk cow feed               | not used      | 2.000E-01  | ---  | AVFG5             |
| 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                                       | 1.000E+00     | 1.000E+00  | ---  | STOR_T(7)         |
| STOR      | Surface water                                    | 1.000E+00     | 1.000E+00  | ---  | STOR_T(8)         |
| STOR      | Livestock fodder                                 | 4.500E+01     | 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              |
| R021      | Total porosity of the building foundation        | not used      | 1.000E-01  | ---  | TPFL              |
| R021      | Volumetric water content of the cover material   | not used      | 5.000E-02  | ---  | PH2OCV            |
| R021      | Volumetric water content of the foundation       | not used      | 3.000E-02  | ---  | PH2OFL            |
| R021      | Diffusion coefficient for radon gas (m/sec):     |               |            |  |                   |
| R021      | in cover material                                | not used      | 2.000E-06  | ---  | DIFCV             |
| R021      | in foundation material                           | not used      | 3.000E-07  | ---  | DIFFL             |
| R021      | in contaminated zone soil                        | not used      | 2.000E-06  | ---  | DIFCZ             |
| R021      | Radon vertical dimension of mixing (m)           | not used      | 2.000E+00  | ---  | HMX               |
| R021      | Average building air exchange rate (1/hr)        | not used      | 5.000E-01  | ---  | REXG              |
| R021      | Height of the building (room) (m)                | not used      | 2.500E+00  | ---  | HRM               |
| R021      | Building interior area factor                    | not used      | 0.000E+00  | ---  | FAI               |
| R021      | Building depth below ground surface (m)          | not used      | -1.000E+00 | ---  | DMFL              |
| R021      | Emanating power of Rn-222 gas                    | not used      | 2.500E-01  | ---  | EMANA(1)          |
| R021      | Emanating power of Rn-220 gas                    | not used      | 1.500E-01  | ---  | EMANA(2)          |
| TITL      | Number of graphical time points                  | 32            | ---        | ---  | NPTS              |

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Site-Specific Parameter Summary (continued)

| 0<br>Menu | Parameter                                     | User<br>Input | Default | Used by RESRAD<br>(If different from user input) | Parameter<br>Name |
|-----------|---|---------------|---------|--|-------------------|
| TITL      | Maximum number of integration points for dose | 17            | ---     | ---  | LYMAX             |
| TITL      | 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         | 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         |

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| Contaminated Zone Dimensions |                       | Initial Soil Concentrations, pCi/g |           |
|------------------------------|-----------------------|------------------------------------|-----------|
| Area:                        | 9846.00 square meters | U-234                              | 2.700E-01 |
| Thickness:                   | 2.00 meters           | U-235                              | 2.000E-02 |
| Cover Depth:                 | 0.00 meters           | U-238                              | 2.700E-01 |

0  
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):  | 4.283E-02 | 4.280E-02 | 4.274E-02 | 4.254E-02 | 4.197E-02 | 4.010E-02 | 3.544E-02 | 2.479E-02 |
| M(t):      | 1.713E-03 | 1.712E-03 | 1.710E-03 | 1.701E-03 | 1.679E-03 | 1.604E-03 | 1.418E-03 | 9.917E-04 |

0Maximum TDOSE(t): 4.283E-02 mrem/yr at t = 0.000E+00 years

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## 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. |
| U-234         | 5.627E-05 | 0.0013 | 6.064E-05  | 0.0014 | 0.000E+00 | 0.0000 | 4.523E-03 | 0.1056 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.459E-03 | 0.0574 |
| U-235         | 7.763E-03 | 0.1813 | 4.186E-06  | 0.0001 | 0.000E+00 | 0.0000 | 3.170E-04 | 0.0074 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.721E-04 | 0.0040 |
| U-238         | 2.079E-02 | 0.4854 | 5.422E-05  | 0.0013 | 0.000E+00 | 0.0000 | 4.295E-03 | 0.1003 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.334E-03 | 0.0545 |
| Total         | 2.861E-02 | 0.6680 | 1.191E-04  | 0.0028 | 0.000E+00 | 0.0000 | 9.135E-03 | 0.2133 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.965E-03 | 0.1159 |

## 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. |
| U-234         | 0.000E+00 | 0.0000 | 7.099E-03     | 0.1658 |
| U-235         | 0.000E+00 | 0.0000 | 8.256E-03     | 0.1928 |
| U-238         | 0.000E+00 | 0.0000 | 2.747E-02     | 0.6415 |
| Total         | 0.000E+00 | 0.0000 | 4.283E-02     | 1.0000 |

\*Sum of all water independent and dependent pathways.

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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

| 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. |
| U-234         | 5.624E-05 | 0.0013 | 6.060E-05  | 0.0014 | 0.000E+00 | 0.0000 | 4.520E-03 | 0.1056 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.457E-03 | 0.0574 |
| U-235         | 7.758E-03 | 0.1813 | 4.184E-06  | 0.0001 | 0.000E+00 | 0.0000 | 3.179E-04 | 0.0074 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.722E-04 | 0.0040 |
| U-238         | 2.077E-02 | 0.4854 | 5.419E-05  | 0.0013 | 0.000E+00 | 0.0000 | 4.292E-03 | 0.1003 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.333E-03 | 0.0545 |
| Total         | 2.859E-02 | 0.6680 | 1.190E-04  | 0.0028 | 0.000E+00 | 0.0000 | 9.129E-03 | 0.2133 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.962E-03 | 0.1159 |

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

| Radio-Nuclide | Water     |        | Fish      |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | All Pathways* |        |
|---------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|---------------|--------|
|               | mrem/yr   | fract. | mrem/yr       | fract. |
| U-234         | 0.000E+00 | 0.0000 | 7.094E-03     | 0.1657 |
| U-235         | 0.000E+00 | 0.0000 | 8.252E-03     | 0.1928 |
| U-238         | 0.000E+00 | 0.0000 | 2.745E-02     | 0.6414 |
| Total         | 0.000E+00 | 0.0000 | 4.280E-02     | 1.0000 |

\*Sum of all water independent and dependent pathways.

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## 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. |
| U-234         | 5.619E-05 | 0.0013 | 6.051E-05  | 0.0014 | 0.000E+00 | 0.0000 | 4.513E-03 | 0.1056 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.454E-03 | 0.0574 |
| U-235         | 7.747E-03 | 0.1813 | 4.181E-06  | 0.0001 | 0.000E+00 | 0.0000 | 3.196E-04 | 0.0075 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.722E-04 | 0.0040 |
| U-238         | 2.074E-02 | 0.4854 | 5.411E-05  | 0.0013 | 0.000E+00 | 0.0000 | 4.286E-03 | 0.1003 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.329E-03 | 0.0545 |
| Total         | 2.855E-02 | 0.6679 | 1.188E-04  | 0.0028 | 0.000E+00 | 0.0000 | 9.119E-03 | 0.2134 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.955E-03 | 0.1159 |

## 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. |
| U-234         | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.0COE+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 7.084E-03     | 0.1657 |
| U-235         | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.0COE+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 8.243E-03     | 0.1929 |
| U-238         | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.0COE+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.741E-02     | 0.6414 |
| Total         | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.0COE+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.274E-02     | 1.0000 |

\*Sum of all water independent and dependent pathways.

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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

| 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. |
| U-234         | 5.621E-05 | 0.0013 | 6.022E-05  | 0.0014 | 0.000E+00 | 0.0000 | 4.491E-03 | 0.1056 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.442E-03 | 0.0574 |
| U-235         | 7.709E-03 | 0.1812 | 4.173E-06  | 0.0001 | 0.000E+00 | 0.0000 | 3.259E-04 | 0.0077 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.726E-04 | 0.0041 |
| U-238         | 2.064E-02 | 0.4852 | 5.384E-05  | 0.0013 | 0.000E+00 | 0.0000 | 4.264E-03 | 0.1002 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.318E-03 | 0.0545 |
| Total         | 2.841E-02 | 0.6678 | 1.182E-04  | 0.0028 | 0.000E+00 | 0.0000 | 9.031E-03 | 0.2135 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.932E-03 | 0.1159 |

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

| Radio-Nuclide | Water     |        | Fish      |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | All Pathways* |        |
|---------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|---------------|--------|
|               | mrem/yr   | fract. | mrem/yr       | fract. |
| U-234         | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.030E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 7.049E-03     | 0.1657 |
| U-235         | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.030E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 8.212E-03     | 0.1930 |
| U-238         | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.030E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.728E-02     | 0.6412 |
| Total         | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.030E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.254E-02     | 1.0000 |

\*Sum of all water independent and dependent pathways.

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 $T_{\frac{1}{2}}$  Limit = 180 days

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## 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. |
| U-234         | 5.784E-05 | 0.0014 | 5.939E-05  | 0.0014 | 0.000E+00 | 0.0000 | 4.429E-03 | 0.1055 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.408E-03 | 0.0574 |
| U-235         | 7.604E-03 | 0.1812 | 4.176E-06  | 0.0001 | 0.000E+00 | 0.0000 | 3.455E-04 | 0.0082 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.749E-04 | 0.0042 |
| U-238         | 2.035E-02 | 0.4848 | 5.308E-05  | 0.0013 | 0.000E+00 | 0.0000 | 4.204E-03 | 0.1002 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.285E-03 | 0.0544 |
| Total         | 2.801E-02 | 0.6673 | 1.166E-04  | 0.0028 | 0.000E+00 | 0.0000 | 8.978E-03 | 0.2139 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.868E-03 | 0.1160 |

## 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. |
| U-234         | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0C00 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.953E-03     | 0.1657 |
| U-235         | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0C00 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 8.129E-03     | 0.1937 |
| U-238         | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0C00 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.689E-02     | 0.6407 |
| Total         | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0C00 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.197E-02     | 1.0000 |

\*Sum of all water independent and dependent pathways.

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T½ Limit = 180 days

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## 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)

| 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. |
| U-234         | 8.100E-05 | 0.0020 | 5.657E-05  | 0.0014 | 0.000E+00 | 0.0000 | 4.224E-03 | 0.1053 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.293E-03 | 0.0572 |
| U-235         | 7.259E-03 | 0.1810 | 4.293E-06  | 0.0001 | 0.000E+00 | 0.0000 | 4.178E-04 | 0.0104 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.866E-04 | 0.0047 |
| U-238         | 1.935E-02 | 0.4826 | 5.050E-05  | 0.0013 | 0.000E+00 | 0.0000 | 4.000E-03 | 0.0997 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.174E-03 | 0.0542 |
| Total         | 2.670E-02 | 0.6657 | 1.114E-04  | 0.0028 | 0.000E+00 | 0.0000 | 8.642E-03 | 0.2155 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.654E-03 | 0.1161 |

## 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

| Radio-Nuclide | Water     |        | Fish      |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | All Pathways* |        |
|---------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|---------------|--------|
|               | mrem/yr   | fract. | mrem/yr       | fract. |
| U-234         | 0.000E+00 | 0.0000 | 6.655E-03     | 0.1660 |
| U-235         | 0.000E+00 | 0.0000 | 7.868E-03     | 0.1962 |
| U-238         | 0.000E+00 | 0.0000 | 2.558E-02     | 0.6378 |
| Total         | 0.000E+00 | 0.0000 | 4.010E-02     | 1.0000 |

\*Sum of all water independent and dependent pathways.

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T<sub>1/2</sub> Limit = 180 days

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Summary : DT-34-Onsite Resident

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## 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. |
| U-234         | 2.740E-04 | 0.0077 | 4.926E-05  | 0.0014 | 0.000E+00 | 0.0000 | 3.763E-03 | 0.1062 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.003E-03 | 0.0565 |
| U-235         | 6.366E-03 | 0.1796 | 4.619E-06  | 0.0001 | 0.000E+00 | 0.0000 | 5.904E-04 | 0.0167 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.161E-04 | 0.0061 |
| U-238         | 1.678E-02 | 0.4734 | 4.380E-05  | 0.0012 | 0.000E+00 | 0.0000 | 3.469E-03 | 0.0979 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.886E-03 | 0.0532 |
| Total         | 2.342E-02 | 0.6607 | 9.768E-05  | 0.0028 | 0.000E+00 | 0.0000 | 7.822E-03 | 0.2207 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.105E-03 | 0.1158 |

## 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. |
| U-234         | 0.000E+00 | 0.0000 | 6.089E-03     | 0.1718 |
| U-235         | 0.000E+00 | 0.0000 | 7.177E-03     | 0.2025 |
| U-238         | 0.000E+00 | 0.0000 | 2.218E-02     | 0.6257 |
| Total         | 0.000E+00 | 0.0000 | 3.544E-02     | 1.0000 |

\*Sum of all water independent and dependent pathways.

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## 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

| Radio-Nuclide | Water Independent Pathways (Inhalation excludes radon) |        |            |        |           |        |           |        |           |        |           |        |           |        |
|---------------|--|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|               | 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. |
| U-234         | 1.773E-03  | 0.0715 | 3.056E-05  | 0.0012 | 0.000E+00 | 0.0000 | 3.117E-03 | 0.1257 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.311E-03 | 0.0529 |
| U-235         | 4.016E-03  | 0.1620 | 4.696E-06  | 0.0002 | 0.000E+00 | 0.0000 | 8.385E-04 | 0.0338 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.457E-04 | 0.0099 |
| U-238         | 1.017E-02  | 0.4104 | 2.662E-05  | 0.0011 | 0.000E+00 | 0.0000 | 2.109E-03 | 0.0851 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.146E-03 | 0.0462 |
| Total         | 1.596E-02  | 0.6439 | 6.188E-05  | 0.0025 | 0.000E+00 | 0.0000 | 6.064E-03 | 0.2446 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.703E-03 | 0.1090 |

## 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

| Radio-Nuclide | Water Dependent Pathways |        |           |        |           |        |           |        |           |        |           |        |               |        |
|---------------|--------------------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|---------------|--------|
|               | 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. |
| U-234         | 0.000E+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 | 6.232E-03     | 0.2514 |
| U-235         | 0.000E+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 | 5.105E-03     | 0.2059 |
| U-238         | 0.000E+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 | 1.346E-02     | 0.5427 |
| 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 | 2.479E-02     | 1.0000 |

\*Sum of all water independent and dependent pathways.

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Dose/Source Ratios Summed Over All Pathways

| 0        | Parent<br>(i)   | Product<br>(j) | Thread<br>Fraction | Parent and Progeny Principal Radionuclide Contributions Indicated |                   |           |           |           |           |           |           |
|----------|-----------------|----------------|--------------------|---|-------------------|-----------|-----------|-----------|-----------|-----------|-----------|
|          |                 |                |                    | 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 |
| U-234    | U-234           | 1.000E+00      | 2.629E-02          | 2.627E-02   | 2.623E-02         | 2.610E-02 | 2.573E-02 | 2.447E-02 | 2.120E-02 | 2.120E-02 | 1.283E-02 |
| U-234    | Th-230          | 1.000E+00      | 1.483E-07          | 4.353E-07   | 1.007E-06         | 3.001E-06 | 8.642E-06 | 2.775E-05 | 7.728E-05 | 2.775E-05 | 2.033E-04 |
| U-234    | Ra-226+D        | 1.000E+00      | 4.442E-09          | 3.133E-08   | 1.664E-07         | 1.486E-06 | 1.240E-05 | 1.295E-04 | 1.038E-03 | 7.935E-03 |           |
| U-234    | Pb-210+D        | 1.000E+00      | 1.302E-11          | 1.705E-10   | 1.814E-09         | 4.339E-08 | 8.971E-07 | 2.046E-05 | 2.386E-04 | 2.114E-03 |           |
| U-234    | $\Sigma$ DSR(j) |                | 2.629E-02          | 2.627E-02   | 2.624E-02         | 2.611E-02 | 2.575E-02 | 2.465E-02 | 2.255E-02 | 2.308E-02 |           |
| OU-235+D | U-235+D         | 1.000E+00      | 4.128E-01          | 4.125E-01   | 4.119E-01         | 4.099E-01 | 4.040E-01 | 3.843E-01 | 3.331E-01 | 2.020E-01 |           |
| U-235+D  | Pa-231          | 1.000E+00      | 3.002E-05          | 9.215E-05   | 2.166E-04         | 6.492E-04 | 1.861E-03 | 5.832E-03 | 1.509E-02 | 3.023E-02 |           |
| U-235+D  | Ac-227+D        | 1.000E+00      | 2.942E-07          | 1.933E-06   | 9.740E-06         | 7.943E-05 | 5.403E-04 | 3.247E-03 | 1.065E-02 | 2.302E-02 |           |
| U-235+D  | $\Sigma$ DSR(j) |                | 4.128E-01          | 4.125E-01   | 4.121E-01         | 4.106E-01 | 4.064E-01 | 3.934E-01 | 3.589E-01 | 2.552E-01 |           |
| OU-238   | U-238           | 5.400E-05      | 1.272E-06          | 1.271E-06   | 1.269E-06         | 1.263E-06 | 1.245E-06 | 1.184E-06 | 1.027E-06 | 6.224E-07 |           |
| OU-238+D | U-238+D         | 9.999E-01      | 1.017E-01          | 1.017E-01   | 1.015E-01         | 1.010E-01 | 9.959E-02 | 9.473E-02 | 8.211E-02 | 4.979E-02 |           |
| U-238+D  | U-234           | 9.999E-01      | 3.726E-08          | 1.117E-07   | 2.603E-07         | 7.770E-07 | 2.225E-06 | 6.973E-06 | 1.807E-05 | 3.644E-05 |           |
| U-238+D  | Th-230          | 9.999E-01      | 1.434E-13          | 9.717E-13   | 5.056E-12         | 4.473E-11 | 3.725E-10 | 3.907E-09 | 3.176E-08 | 2.548E-07 |           |
| U-238+D  | Ra-226+D        | 9.999E-01      | 3.130E-15          | 4.748E-14   | 5.567E-13         | 1.475E-11 | 3.570E-10 | 1.225E-08 | 2.910E-07 | 7.157E-06 |           |
| U-238+D  | Pb-210+D        | 9.999E-01      | 7.749E-18          | 2.077E-16   | 4.714E-15         | 3.314E-13 | 2.028E-11 | 1.626E-09 | 6.128E-08 | 1.852E-06 |           |
| U-238+D  | $\Sigma$ DSR(j) |                | 1.017E-01          | 1.017E-01   | 1.015E-01         | 1.010E-01 | 9.959E-02 | 9.474E-02 | 8.213E-02 | 4.983E-02 |           |

The DSR includes contributions from associated (half-life  $\leq$  180 days) daughters.

0

Single Radionuclide Soil Guidelines G(i,t) in pCi/g  
 Basic Radiation Dose Limit = 2.500E+01 mrem/yr

| ONuclide<br>(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 |
|-----------------|--------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| U-234           | 9.509E+02    | 9.515E+02 | 9.529E+02 | 9.576E+02 | 9.707E+02 | 1.014E+03 | 1.108E+03 | 1.083E+03 |
| U-235           | 6.056E+01    | 6.059E+01 | 6.066E+01 | 6.089E+01 | 6.151E+01 | 6.355E+01 | 6.966E+01 | 9.795E+01 |
| U-238           | 2.457E+02    | 2.459E+02 | 2.462E+02 | 2.475E+02 | 2.510E+02 | 2.639E+02 | 3.044E+02 | 5.017E+02 |

0

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 = 0.000E+00 years

| ONuclide<br>(i) | Initial<br>(pCi/g) | tmin<br>(years) | DSR(i,tmin) | G(i,tmin) | DSR(i,tmax) | G(i,tmax) |
|-----------------|--------------------|-----------------|-------------|-----------|-------------|-----------|
|                 |                    |                 | (pCi/g)     | (pCi/g)   |             | (pCi/g)   |
| U-234           | 2.700E-01          | 0.000E+00       | 2.629E-02   | 9.509E+02 | 2.629E-02   | 9.509E+02 |
| U-235           | 2.000E-02          | 0.000E+00       | 4.128E-01   | 6.056E+01 | 4.128E-01   | 6.056E+01 |
| U-238           | 2.700E-01          | 0.000E+00       | 1.017E-01   | 2.457E+02 | 1.017E-01   | 2.457E+02 |

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

| ONuclide<br>(j) | Parent<br>(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 |
| U-234           | U-234         | 1.000E+00 | 7.099E-03          | 7.094E-03 | 7.083E-03 | 7.048E-03 | 6.947E-03 | 6.607E-03 | 5.724E-03 | 3.464E-03 |
| U-234           | U-238         | 9.999E-01 | 1.006E-08          | 3.016E-08 | 7.028E-08 | 2.098E-07 | 6.007E-07 | 1.883E-06 | 4.878E-06 | 9.838E-06 |
| U-234           | ΣDOSE(j)      |           | 7.099E-03          | 7.094E-03 | 7.083E-03 | 7.048E-03 | 6.948E-03 | 6.609E-03 | 5.729E-03 | 3.474E-03 |
| OTh-230         | U-234         | 1.000E+00 | 4.005E-08          | 1.175E-07 | 2.718E-07 | 8.102E-07 | 2.333E-06 | 7.493E-06 | 2.086E-05 | 5.489E-05 |
| Th-230          | U-238         | 9.999E-01 | 3.873E-14          | 2.624E-13 | 1.365E-12 | 1.208E-11 | 1.006E-10 | 1.055E-09 | 8.575E-09 | 6.878E-08 |
| Th-230          | ΣDOSE(j)      |           | 4.005E-08          | 1.175E-07 | 2.718E-07 | 8.102E-07 | 2.333E-06 | 7.494E-06 | 2.087E-05 | 5.495E-05 |
| ORa-226         | U-234         | 1.000E+00 | 1.199E-09          | 8.471E-09 | 4.492E-08 | 4.012E-07 | 3.348E-06 | 3.498E-05 | 2.802E-04 | 2.142E-03 |
| Ra-226          | U-238         | 9.999E-01 | 8.451E-16          | 1.282E-14 | 1.503E-13 | 3.983E-12 | 9.638E-11 | 3.308E-09 | 7.857E-08 | 1.932E-06 |
| Ra-226          | ΣDOSE(j)      |           | 1.199E-09          | 8.471E-09 | 4.492E-08 | 4.012E-07 | 3.348E-06 | 3.498E-05 | 2.803E-04 | 2.144E-03 |
| 0Pb-210         | U-234         | 1.000E+00 | 3.516E-12          | 4.605E-11 | 4.897E-10 | 1.172E-08 | 2.422E-07 | 5.524E-06 | 6.441E-05 | 5.707E-04 |
| Pb-210          | U-238         | 9.999E-01 | 2.092E-18          | 5.608E-17 | 1.273E-15 | 8.947E-14 | 5.476E-12 | 4.390E-10 | 1.655E-08 | 5.001E-07 |
| Pb-210          | ΣDOSE(j)      |           | 3.516E-12          | 4.605E-11 | 4.897E-10 | 1.172E-08 | 2.422E-07 | 5.525E-06 | 6.443E-05 | 5.712E-04 |
| 0U-235          | U-235         | 1.000E+00 | 8.256E-03          | 8.250E-03 | 8.238E-03 | 8.197E-03 | 8.081E-03 | 7.686E-03 | 6.663E-03 | 4.040E-03 |
| 0Pa-231         | U-235         | 1.000E+00 | 6.003E-07          | 1.843E-06 | 4.331E-06 | 1.298E-05 | 3.722E-05 | 1.166E-04 | 3.017E-04 | 6.047E-04 |
| 0Ac-227         | U-235         | 1.000E+00 | 5.883E-09          | 3.867E-08 | 1.948E-07 | 1.589E-06 | 1.081E-05 | 6.493E-05 | 2.130E-04 | 4.603E-04 |
| 0U-238          | U-238         | 5.400E-05 | 3.434E-07          | 3.432E-07 | 3.427E-07 | 3.410E-07 | 3.362E-07 | 3.198E-07 | 2.772E-07 | 1.681E-07 |
| U-238           | U-238         | 9.999E-01 | 2.747E-02          | 2.745E-02 | 2.741E-02 | 2.728E-02 | 2.689E-02 | 2.558E-02 | 2.217E-02 | 1.344E-02 |
| U-238           | ΣDOSE(j)      |           | 2.747E-02          | 2.745E-02 | 2.741E-02 | 2.728E-02 | 2.689E-02 | 2.558E-02 | 2.217E-02 | 1.344E-02 |

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

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Summary : DT-34-Onsite Resident

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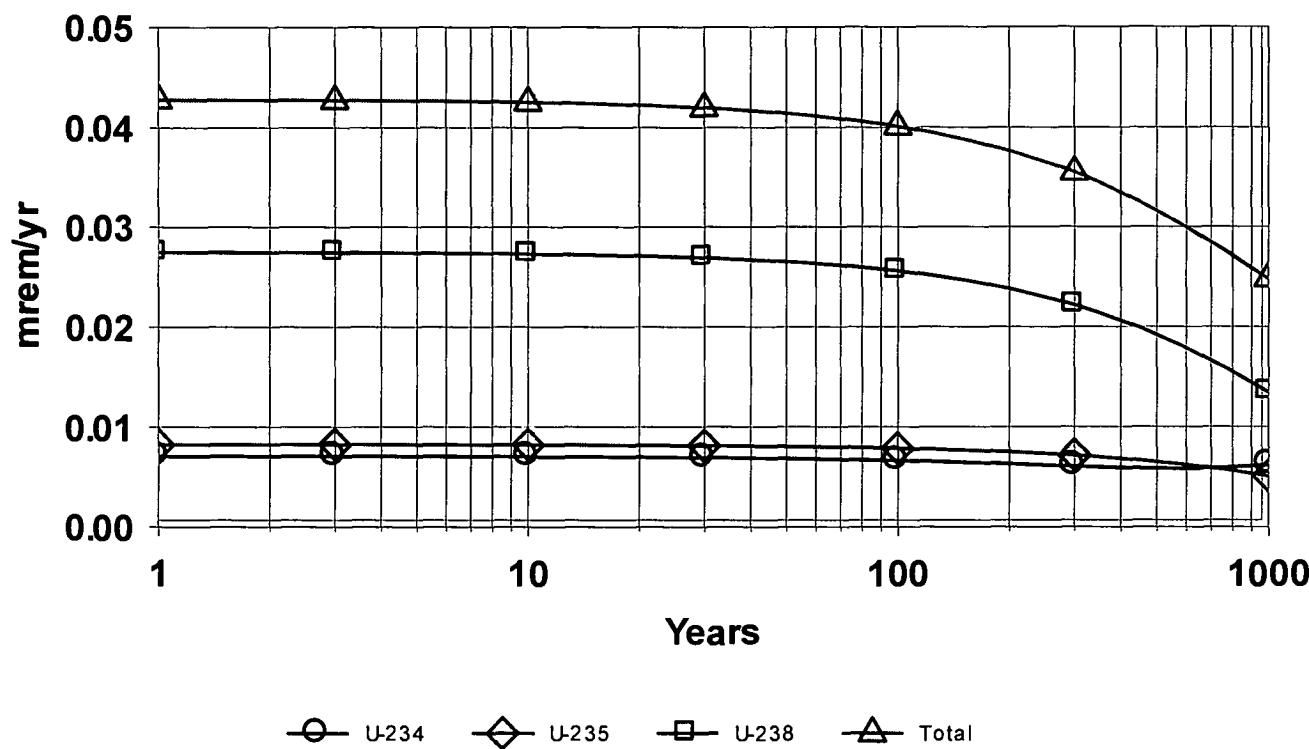
Individual Nuclide Soil Concentration  
Parent Nuclide and Branch Fraction Indicated

| ONuclide | Parent          | THF(i)    |    | S(j,t), pCi/g |           |           |           |           |           |           |           |
|----------|-----------------|-----------|----|---------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| (j)      | (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 |
| U-234    | U-234           | 1.000E+00 |    | 2.700E-01     | 2.698E-01 | 2.694E-01 | 2.681E-01 | 2.643E-01 | 2.513E-01 | 2.177E-01 | 1.317E-01 |
| U-234    | U-238           | 9.999E-01 |    | 0.000E+00     | 7.648E-07 | 2.291E-06 | 7.599E-06 | 2.247E-05 | 7.125E-05 | 1.852E-04 | 3.740E-04 |
| U-234    | $\Sigma S(j)$ : |           |    | 2.700E-01     | 2.698E-01 | 2.694E-01 | 2.681E-01 | 2.643E-01 | 2.514E-01 | 2.179E-01 | 1.321E-01 |
| OTh-230  | U-234           | 1.000E+00 |    | 0.000E+00     | 2.430E-06 | 7.284E-06 | 2.422E-05 | 7.213E-05 | 2.344E-04 | 6.550E-04 | 1.725E-03 |
| Th-230   | U-238           | 9.999E-01 |    | 0.000E+00     | 3.443E-12 | 3.096E-11 | 3.429E-10 | 3.056E-09 | 3.284E-08 | 2.688E-07 | 2.161E-06 |
| Th-230   | $\Sigma S(j)$ : |           |    | 0.000E+00     | 2.430E-06 | 7.284E-06 | 2.422E-05 | 7.213E-05 | 2.345E-04 | 6.553E-04 | 1.727E-03 |
| 0Ra-226  | U-234           | 1.000E+00 |    | 0.000E+00     | 5.262E-10 | 4.730E-09 | 5.235E-08 | 4.660E-07 | 4.980E-06 | 4.016E-05 | 3.078E-04 |
| Ra-226   | U-238           | 9.999E-01 |    | 0.000E+00     | 4.972E-16 | 1.341E-14 | 4.945E-13 | 1.319E-11 | 4.687E-10 | 1.124E-08 | 2.775E-07 |
| Ra-226   | $\Sigma S(j)$ : |           |    | 0.000E+00     | 5.262E-10 | 4.730E-09 | 5.236E-08 | 4.660E-07 | 4.981E-06 | 4.017E-05 | 3.080E-04 |
| 0Pb-210  | U-234           | 1.000E+00 |    | 0.000E+00     | 5.410E-12 | 1.437E-10 | 5.030E-09 | 1.167E-07 | 2.769E-06 | 3.263E-05 | 2.900E-04 |
| Pb-210   | U-238           | 9.999E-01 |    | 0.000E+00     | 3.840E-18 | 3.069E-16 | 3.617E-14 | 2.584E-12 | 2.187E-10 | 8.364E-09 | 2.539E-07 |
| Pb-210   | $\Sigma S(j)$ : |           |    | 0.000E+00     | 5.410E-12 | 1.437E-10 | 5.030E-09 | 1.167E-07 | 2.770E-06 | 3.263E-05 | 2.902E-04 |
| 0U-235   | U-235           | 1.000E+00 |    | 2.000E-02     | 1.999E-02 | 1.996E-02 | 1.986E-02 | 1.958E-02 | 1.862E-02 | 1.614E-02 | 9.787E-03 |
| 0Pa-231  | U-235           | 1.000E+00 |    | 0.000E+00     | 4.229E-07 | 1.267E-06 | 4.201E-06 | 1.242E-05 | 3.936E-05 | 1.021E-04 | 2.049E-04 |
| 0Ac-227  | U-235           | 1.000E+00 |    | 0.000E+00     | 6.658E-09 | 5.855E-08 | 6.011E-07 | 4.381E-06 | 2.695E-05 | 8.885E-05 | 1.923E-04 |
| 0U-238   | U-238           | 5.400E-05 |    | 1.458E-05     | 1.457E-05 | 1.455E-05 | 1.448E-05 | 1.427E-05 | 1.357E-05 | 1.177E-05 | 7.135E-06 |
| U-238    | U-238           | 9.999E-01 |    | 2.700E-01     | 2.698E-01 | 2.694E-01 | 2.681E-01 | 2.643E-01 | 2.514E-01 | 2.179E-01 | 1.321E-01 |
| U-238    | $\Sigma S(j)$ : |           |    | 2.700E-01     | 2.698E-01 | 2.694E-01 | 2.681E-01 | 2.643E-01 | 2.514E-01 | 2.179E-01 | 1.321E-01 |

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

0RESCALC.EXE execution time = 3.18 seconds

**DOSE: All Nuclides Summed, All Pathways Summed**



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GRAPHICS.ASC Includes All Pathways

DT-34 Resident  
RESRAD Risk Summary

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Cancer Risk Slope Factors Summary Table  
Risk Library: HEAST 2001 Morbidity

| 0<br>Menu | Parameter  | Current Value | Base Case* | Parameter Name |
|-----------|--|---------------|------------|----------------|
| Sf-1      | Ground external radiation slope factors, 1/yr per (pCi/g): |               |            |                |
| Sf-1      | Ac-227+D   | 1.47E-06      | 3.48E-10   | SLPF( 1,1)     |
| Sf-1      | Pa-231   | 1.39E-07      | 1.39E-07   | SLPF( 2,1)     |
| Sf-1      | Pb-210+D   | 4.21E-09      | 1.41E-09   | SLPF( 3,1)     |
| Sf-1      | Ra-226+D   | 8.49E-06      | 2.29E-08   | SLPF( 4,1)     |
| Sf-1      | Th-230   | 8.19E-10      | 8.19E-10   | SLPF( 5,1)     |
| Sf-1      | U-234  | 2.52E-10      | 2.52E-10   | SLPF( 6,1)     |
| Sf-1      | U-235+D  | 5.43E-07      | 5.18E-07   | SLPF( 7,1)     |
| Sf-1      | U-238  | 4.99E-11      | 4.99E-11   | SLPF( 8,1)     |
| Sf-1      | U-238+D  | 1.14E-07      | 4.99E-11   | SLPF( 9,1)     |
| Sf-2      | Inhalation, slope factors, 1/(pCi):                        |               |            |                |
| Sf-2      | Ac-227+D   | 2.09E-07      | 1.49E-07   | SLPF( 1,2)     |
| Sf-2      | Pa-231   | 4.55E-08      | 4.55E-08   | SLPF( 2,2)     |
| Sf-2      | Pb-210+D   | 1.39E-08      | 2.77E-09   | SLPF( 3,2)     |
| Sf-2      | Ra-226+D   | 1.16E-08      | 1.15E-08   | SLPF( 4,2)     |
| Sf-2      | Th-230   | 2.85E-08      | 2.85E-08   | SLPF( 5,2)     |
| Sf-2      | U-234  | 1.14E-08      | 1.14E-08   | SLPF( 6,2)     |
| Sf-2      | U-235+D  | 1.01E-08      | 1.01E-08   | SLPF( 7,2)     |
| Sf-2      | U-238  | 9.32E-09      | 9.32E-09   | SLPF( 8,2)     |
| Sf-2      | U-238+D  | 9.35E-09      | 9.32E-09   | SLPF( 9,2)     |
| Sf-3      | Food ingestion, slope factors, 1/(pCi):                    |               |            |                |
| Sf-3      | Ac-227+D   | 6.53E-10      | 2.45E-10   | SLPF( 1,3)     |
| Sf-3      | Pa-231   | 2.26E-10      | 2.26E-10   | SLPF( 2,3)     |
| Sf-3      | Pb-210+D   | 3.44E-09      | 1.18E-09   | SLPF( 3,3)     |
| Sf-3      | Ra-226+D   | 5.15E-10      | 5.14E-10   | SLPF( 4,3)     |
| Sf-3      | Th-230   | 1.19E-10      | 1.19E-10   | SLPF( 5,3)     |
| Sf-3      | U-234  | 9.55E-11      | 9.55E-11   | SLPF( 6,3)     |
| Sf-3      | U-235+D  | 9.76E-11      | 9.44E-11   | SLPF( 7,3)     |
| Sf-3      | U-238  | 8.66E-11      | 8.66E-11   | SLPF( 8,3)     |
| Sf-3      | U-238+D  | 1.21E-10      | 8.66E-11   | SLPF( 9,3)     |
| Sf-3      | Water ingestion, slope factors, 1/(pCi):                   |               |            |                |
| Sf-3      | Ac-227+D   | 4.86E-10      | 2.01E-10   | SLPF( 1,4)     |
| Sf-3      | Pa-231   | 1.73E-10      | 1.73E-10   | SLPF( 2,4)     |
| Sf-3      | Pb-210+D   | 1.27E-09      | 8.81E-10   | SLPF( 3,4)     |
| Sf-3      | Ra-226+D   | 3.86E-10      | 3.85E-10   | SLPF( 4,4)     |
| Sf-3      | Th-230   | 9.10E-11      | 9.10E-11   | SLPF( 5,4)     |
| Sf-3      | U-234  | 7.07E-11      | 7.07E-11   | SLPF( 6,4)     |
| Sf-3      | U-235+D  | 7.18E-11      | 6.96E-11   | SLPF( 7,4)     |
| Sf-3      | U-238  | 6.40E-11      | 6.40E-11   | SLPF( 8,4)     |
| Sf-3      | U-238+D  | 8.71E-11      | 6.40E-11   | SLPF( 9,4)     |
| Sf-3      | Soil ingestion, slope factors, 1/(pCi):                    |               |            |                |
| Sf-3      | Ac-227+D   | 1.16E-09      | 3.81E-10   | SLPF( 1,5)     |
| Sf-3      | Pa-231   | 3.74E-10      | 3.74E-10   | SLPF( 2,5)     |
| Sf-3      | Pb-210+D   | 2.66E-09      | 1.84E-09   | SLPF( 3,5)     |
| Sf-3      | Ra-226+D   | 7.30E-10      | 7.29E-10   | SLPF( 4,5)     |
| Sf-3      | Th-230   | 2.02E-10      | 2.02E-10   | SLPF( 5,5)     |

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Cancer Risk Slope Factors Summary Table (continued)  
Risk Library: HEAST 2001 Morbidity

| 0<br>Menu | Parameter                                | Current Value | Base Case* | Parameter Name |
|-----------|--|---------------|------------|----------------|
| Sf-3      | U-234                                    | 1.58E-10      | 1.58E-10   | SLPF( 6,5)     |
| Sf-3      | U-235+D                                  | 1.63E-10      | 1.57E-10   | SLPF( 7,5)     |
| Sf-3      | U-238                                    | 1.43E-10      | 1.43E-10   | SLPF( 8,5)     |
| Sf-3      | U-238+D                                  | 2.10E-10      | 1.43E-10   | SLPF( 9,5)     |
| Sf-Rn     | Radon Inhalation slope factors, 1/(pCi): |               |            |                |
| Sf-Rn     | Rn-222                                   | 1.80E-12      | 1.80E-12   | SLPFRN(1,1)    |
| Sf-Rn     | Po-218                                   | 3.70E-12      | 3.70E-12   | SLPFRN(1,2)    |
| Sf-Rn     | Pb-214                                   | 6.20E-12      | 6.20E-12   | SLPFRN(1,3)    |
| Sf-Rn     | Bi-214                                   | 1.50E-11      | 1.50E-11   | SLPFRN(1,4)    |
| Sf-Rn     | Radon K factors, (mrem/WLM):             |               |            |                |
| Sf-Rn     | Rn-222 Indoor                            | 7.60E+02      | 7.60E+02   | KFACTR(1,1)    |
| Sf-Rn     | Rn-222 Outdoor                           | 5.70E+02      | 5.70E+02   | KFACTR(1,2)    |

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

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| ONuclide<br>(i) | Risk Slope and Environmental Transport Factors for the Ground Pathway |  |           |           |           |           |           |           |           |
|-----------------|---|--|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
|                 | Slope(i)*   | ETFG(i,t) At Time in Years (dimensionless) |           |           |           |           |           |           |           |
|                 |   | 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 |
| Ac-227          | 3.480E-10   | 5.149E-01                                  | 5.149E-01 | 5.149E-01 | 5.149E-01 | 5.149E-01 | 5.149E-01 | 5.149E-01 | 5.149E-01 |
| At-218          | 3.570E-09   | 5.222E-01                                  | 5.222E-01 | 5.222E-01 | 5.222E-01 | 5.222E-01 | 5.222E-01 | 5.222E-01 | 5.222E-01 |
| Bi-210          | 2.760E-09   | 5.086E-01                                  | 5.086E-01 | 5.086E-01 | 5.086E-01 | 5.086E-01 | 5.086E-01 | 5.086E-01 | 5.086E-01 |
| Bi-211          | 1.880E-07   | 5.088E-01                                  | 5.088E-01 | 5.088E-01 | 5.088E-01 | 5.088E-01 | 5.088E-01 | 5.088E-01 | 5.088E-01 |
| Bi-214          | 7.480E-06   | 5.059E-01                                  | 5.059E-01 | 5.059E-01 | 5.059E-01 | 5.059E-01 | 5.059E-01 | 5.059E-01 | 5.059E-01 |
| Fr-223          | 1.400E-07   | 5.114E-01                                  | 5.114E-01 | 5.114E-01 | 5.114E-01 | 5.114E-01 | 5.114E-01 | 5.114E-01 | 5.114E-01 |
| Pa-231          | 1.390E-07   | 5.089E-01                                  | 5.089E-01 | 5.089E-01 | 5.089E-01 | 5.089E-01 | 5.089E-01 | 5.089E-01 | 5.089E-01 |
| Pa-234          | 8.710E-06   | 5.059E-01                                  | 5.059E-01 | 5.059E-01 | 5.059E-01 | 5.059E-01 | 5.059E-01 | 5.059E-01 | 5.059E-01 |
| Pa-234m         | 6.870E-08   | 5.055E-01                                  | 5.055E-01 | 5.055E-01 | 5.055E-01 | 5.055E-01 | 5.055E-01 | 5.055E-01 | 5.055E-01 |
| Pb-210          | 1.410E-09   | 5.281E-01                                  | 5.281E-01 | 5.281E-01 | 5.281E-01 | 5.281E-01 | 5.281E-01 | 5.281E-01 | 5.281E-01 |
| Pb-211          | 2.290E-07   | 5.058E-01                                  | 5.058E-01 | 5.058E-01 | 5.058E-01 | 5.058E-01 | 5.058E-01 | 5.058E-01 | 5.058E-01 |
| Pb-214          | 9.820E-07   | 5.089E-01                                  | 5.089E-01 | 5.089E-01 | 5.089E-01 | 5.089E-01 | 5.089E-01 | 5.089E-01 | 5.089E-01 |
| Po-210          | 3.950E-11   | 5.054E-01                                  | 5.054E-01 | 5.054E-01 | 5.054E-01 | 5.054E-01 | 5.054E-01 | 5.054E-01 | 5.054E-01 |
| Po-211          | 3.580E-08   | 5.037E-01                                  | 5.037E-01 | 5.037E-01 | 5.037E-01 | 5.037E-01 | 5.037E-01 | 5.037E-01 | 5.037E-01 |
| Po-214          | 3.860E-10   | 5.037E-01                                  | 5.037E-01 | 5.037E-01 | 5.037E-01 | 5.037E-01 | 5.037E-01 | 5.037E-01 | 5.037E-01 |
| Po-215          | 7.480E-10   | 5.064E-01                                  | 5.064E-01 | 5.064E-01 | 5.064E-01 | 5.064E-01 | 5.064E-01 | 5.064E-01 | 5.064E-01 |
| Po-218          | 4.260E-11   | 5.054E-01                                  | 5.054E-01 | 5.054E-01 | 5.054E-01 | 5.054E-01 | 5.054E-01 | 5.054E-01 | 5.054E-01 |
| Ra-223          | 4.340E-07   | 5.111E-01                                  | 5.111E-01 | 5.111E-01 | 5.111E-01 | 5.111E-01 | 5.111E-01 | 5.111E-01 | 5.111E-01 |
| Ra-226          | 2.290E-08   | 5.126E-01                                  | 5.126E-01 | 5.126E-01 | 5.126E-01 | 5.126E-01 | 5.126E-01 | 5.126E-01 | 5.126E-01 |
| Rn-219          | 2.250E-07   | 5.092E-01                                  | 5.092E-01 | 5.092E-01 | 5.092E-01 | 5.092E-01 | 5.092E-01 | 5.092E-01 | 5.092E-01 |
| Rn-222          | 1.740E-09   | 5.043E-01                                  | 5.043E-01 | 5.043E-01 | 5.043E-01 | 5.043E-01 | 5.043E-01 | 5.043E-01 | 5.043E-01 |
| Th-227          | 3.780E-07   | 5.118E-01                                  | 5.118E-01 | 5.118E-01 | 5.118E-01 | 5.118E-01 | 5.118E-01 | 5.118E-01 | 5.118E-01 |
| Th-230          | 8.190E-10   | 5.160E-01                                  | 5.160E-01 | 5.160E-01 | 5.160E-01 | 5.160E-01 | 5.160E-01 | 5.160E-01 | 5.160E-01 |
| Th-231          | 2.450E-08   | 5.166E-01                                  | 5.166E-01 | 5.166E-01 | 5.166E-01 | 5.166E-01 | 5.166E-01 | 5.166E-01 | 5.166E-01 |
| Th-234          | 1.630E-08   | 5.172E-01                                  | 5.172E-01 | 5.172E-01 | 5.172E-01 | 5.172E-01 | 5.172E-01 | 5.172E-01 | 5.172E-01 |
| Tl-207          | 1.520E-08   | 5.060E-01                                  | 5.060E-01 | 5.060E-01 | 5.060E-01 | 5.060E-01 | 5.060E-01 | 5.060E-01 | 5.060E-01 |
| Tl-210          | 0.000E+00   | 5.384E-01                                  | 5.384E-01 | 5.384E-01 | 5.384E-01 | 5.384E-01 | 5.384E-01 | 5.384E-01 | 5.384E-01 |
| U-234           | 2.520E-10   | 5.190E-01                                  | 5.190E-01 | 5.190E-01 | 5.190E-01 | 5.190E-01 | 5.190E-01 | 5.190E-01 | 5.190E-01 |
| U-235           | 5.180E-07   | 5.124E-01                                  | 5.124E-01 | 5.124E-01 | 5.124E-01 | 5.124E-01 | 5.124E-01 | 5.124E-01 | 5.124E-01 |
| U-238           | 4.990E-11   | 5.336E-01                                  | 5.336E-01 | 5.336E-01 | 5.336E-01 | 5.336E-01 | 5.336E-01 | 5.336E-01 | 5.336E-01 |

\* - Units are 1/yr per (pCi/g) at infinite depth and area. Multiplication by ETFG(i,t) converts to site conditions.

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Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
As pCi/yr at t= 0.000E+00 years

| Radio-Nuclide | Water Independent Pathways (Inhalation w/o radon) |           |           |           |           | Water Dependent Pathways |           |           |           |           | Total Ingestion* |
|---------------|---|-----------|-----------|-----------|-----------|--------------------------|-----------|-----------|-----------|-----------|------------------|
|               | Inhalation  | Plant     | Meat      | Milk      | Soil      | Water                    | Fish      | Plant     | Meat      | Milk      |                  |
| Ac-227        | 0.000E+00   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00        |
| Pa-231        | 0.000E+00   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00        |
| Pb-210        | 0.000E+00   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00        |
| Ra-226        | 0.000E+00   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00        |
| Th-230        | 0.000E+00   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00        |
| U-234         | 4.596E-04   | 1.599E+01 | 0.000E+00 | 0.000E+00 | 8.691E+00 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 2.468E+01        |
| U-235         | 3.404E-05   | 1.184E+00 | 0.000E+00 | 0.000E+00 | 6.438E-01 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 1.828E+00        |
| U-238         | 4.596E-04   | 1.599E+01 | 0.000E+00 | 0.000E+00 | 8.691E+00 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 2.468E+01        |

\* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil  
and water-dependent water, fish, plant, meat, milk pathways

0 Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of  
Radon and its Decay Products as pCi/yr at t= 0.000E+00 years

| Radon Pathway | Rn-222    | Po-218    | Pb-214    | Bi-214    | Rn-220    | Po-216    | Pb-212    | Bi-212    |
|---------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| Water-ind.    | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E-00 | 0.000E+00 | 0.000E+00 |
| Water-dep.    | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E-00 | 0.000E+00 | 0.000E+00 |
| Total         | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E-00 | 0.000E+00 | 0.000E+00 |

Water-ind. == Water-independent      Water-dep. == Water-dependent

0 Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
and Fraction of Total Risk at t= 0.000E+00 years

| Radio-Nuclide | Water Independent Pathways (Inhalation excludes radon) |        |            |        |           |        |           |        |           |        |           |        |
|---------------|--|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|               | Ground   |        | Inhalation |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|               | risk   | fract. | risk       | fract. | risk      | fract. | risk      | fract. | risk      | fract. | risk      | fract. |
| Ac-227        | 3.547E-11  | 0.0000 | 1.684E-14  | 0.0000 | 1.858E-12 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.773E-12 | 0.0000 |
| Pa-231        | 1.328E-11  | 0.0000 | 1.454E-14  | 0.0000 | 1.003E-11 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.259E-12 | 0.0000 |
| Pb-210        | 1.985E-15  | 0.0000 | 2.164E-17  | 0.0000 | 7.588E-13 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 7.843E-14 | 0.0000 |
| Ra-226        | 2.011E-11  | 0.0000 | 9.211E-17  | 0.0000 | 2.274E-12 | 0.0000 | 0.000E+00 | 0.3000 | 0.000E+00 | 0.0000 | 1.100E-13 | 0.0000 |
| Th-230        | 4.589E-13  | 0.0000 | 5.267E-14  | 0.0000 | 3.072E-12 | 0.0000 | 0.000E+00 | 0.3000 | 0.000E+00 | 0.0000 | 7.060E-12 | 0.0000 |
| U-234         | 1.048E-09  | 0.0013 | 1.555E-10  | 0.0002 | 4.532E-08 | 0.0544 | 0.000E+00 | 0.3000 | 0.000E+00 | 0.0000 | 4.076E-08 | 0.0490 |
| U-235         | 1.651E-07  | 0.1983 | 1.021E-11  | 0.0000 | 3.432E-09 | 0.0041 | 0.000E+00 | 0.3000 | 0.000E+00 | 0.0000 | 3.121E-09 | 0.0037 |
| U-238         | 4.619E-07  | 0.5549 | 1.275E-10  | 0.0002 | 5.724E-08 | 0.0688 | 0.000E+00 | 0.3000 | 0.000E+00 | 0.0000 | 5.418E-08 | 0.0651 |
| Total         | 6.281E-07  | 0.7545 | 2.933E-10  | 0.0004 | 1.060E-07 | 0.1273 | 0.000E+00 | 0.3000 | 0.000E+00 | 0.0000 | 9.806E-08 | 0.1178 |

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Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
and Fraction of Total Risk at t= 0.000E+00 years

Water Dependent Pathways

| Radio-Nuclide | Water     |        | Fish      |        | Plant     |        | Meat      |        | Milk      |        | All Pathways** |        |
|---------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|----------------|--------|
|               | risk      | fract. | risk           | fract. |
| Ac-227        | 0.000E+00 | 0.0000 | 3.912E-11      | 0.0000 |
| Pa-231        | 0.000E+00 | 0.0000 | 2.558E-11      | 0.0000 |
| Pb-210        | 0.000E+00 | 0.0000 | 8.393E-13      | 0.0000 |
| Ra-226        | 0.000E+00 | 0.0000 | 2.249E-11      | 0.0000 |
| Th-230        | 0.000E+00 | 0.0000 | 1.064E-11      | 0.0000 |
| U-234         | 0.000E+00 | 0.0000 | 8.728E-08      | 0.1048 |
| U-235         | 0.000E+00 | 0.0000 | 1.716E-07      | 0.2062 |
| U-238         | 0.000E+00 | 0.0000 | 5.735E-07      | 0.6889 |
| Total         | 0.000E+00 | 0.0000 | 8.325E-07      | 1.0000 |

\*\* Sum of water independent ground, inhalation, plant, meat, milk, soil  
and water dependent water, fish, plant, meat, milk pathways

0

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of  
Radon and its Decay Products at t= 0.000E+00 years  
Radionuclides

| Radon Pathway | Rn-222    | Po-218    | Pb-214    | Bi-214    | Rn-220    | Po-216    | Pb-212    | Bi-212    |
|---------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| Water-ind.    | 0.000E+00 | 3.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 |
| Water-dep.    | 0.000E+00 | 3.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 |
| Total         | 0.000E+00 |

Water-ind. == Water-independent      Water-dep. == Water-dependent

0

Total Excess Cancer Risk CNRS(i,p,t)\*\*\* for Initially Existent Radionuclides (i) and Pathways (p)  
and Fraction of Total Risk at t= 0.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

| Radio-Nuclide | Ground    |        | Inhalation |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|---------------|-----------|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|               | risk      | fract. | risk       | fract. | risk      | fract. | risk      | fract. | risk      | fract. | risk      | fract. | risk      | fract. |
| U-234         | 1.069E-09 | 0.0013 | 1.555E-10  | 0.0002 | 0.000E+00 | 0.0000 | 4.532E-08 | 0.0544 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.076E-08 | 0.0490 |
| U-235         | 1.651E-07 | 0.1983 | 1.024E-11  | 0.0000 | 0.000E+00 | 0.0000 | 3.444E-09 | 0.0041 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.125E-09 | 0.0038 |
| U-238         | 4.619E-07 | 0.5549 | 1.276E-10  | 0.0002 | 0.000E+00 | 0.0000 | 5.724E-08 | 0.0688 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 5.418E-08 | 0.0651 |
| Total         | 6.281E-07 | 0.7545 | 2.933E-10  | 0.0004 | 0.000E+00 | 0.0000 | 1.060E-07 | 0.1273 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 9.806E-08 | 0.1178 |

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Total Excess Cancer Risk CNRS(i,p,t)\*\*\* for Initially Existent Radionuclides (i) and Pathways (p)  
and Fraction of Total Risk at t= 0.000E+00 years

Water Dependent Pathways

| Radio-Nuclide | Water     |        | Fish      |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | All pathways |        |
|---------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|--------------|--------|
|               | risk      | fract. | risk         | fract. |
| U-234         | 0.000E+00 | 0.0000 | 8.731E-08    | 0.1049 |
| U-235         | 0.000E+00 | 0.0000 | 1.717E-07    | 0.2062 |
| U-238         | 0.000E+00 | 0.0000 | 5.735E-07    | 0.6889 |
| Total         | 0.000E+00 | 0.0000 | 8.325E-07    | 1.0000 |

\*\*\*CNRSI(i,p,t) includes contribution from decay daughter radionuclides

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Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
 As pCi/yr at t= 1.000E+00 years

| Radio-Nuclide | Water Independent Pathways (Inhalation w/o radon) |           |           |           |           | Water Dependent Pathways |           |           |           |           | Total Ingestion* |
|---------------|---|-----------|-----------|-----------|-----------|--------------------------|-----------|-----------|-----------|-----------|------------------|
|               | Inhalation  | Plant     | Meat      | Milk      | Soil      | Water                    | Fish      | Plant     | Meat      | Milk      |                  |
| Ac-227        | 1.133E-11   | 4.744E-07 | 0.000E+00 | 0.000E+00 | 2.143E-07 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 6.887E-07        |
| Pa-231        | 7.197E-10   | 9.753E-05 | 0.000E+00 | 0.000E+00 | 1.361E-05 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 1.111E-04        |
| Pb-210        | 9.208E-15   | 1.652E-09 | 0.000E+00 | 0.000E+00 | 1.741E-10 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 1.826E-09        |
| Ra-226        | 8.956E-13   | 4.653E-07 | 0.000E+00 | 0.000E+00 | 1.694E-08 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 4.823E-07        |
| Th-230        | 4.135E-09   | 6.057E-05 | 0.000E+00 | 0.000E+00 | 7.821E-05 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 1.388E-04        |
| U-234         | 4.592E-04   | 1.598E+01 | 0.000E+00 | 0.000E+00 | 8.685E+00 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 2.466E+01        |
| U-235         | 3.402E-05   | 1.183E+00 | 0.000E+00 | 0.000E+00 | 6.433E-01 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 1.827E+00        |
| U-238         | 4.592E-04   | 1.598E+01 | 0.000E+00 | 0.000E+00 | 8.685E+00 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 2.466E+01        |

\* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil and water-dependent water, fish, plant, meat, milk pathways

0 Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of Radon and its Decay Products as pCi/yr at t= 1.000E+00 years

| Radon Pathway | Radionuclides |           |           |           |           |           |           |           |
|---------------|---------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
|               | Rn-222        | Po-218    | Pb-214    | Bi-214    | Rn-220    | Po-216    | Pb-212    | Bi-212    |
| Water-ind.    | 0.000E+00     | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 |
| Water-dep.    | 0.000E+00     | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 |
| Total         | 0.000E+00     | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 |

Water-ind. == Water-independent Water-dep. == Water-dependent

0 Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p) and Fraction of Total Risk at t= 1.000E+00 years

| Radio-Nuclide | Water Independent Pathways (Inhalation excludes radon) |        |            |        |           |        |           |        |           |        |
|---------------|--|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|
|               | Ground   |        | Inhalation |        | Plant     |        | Meat      |        |           |        |
|               | risk   | fract. | risk       | fract. | risk      | fract. | risk      | fract. |           |        |
| Ac-227        | 3.884E-11  | 0.0000 | 1.844E-14  | 0.0000 | 2.034E-12 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Pa-231        | 1.415E-11  | 0.0000 | 1.550E-14  | 0.0000 | 1.069E-11 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Pb-210        | 2.250E-15  | 0.0000 | 2.453E-17  | 0.0000 | 8.597E-13 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Ra-226        | 2.218E-11  | 0.0000 | 1.016E-16  | 0.0000 | 2.508E-12 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Th-230        | 4.894E-13  | 0.0000 | 5.617E-14  | 0.0000 | 3.276E-12 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| U-234         | 1.047E-09  | 0.0013 | 1.554E-10  | 0.0002 | 4.529E-08 | 0.0544 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| U-235         | 1.649E-07  | 0.1983 | 1.020E-11  | 0.0000 | 3.430E-09 | 0.0041 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| U-238         | 4.616E-07  | 0.5549 | 1.275E-10  | 0.0002 | 5.719E-08 | 0.0688 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Total         | 6.277E-07  | 0.7545 | 2.931E-10  | 0.0004 | 1.059E-07 | 0.1273 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.1178 |

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Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
 and Fraction of Total Risk at t= 1.000E+00 years

Water Dependent Pathways

| Radio-Nuclide | Water     |        | Fish      |        | Plant     |        | Meat      |        | Milk      |        | All Pathways** |        |
|---------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|----------------|--------|
|               | risk      | fract. | risk           | fract. |
| Ac-227        | 0.000E+00 | 0.0000 | 4.284E-11      | 0.0001 |
| Pa-231        | 0.000E+00 | 0.0000 | 2.727E-11      | 0.0000 |
| Pb-210        | 0.000E+00 | 0.0000 | 9.509E-13      | 0.0000 |
| Ra-226        | 0.000E+00 | 0.0000 | 2.480E-11      | 0.0000 |
| Th-230        | 0.000E+00 | 0.0000 | 1.135E-11      | 0.0000 |
| U-234         | 0.000E+00 | 0.0000 | 8.722E-08      | 0.1048 |
| U-235         | 0.000E+00 | 0.0000 | 1.715E-07      | 0.2062 |
| U-238         | 0.000E+00 | 0.0000 | 5.731E-07      | 0.6889 |
| Total         | 0.000E+00 | 0.0000 | 8.319E-07      | 1.0000 |

\*\* Sum of water independent ground, inhalation, plant, meat, milk, soil  
 and water dependent water, fish, plant, meat, milk pathways

0

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of  
 Radon and its Decay Products at t= 1.000E+00 years  
 Radionuclides

| Radon Pathway | Rn-222    | Po-218    | Pb-214    | Bi-214    | Rn-220    | Po-216    | Pb-212    | Bi-212    |
|---------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| Water-ind.    | 0.000E+00 |
| Water-dep.    | 0.000E+00 |
| Total         | 0.000E+00 |

Water-ind. == Water-independent      Water-dep. == Water-dependent

0

Total Excess Cancer Risk CNRS(i,p,t)\*\*\* for Initially Existent Radionuclides (i) and Pathways (p)  
 and Fraction of Total Risk at t= 1.000E+00 years

| Radio-Nuclide | Ground    |        | Inhalation |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|---------------|-----------|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|               | risk      | fract. | risk       | fract. | risk      | fract. | risk      | fract. | risk      | fract. | risk      | fract. | risk      | fract. |
| U-234         | 1.070E-09 | 0.0013 | 1.554E-10  | 0.0002 | 0.000E+00 | 0.0000 | 4.529E-08 | 0.0544 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.073E-08 | 0.0490 |
| U-235         | 1.650E-07 | 0.1983 | 1.023E-11  | 0.0000 | 0.000E+00 | 0.0000 | 3.442E-09 | 0.0041 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.124E-09 | 0.0038 |
| U-238         | 4.616E-07 | 0.5549 | 1.275E-10  | 0.0002 | 0.000E+00 | 0.0000 | 5.72CE-08 | 0.0688 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 5.414E-08 | 0.0651 |
| Total         | 6.277E-07 | 0.7545 | 2.931E-10  | 0.0004 | 0.000E+00 | 0.0000 | 1.059E-07 | 0.1273 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 9.800E-08 | 0.1178 |

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Total Excess Cancer Risk CNRS(i,p,t)\*\*\* for Initially Existent Radionuclides (i) and Pathways (p)  
and Fraction of Total Risk at t= 1.000E+00 years

Water Dependent Pathways

| Radio-Nuclide | Water     |        | Fish      |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | All pathways |        |
|---------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|--------------|--------|
|               | risk      | fract. | risk         | fract. |
| U-234         | 0.000E+00 | 0.0000 | 8.725E-08    | 0.1049 |
| U-235         | 0.000E+00 | 0.0000 | 1.716E-07    | 0.2062 |
| U-238         | 0.000E+00 | 0.0000 | 5.731E-07    | 0.6889 |
| Total         | 0.000E+00 | 0.0000 | 8.319E-07    | 1.0000 |

\*\*\*CNRSI(i,p,t) includes contribution from decay daughter radionuclides

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Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
As pCi/yr at t = 3.000E+00 years

| Radio-Nuclide | Water Independent Pathways (Inhalation w/o radon) |           |            |            |           | Water Dependent Pathways |            |            |            |            | Total Ingestion* |
|---------------|---|-----------|------------|------------|-----------|--------------------------|------------|------------|------------|------------|------------------|
|               | Inhalation  | Plant     | Meat       | Milk       | Soil      | Water                    | Fish       | Plant      | Meat       | Milk       |                  |
| Ac-227        | 9.966E-11   | 3.713E-06 | 0.0000E+00 | 0.0000E+00 | 1.885E-06 | 0.0000E+00               | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 5.598E-06        |
| Pa-231        | 2.156E-09   | 2.974E-04 | 0.0000E+00 | 0.0000E+00 | 4.077E-05 | 0.0000E+00               | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 3.382E-04        |
| Pb-210        | 2.446E-13   | 3.756E-08 | 0.0000E+00 | 0.0000E+00 | 4.625E-09 | 0.0000E+00               | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 4.219E-08        |
| Ra-226        | 8.051E-12   | 4.380E-06 | 0.0000E+00 | 0.0000E+00 | 1.523E-07 | 0.0000E+00               | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 4.532E-06        |
| Th-230        | 1.240E-08   | 1.756E-04 | 0.0000E+00 | 0.0000E+00 | 2.345E-04 | 0.0000E+00               | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 4.100E-04        |
| U-234         | 4.586E-04   | 1.595E+01 | 0.0000E+00 | 0.0000E+00 | 8.672E+00 | 0.0000E+00               | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 2.463E+01        |
| U-235         | 3.397E-05   | 1.182E+00 | 0.0000E+00 | 0.0000E+00 | 6.424E-01 | 0.0000E+00               | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 1.824E+00        |
| U-238         | 4.586E-04   | 1.595E+01 | 0.0000E+00 | 0.0000E+00 | 8.672E+00 | 0.0000E+00               | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 2.463E+01        |

\* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil  
and water-dependent water, fish, plant, meat, milk pathways

0 Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of  
Radon and its Decay Products as pCi/yr at t = 3.000E+00 years

| Radon Pathway | Radionuclides |            |            |            |            |            |            |            |
|---------------|---------------|------------|------------|------------|------------|------------|------------|------------|
|               | Rn-222        | Po-218     | Pb-214     | Bi-214     | Rn-220     | Po-216     | Pb-212     | Bi-212     |
| Water-ind.    | 0.0000E+00    | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| Water-dep.    | 0.0000E+00    | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |
| Total         | 0.0000E+00    | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 | 0.0000E+00 |

Water-ind. == Water-independent Water-dep. == Water-dependent

0 Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
and Fraction of Total Risk at t = 3.000E+00 years

| Radio-Nuclide | Water Independent Pathways (Inhalation excludes radon) |        |            |        |           |        |            |        |            |        |           |        |
|---------------|--|--------|------------|--------|-----------|--------|------------|--------|------------|--------|-----------|--------|
|               | Ground   |        | Inhalation |        | Plant     |        | Meat       |        | Milk       |        | Soil      |        |
|               | risk   | fract. | risk       | fract. | risk      | fract. | risk       | fract. | risk       | fract. | risk      | fract. |
| Ac-227        | 4.611E-11  | 0.0001 | 2.189E-14  | 0.0000 | 2.413E-12 | 0.0000 | 0.0000E+00 | 0.0000 | 0.0000E+00 | 0.0000 | 2.305E-12 | 0.0000 |
| Pa-231        | 1.591E-11  | 0.0000 | 1.741E-14  | 0.0000 | 1.202E-11 | 0.0000 | 0.0000E+00 | 0.0000 | 0.0000E+00 | 0.0000 | 2.707E-12 | 0.0000 |
| Pb-210        | 2.856E-15  | 0.0000 | 3.113E-17  | 0.0000 | 1.090E-12 | 0.0000 | 0.0000E+00 | 0.0000 | 0.0000E+00 | 0.0000 | 1.128E-13 | 0.0000 |
| Ra-226        | 2.671E-11  | 0.0000 | 1.224E-16  | 0.0000 | 3.021E-12 | 0.0000 | 0.0000E+00 | 0.0000 | 0.0000E+00 | 0.0000 | 1.461E-13 | 0.0000 |
| Th-230        | 5.502E-13  | 0.0000 | 6.316E-14  | 0.0000 | 3.682E-12 | 0.0000 | 0.0000E+00 | 0.0000 | 0.0000E+00 | 0.0000 | 8.466E-12 | 0.0000 |
| U-234         | 1.046E-09  | 0.0013 | 1.552E-10  | 0.0002 | 4.522E-08 | 0.0544 | 0.0000E+00 | 0.0000 | 0.0000E+00 | 0.0000 | 4.067E-08 | 0.0490 |
| U-235         | 1.647E-07  | 0.1983 | 1.018E-11  | 0.0000 | 3.425E-09 | 0.0041 | 0.0000E+00 | 0.0000 | 0.0000E+00 | 0.0000 | 3.115E-09 | 0.0037 |
| U-238         | 4.610E-07  | 0.5549 | 1.273E-10  | 0.0002 | 5.711E-08 | 0.0687 | 0.0000E+00 | 0.0000 | 0.0000E+00 | 0.0000 | 5.406E-08 | 0.0651 |
| Total         | 6.268E-07  | 0.7545 | 2.927E-10  | 0.0004 | 1.058E-07 | 0.1273 | 0.0000E+00 | 0.0000 | 0.0000E+00 | 0.0000 | 9.786E-08 | 0.1178 |

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T<sub>1/2</sub> Limit = 180 days

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Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
and Fraction of Total Risk at t= 3.000E+00 years

Water Dependent Pathways

| Radio-Nuclide | Water     |        | Fish      |        | Plant     |        | Meat      |        | Milk      |        | All Pathways** |        |
|---------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|----------------|--------|
|               | risk      | fract. | risk           | fract. |
| Ac-227        | 0.000E+00 | 0.0000 | 5.085E-11      | 0.0001 |
| Pa-231        | 0.000E+00 | 0.0000 | 3.065E-11      | 0.0000 |
| Pb-210        | 0.000E+00 | 0.0000 | 1.206E-12      | 0.0000 |
| Ra-226        | 0.000E+00 | 0.0000 | 2.988E-11      | 0.0000 |
| Th-230        | 0.000E+00 | 0.0000 | 1.276E-11      | 0.0000 |
| U-234         | 0.000E+00 | 0.0000 | 8.709E-08      | 0.1048 |
| U-235         | 0.000E+00 | 0.0000 | 1.713E-07      | 0.2062 |
| U-238         | 0.000E+00 | 0.0000 | 5.723E-07      | 0.6889 |
| Total         | 0.000E+00 | 0.0000 | 8.307E-07      | 1.0000 |

\*\* Sum of water independent ground, inhalation, plant, meat, milk, soil  
and water dependent water, fish, plant, meat, milk pathways

0

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of  
Radon and its Decay Products at t= 3.000E+00 years  
Radionuclides

| Radon Pathway | Rn-222    | Po-218    | Pb-214    | Bi-214    | Rn-220    | Po-216    | Pb-212    | Bi-212    |
|---------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| Water-ind.    | 0.000E+00 |
| Water-dep.    | 0.000E+00 |
| Total         | 0.000E+00 |

Water-ind. == Water-independent      Water-dep. == Water-dependent

0

Total Excess Cancer Risk CNRS(i,p,t)\*\*\* for Initially Existent Radionuclides (i) and Pathways (p)  
and Fraction of Total Risk at t= 3.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

| Radio-Nuclide | Ground    |        | Inhalation |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|---------------|-----------|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|               | risk      | fract. | risk       | fract. | risk      | fract. | risk      | fract. | risk      | fract. | risk      | fract. | risk      | fract. |
| U-234         | 1.073E-09 | 0.0013 | 1.552E-10  | 0.0002 | 0.000E+00 | 0.0000 | 4.523E-08 | 0.0544 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.068E-08 | 0.0490 |
| U-235         | 1.648E-07 | 0.1983 | 1.022E-11  | 0.0000 | 0.000E+00 | 0.0000 | 3.439E-09 | 0.0041 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.120E-09 | 0.0038 |
| U-238         | 4.610E-07 | 0.5549 | 1.273E-10  | 0.0002 | 0.000E+00 | 0.0000 | 5.712E-08 | 0.0688 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 5.406E-08 | 0.0651 |
| Total         | 6.268E-07 | 0.7545 | 2.927E-10  | 0.0004 | 0.000E+00 | 0.0000 | 1.058E-07 | 0.1273 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 9.786E-08 | 0.1178 |

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Total Excess Cancer Risk CNRS(i,p,t)\*\*\* for Initially Existent Radionuclides (i) and Pathways (p)  
and Fraction of Total Risk at t= 3.000E+00 years

Water Dependent Pathways

| Radio-Nuclide | Water      |        | Fish       |        | Radon      |        | Plant      |        | Meat       |        | Milk       |        | All pathways |        |
|---------------|------------|--------|------------|--------|------------|--------|------------|--------|------------|--------|------------|--------|--------------|--------|
|               | risk       | fract. | risk         | fract. |
| U-234         | 0.0000E+00 | 0.0000 | 8.713E-08    | 0.1049 |
| U-235         | 0.0000E+00 | 0.0000 | 1.713E-07    | 0.2063 |
| U-238         | 0.0000E+00 | 0.0000 | 5.723E-07    | 0.6889 |
| Total         | 0.0000E+00 | 0.0000 | 8.307E-07    | 1.0000 |

\*\*\*CNRSI(i,p,t) includes contribution from decay daughter radionuclides

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Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
As pCi/yr at t= 1.000E+01 years

| Radio-Nuclide | Water Independent Pathways (Inhalation w/o radon) |           |           |           |           | Water Dependent Pathways |           |           |           |           | Total Ingestion* |
|---------------|---|-----------|-----------|-----------|-----------|--------------------------|-----------|-----------|-----------|-----------|------------------|
|               | Inhalation  | Plant     | Meat      | Milk      | Soil      | Water                    | Fish      | Plant     | Meat      | Milk      |                  |
| Ac-227        | 1.023E-09   | 3.642E-05 | 0.000E+00 | 0.000E+00 | 1.935E-05 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 5.577E-05        |
| Pa-231        | 7.151E-09   | 9.923E-04 | 0.000E+00 | 0.000E+00 | 1.352E-04 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 1.128E-03        |
| Pb-210        | 8.562E-12   | 1.231E-06 | 0.000E+00 | 0.000E+00 | 1.619E-07 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 1.393E-06        |
| Ra-226        | 8.911E-11   | 4.926E-05 | 0.000E+00 | 0.000E+00 | 1.685E-06 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 5.094E-05        |
| Th-230        | 4.122E-08   | 5.768E-04 | 0.000E+00 | 0.000E+00 | 7.795E-04 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 1.356E-03        |
| U-234         | 4.563E-04   | 1.587E+01 | 0.000E+00 | 0.000E+00 | 8.629E+00 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 2.450E+01        |
| U-235         | 3.380E-05   | 1.176E+00 | 0.000E+00 | 0.000E+00 | 6.392E-01 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 1.815E+00        |
| U-238         | 4.563E-04   | 1.587E+01 | 0.000E+00 | 0.000E+00 | 8.629E+00 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 2.450E+01        |

\* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil  
and water-dependent water, fish, plant, meat, milk pathways

0 Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of  
Radon and its Decay Products as pCi/yr at t= 1.000E+01 years

| Radionuclides |           |           |           |           |           |           |           |           |
|---------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| Radon Pathway | Rn-222    | Po-218    | Pb-214    | Bi-214    | Rn-220    | Po-216    | Pb-212    | Bi-212    |
| Water-ind.    | 0.000E+00 |
| Water-dep.    | 0.000E+00 |
| Total         | 0.000E+00 |

Water-ind. == Water-independent      Water-dep. == Water-dependent

0 Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
and Fraction of Total Risk at t= 1.000E+01 years

| Water Independent Pathways (Inhalation excludes radon) |           |        |            |        |           |        |           |        |           |        |           |        |
|--|-----------|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
| Radio-Nuclide  | Ground    |        | Inhalation |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|  | risk      | fract. | risk       | fract. | risk      | fract. | risk      | fract. | risk      | fract. | risk      | fract. |
| Ac-227   | 7.650E-11 | 0.0001 | 3.633E-14  | 0.0000 | 3.995E-12 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.824E-12 | 0.0000 |
| Pa-231   | 2.200E-11 | 0.0000 | 2.409E-14  | 0.0000 | 1.663E-11 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.744E-12 | 0.0000 |
| Pb-210   | 5.892E-15 | 0.0000 | 6.423E-17  | 0.0000 | 2.244E-12 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.328E-13 | 0.0000 |
| Ra-226   | 4.671E-11 | 0.0001 | 2.140E-16  | 0.0000 | 5.288E-12 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.555E-13 | 0.0000 |
| Th-230   | 7.626E-13 | 0.0000 | 8.754E-14  | 0.0000 | 5.099E-12 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.173E-11 | 0.0000 |
| U-234  | 1.041E-09 | 0.0013 | 1.544E-10  | 0.0002 | 4.500E-08 | 0.0544 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.047E-08 | 0.0490 |
| U-235  | 1.639E-07 | 0.1983 | 1.013E-11  | 0.0000 | 3.408E-09 | 0.0041 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.099E-09 | 0.0037 |
| U-238  | 4.587E-07 | 0.5548 | 1.266E-10  | 0.0002 | 5.683E-08 | 0.0687 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 5.379E-08 | 0.0651 |
| Total  | 6.237E-07 | 0.7545 | 2.913E-10  | 0.0004 | 1.053E-07 | 0.1273 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 9.737E-08 | 0.1178 |

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Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
 and Fraction of Total Risk at t= 1.000E+01 years

## Water Dependent Pathways

| Radio-Nuclide | Water     |        | Fish      |        | Plant     |        | Meat      |        | Milk      |        | All Pathways** |        |
|---------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|----------------|--------|
|               | risk      | fract. | risk           | fract. |
| Ac-227        | 0.000E+00 | 0.0000 | 8.436E-11      | 0.0001 |
| Pa-231        | 0.000E+00 | 0.0000 | 4.240E-11      | 0.0001 |
| Pb-210        | 0.000E+00 | 0.0000 | 2.483E-12      | 0.0000 |
| Ra-226        | 0.000E+00 | 0.0000 | 5.226E-11      | 0.0001 |
| Th-230        | 0.000E+00 | 0.0000 | 1.768E-11      | 0.0000 |
| U-234         | 0.000E+00 | 0.0000 | 8.666E-08      | 0.1048 |
| U-235         | 0.000E+00 | 0.0000 | 1.704E-07      | 0.2061 |
| U-238         | 0.000E+00 | 0.0000 | 5.694E-07      | 0.6888 |
| Total         | 0.000E+00 | 0.0000 | 8.267E-07      | 1.0000 |

\*\* Sum of water independent ground, inhalation, plant, meat, milk, soil  
 and water dependent water, fish, plant, meat, milk pathways

0

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of  
 Radon and its Decay Products at t= 1.000E+01 years  
 Radionuclides

| Radon Pathway | Rn-222    | Po-218    | Pb-214    | Bi-214    | Rn-220    | Po-216    | Pb-212    | Bi-212    |
|---------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| Water-ind.    | 0.000E+00 |
| Water-dep.    | 0.000E+00 |
| Total         | 0.000E+00 |

Water-ind. == Water-independent      Water-dep. == Water-dependent

0

Total Excess Cancer Risk CNRS(i,p,t)\*\*\* for Initially Existent Radionuclides (i) and Pathways (p)  
 and Fraction of Total Risk at t= 1.000E+01 years

| Radio-Nuclide | Ground    |        | Inhalation |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|---------------|-----------|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|               | risk      | fract. | risk       | fract. | risk      | fract. | risk      | fract. | risk      | fract. | risk      | fract. | risk      | fract. |
| U-234         | 1.088E-09 | 0.0013 | 1.545E-10  | 0.0002 | 0.000E+00 | 0.0000 | 4.501E-08 | 0.0544 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.048E-08 | 0.0490 |
| U-235         | 1.640E-07 | 0.1984 | 1.019E-11  | 0.0000 | 0.000E+00 | 0.0000 | 3.428E-09 | 0.0041 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.107E-09 | 0.0038 |
| U-238         | 4.587E-07 | 0.5548 | 1.266E-10  | 0.0002 | 0.000E+00 | 0.0000 | 5.683E-08 | 0.0687 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 5.379E-08 | 0.0651 |
| Total         | 6.237E-07 | 0.7545 | 2.913E-10  | 0.0004 | 0.000E+00 | 0.0000 | 1.053E-07 | 0.1273 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 9.737E-08 | 0.1178 |

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T<sub>1/2</sub> Limit = 180 days

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Total Excess Cancer Risk CNRS(i,p,t)\*\*\* for Initially Existent Radionuclides (i) and Pathways (p)  
and Fraction of Total Risk at t= 1.000E+01 years

## Water Dependent Pathways

| Radio-Nuclide | Water     |        | Fish      |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | All pathways |        |
|---------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|--------------|--------|
|               | risk      | fract. | risk         | fract. |
| U-234         | 0.000E+00 | 0.0000 | 8.672E-08    | 0.1049 |
| U-235         | 0.000E+00 | 0.0000 | 1.705E-07    | 0.2063 |
| U-238         | 0.000E+00 | 0.0000 | 5.694E-07    | 0.6888 |
| Total         | 0.000E+00 | 0.0000 | 8.267E-07    | 1.0000 |

\*\*\*CNRSI(i,p,t) includes contribution from decay daughter radionuclides

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Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
 As pCi/yr at t= 3.000E+01 years

| Radio-Nuclide | Water Independent Pathways (Inhalation w/o radon) |           |           |           |           | Water Dependent Pathways |           |           |           |           | Total Ingestion* |
|---------------|---|-----------|-----------|-----------|-----------|--------------------------|-----------|-----------|-----------|-----------|------------------|
|               | Inhalation  | Plant     | Meat      | Milk      | Soil      | Water                    | Fish      | Plant     | Meat      | Milk      |                  |
| Ac-227        | 7.457E-09   | 2.619E-04 | 0.000E+00 | 0.000E+00 | 1.410E-04 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 4.029E-04        |
| Pa-231        | 2.114E-08   | 2.939E-03 | 0.000E+00 | 0.000E+00 | 3.998E-04 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 3.339E-03        |
| Pb-210        | 1.986E-10   | 2.798E-05 | 0.000E+00 | 0.000E+00 | 3.755E-06 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 3.174E-05        |
| Ra-226        | 7.932E-10   | 4.404E-04 | 0.000E+00 | 0.000E+00 | 1.500E-05 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 4.554E-04        |
| Th-230        | 1.228E-07   | 1.712E-03 | 0.000E+00 | 0.000E+00 | 2.322E-03 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 4.034E-03        |
| U-234         | 4.498E-04   | 1.565E+01 | 0.000E+00 | 0.000E+00 | 8.507E+00 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 2.416E+01        |
| U-235         | 3.332E-05   | 1.159E+00 | 0.000E+00 | 0.000E+00 | 6.301E-01 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 1.789E+00        |
| U-238         | 4.498E-04   | 1.565E+01 | 0.000E+00 | 0.000E+00 | 8.507E+00 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 2.416E+01        |

\* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil  
 and water-dependent water, fish, plant, meat, milk pathways

0  
 Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of  
 Radon and its Decay Products as pCi/yr at t= 3.000E+01 years

| Radon Pathway | Rn-222    | Po-218    | Pb-214    | Bi-214    | Rn-220    | Po-216    | Pb-212    | Bi-212    |
|---------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| Water-ind.    | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E-00 | 0.000E+00 | 0.000E+00 |
| Water-dep.    | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E-00 | 0.000E+00 | 0.000E+00 |
| Total         | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E-00 | 0.000E+00 | 0.000E+00 |

Water-ind. == Water-independent      Water-dep. == Water-dependent

0  
 Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
 and Fraction of Total Risk at t= 3.000E+01 years

| Radio-Nuclide | Water Independent Pathways (Inhalation excludes radon) |        |            |        |           |        |           |        |           |        |           |        |
|---------------|--|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|               | Ground   |        | Inhalation |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|               | risk   | fract. | risk       | fract. | risk      | fract. | risk      | fract. | risk      | fract. | risk      | fract. |
| Ac-227        | 1.936E-10  | 0.0002 | 9.192E-14  | 0.0000 | 1.008E-11 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 9.676E-12 | 0.0000 |
| Pa-231        | 3.907E-11  | 0.0000 | 4.277E-14  | 0.0000 | 2.954E-11 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.649E-12 | 0.0000 |
| Pb-210        | 2.487E-14  | 0.0000 | 2.711E-16  | 0.0000 | 9.436E-12 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 9.824E-13 | 0.0000 |
| Ra-226        | 1.388E-10  | 0.0002 | 6.357E-16  | 0.0000 | 1.572E-11 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 7.591E-13 | 0.0000 |
| Th-230        | 1.364E-12  | 0.0000 | 1.565E-13  | 0.0000 | 9.108E-12 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.098E-11 | 0.0000 |
| U-234         | 1.026E-09  | 0.0013 | 1.522E-10  | 0.0002 | 4.436E-08 | 0.0544 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.989E-08 | 0.0489 |
| U-235         | 1.616E-07  | 0.1982 | 9.990E-12  | 0.0000 | 3.359E-09 | 0.0041 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.055E-09 | 0.0037 |
| U-238         | 4.521E-07  | 0.5546 | 1.248E-10  | 0.0002 | 5.602E-08 | 0.0687 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 5.303E-08 | 0.0650 |
| Total         | 6.151E-07  | 0.7545 | 2.873E-10  | 0.0004 | 1.038E-07 | 0.1273 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 9.601E-08 | 0.1178 |

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Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
and Fraction of Total Risk at t= 3.000E+01 years

Water Dependent Pathways

| Radio-Nuclide | Water     |        | Fish      |        | Plant     |        | Meat      |        | Milk      |        | All Pathways** |        |
|---------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|----------------|--------|
|               | risk      | fract. | risk           | fract. |
| Ac-227        | 0.000E+00 | 0.0000 | 2.134E-10      | 0.0003 |
| Pa-231        | 0.000E+00 | 0.0000 | 7.530E-11      | 0.0001 |
| Pb-210        | 0.000E+00 | 0.0000 | 1.044E-11      | 0.0000 |
| Ra-226        | 0.000E+00 | 0.0000 | 1.552E-10      | 0.0002 |
| Th-230        | 0.000E+00 | 0.0000 | 3.161E-11      | 0.0000 |
| U-234         | 0.000E+00 | 0.0000 | 8.543E-08      | 0.1048 |
| U-235         | 0.000E+00 | 0.0000 | 1.680E-07      | 0.2061 |
| U-238         | 0.000E+00 | 0.0000 | 5.613E-07      | 0.6886 |
| Total         | 0.000E+00 | 0.0000 | 8.152E-07      | 1.0000 |

\*\* Sum of water independent ground, inhalation, plant, meat, milk, soil  
and water dependent water, fish, plant, meat, milk pathways

0

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of  
Radon and its Decay Products at t= 3.000E+01 years  
Radionuclides

| Radon Pathway | Rn-222    | Po-218    | Pb-214    | Bi-214    | Rn-220    | Po-216    | Pb-212    | Bi-212    |
|---------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| Water-ind.    | 0.000E+00 |
| Water-dep.    | 0.000E+00 |
| Total         | 0.000E+00 |

Water-ind. == Water-independent      Water-dep. == Water-dependent

0

Total Excess Cancer Risk CNRS(i,p,t)\*\*\* for Initially Existent Radionuclides (i) and Pathways (p)  
and Fraction of Total Risk at t= 3.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

| Radio-Nuclide | Ground    |        | Inhalation |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|---------------|-----------|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|               | risk      | fract. | risk       | fract. | risk      | fract. | risk      | fract. | risk      | fract. | risk      | fract. | risk      | fract. |
| U-234         | 1.166E-09 | 0.0014 | 1.523E-10  | 0.0002 | 0.000E+00 | 0.0000 | 4.439E-08 | 0.0544 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.991E-08 | 0.0490 |
| U-235         | 1.618E-07 | 0.1985 | 1.012E-11  | 0.0000 | 0.000E+00 | 0.0000 | 3.399E-09 | 0.0042 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.072E-09 | 0.0038 |
| U-238         | 4.521E-07 | 0.5546 | 1.249E-10  | 0.0002 | 0.000E+00 | 0.0000 | 5.603E-08 | 0.0687 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 5.303E-08 | 0.0651 |
| Total         | 6.151E-07 | 0.7545 | 2.873E-10  | 0.0004 | 0.000E+00 | 0.0000 | 1.038E-07 | 0.1273 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 9.601E-08 | 0.1178 |

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T<sub>½</sub> Limit = 180 days

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Total Excess Cancer Risk CNRS(i,p,t)\*\*\* for Initially Existent Radionuclides (i) and Pathways (p)  
and Fraction of Total Risk at t= 1.000E+01 years

Water Dependent Pathways

| Radio-Nuclide | Water     |        | Fish      |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | All pathways |        |
|---------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|--------------|--------|
|               | risk      | fract. | risk         | fract. |
| U-234         | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.030E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 8.561E-08    | 0.1050 |
| U-235         | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.030E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.683E-07    | 0.2064 |
| U-238         | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.030E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 5.613E-07    | 0.6886 |
| Total         | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.030E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 8.152E-07    | 1.0000 |

\*\*\*CNRSI(i,p,t) includes contribution from decay daughter radionuclides

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T<sub>1/2</sub> Limit = 180 days 03/16/2011 10:17 Page 20

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Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
As pCi/yr at t= 1.000E+02 years

| Radio-Nuclide | Water Independent Pathways (Inhalation w/o radon) |           |           |           |           | Water Dependent Pathways |           |           |           |           | Total Ingestion* |
|---------------|---|-----------|-----------|-----------|-----------|--------------------------|-----------|-----------|-----------|-----------|------------------|
|               | Inhalation  | Plant     | Meat      | Milk      | Soil      | Water                    | Fish      | Plant     | Meat      | Milk      |                  |
| Ac-227        | 4.587E-08   | 1.604E-03 | 0.000E+00 | 0.000E+00 | 8.674E-04 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 2.471E-03        |
| Pa-231        | 6.699E-08   | 9.318E-03 | 0.000E+00 | 0.000E+00 | 1.267E-03 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 1.058E-02        |
| Pb-210        | 4.714E-09   | 6.597E-04 | 0.000E+00 | 0.000E+00 | 8.915E-05 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 7.489E-04        |
| Ra-226        | 8.478E-09   | 4.715E-03 | 0.000E+00 | 0.000E+00 | 1.603E-04 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 4.875E-03        |
| Th-230        | 3.991E-07   | 5.558E-03 | 0.000E+00 | 0.000E+00 | 7.547E-03 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 1.311E-02        |
| U-234         | 4.279E-04   | 1.489E+01 | 0.000E+00 | 0.000E+00 | 8.091E+00 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 2.298E+01        |
| U-235         | 3.169E-05   | 1.103E+00 | 0.000E+00 | 0.000E+00 | 5.994E-01 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 1.702E+00        |
| U-238         | 4.279E-04   | 1.489E+01 | 0.000E+00 | 0.000E+00 | 8.091E+00 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 2.298E+01        |

\* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil  
and water-dependent water, fish, plant, meat, milk pathways

0

Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of  
Radon and its Decay Products as pCi/yr at t= 1.000E+02 years

0

| Radon Pathway | Radionuclides |           |           |           |           |           |           |           |
|---------------|---------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
|               | Rn-222        | Po-218    | Pb-214    | Bi-214    | Rn-220    | Po-216    | Pb-212    | Bi-212    |
| Water-ind.    | 0.000E+00     | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 |
| Water-dep.    | 0.000E+00     | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 |
| Total         | 0.000E+00     | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 |

Water-ind. == Water-independent      Water-dep. == Water-dependent

0

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
and Fraction of Total Risk at t= 1.000E+02 years

0

| Radio-Nuclide | Water Independent Pathways (Inhalation excludes radon) |        |            |        |           |        |           |        |           |        |           |        |
|---------------|--|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|               | Ground   |        | Inhalation |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|               | risk   | fract. | risk       | fract. | risk      | fract. | risk      | fract. | risk      | fract. | risk      | fract. |
| Ac-227        | 7.210E-10  | 0.0009 | 3.424E-13  | 0.0000 | 3.745E-11 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.604E-11 | 0.0000 |
| Pa-231        | 9.497E-11  | 0.0001 | 1.040E-13  | 0.0000 | 7.184E-11 | 0.0001 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.616E-11 | 0.0000 |
| Pb-210        | 2.548E-13  | 0.0000 | 2.778E-15  | 0.0000 | 9.635E-11 | 0.0001 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.007E-11 | 0.0000 |
| Ra-226        | 8.463E-10  | 0.0011 | 3.877E-15  | 0.0000 | 9.598E-11 | 0.0001 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.630E-12 | 0.0000 |
| Th-230        | 3.399E-12  | 0.0000 | 3.902E-13  | 0.0000 | 2.269E-11 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 5.230E-11 | 0.0001 |
| U-234         | 9.758E-10  | 0.0013 | 1.448E-10  | 0.0002 | 4.219E-08 | 0.0543 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.795E-08 | 0.0488 |
| U-235         | 1.537E-07  | 0.1978 | 9.502E-12  | 0.0000 | 3.195E-09 | 0.0041 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.906E-09 | 0.0037 |
| U-238         | 4.301E-07  | 0.5535 | 1.187E-10  | 0.0002 | 5.329E-08 | 0.0686 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 5.044E-08 | 0.0649 |
| Total         | 5.864E-07  | 0.7546 | 2.739E-10  | 0.0004 | 9.900E-08 | 0.1274 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 9.141E-08 | 0.1176 |

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Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
 and Fraction of Total Risk at t = 1.000E+02 years

## Water Dependent Pathways

| Radio-Nuclide | Water     |        | Fish      |        | Plant     |        | Meat      |        | Milk      |        | All Pathways** |        |
|---------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|----------------|--------|
|               | risk      | fract. | risk           | fract. |
| Ac-227        | 0.000E+00 | 0.0000 | 7.949E-10      | 0.0010 |
| Pa-231        | 0.000E+00 | 0.0000 | 1.831E-10      | 0.0002 |
| Pb-210        | 0.000E+00 | 0.0000 | 1.067E-10      | 0.0001 |
| Ra-226        | 0.000E+00 | 0.0000 | 9.469E-10      | 0.0012 |
| Th-230        | 0.000E+00 | 0.0000 | 7.878E-11      | 0.0001 |
| U-234         | 0.000E+00 | 0.0000 | 8.126E-08      | 0.1046 |
| U-235         | 0.000E+00 | 0.0000 | 1.598E-07      | 0.2056 |
| U-238         | 0.000E+00 | 0.0000 | 5.339E-07      | 0.6871 |
| Total         | 0.000E+00 | 0.0000 | 7.771E-07      | 1.0000 |

\*\* Sum of water independent ground, inhalation, plant, meat, milk, soil  
 and water dependent water, fish, plant, meat, milk pathways

0  
 Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of  
 Radon and its Decay Products at t= 1.000E+02 years

| Radon Pathway | Rn-222    | Po-218    | Pb-214    | Bi-214    | Rn-220    | Po-216    | Pb-212    | Bi-212    |
|---------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| Water-ind.    | 0.000E+00 |
| Water-dep.    | 0.000E+00 |
| Total         | 0.000E+00 |

Water-ind. == Water-independent      Water-dep. == Water-dependent

0  
 Total Excess Cancer Risk CNRS(i,p,t)\*\*\* for Initially Existent Radionuclides (i) and Pathways (p)  
 and Fraction of Total Risk at t = 1.000E+02 years

| Radio-Nuclide | Ground    |        | Inhalation |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|---------------|-----------|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|               | risk      | fract. | risk       | fract. | risk      | fract. | risk      | fract. | risk      | fract. | risk      | fract. | risk      | fract. |
| U-234         | 1.825E-09 | 0.0023 | 1.451E-10  | 0.0002 | 0.000E+00 | 0.0000 | 4.239E-08 | 0.0546 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.800E-08 | 0.0489 |
| U-235         | 1.545E-07 | 0.1988 | 9.949E-12  | 0.0000 | 0.000E+00 | 0.0000 | 3.305E-09 | 0.0043 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.958E-09 | 0.0038 |
| U-238         | 4.301E-07 | 0.5535 | 1.188E-10  | 0.0002 | 0.000E+00 | 0.0000 | 5.330E-08 | 0.0686 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 5.045E-08 | 0.0649 |
| Total         | 5.864E-07 | 0.7546 | 2.739E-10  | 0.0004 | 0.000E+00 | 0.0000 | 9.900E-08 | 0.1274 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 9.141E-08 | 0.1176 |

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T<sub>1/2</sub> Limit = 180 days

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Total Excess Cancer Risk CNRS(i,p,t)\*\*\* for Initially Existent Radionuclides (i) and Pathways (p)  
 and Fraction of Total Risk at t= 1.000E+02 years

## Water Dependent Pathways

| Radio-Nuclide | Water     |        | Fish      |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | All pathways |        |
|---------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|--------------|--------|
|               | risk      | fract. | risk         | fract. |
| U-234         | 0.000E+00 | 0.0000 | 8.236E-08    | 0.1060 |
| U-235         | 0.000E+00 | 0.0000 | 1.608E-07    | 0.2069 |
| U-238         | 0.000E+00 | 0.0000 | 5.340E-07    | 0.6871 |
| Total         | 0.000E+00 | 0.0000 | 7.771E-07    | 1.0000 |

\*\*\*CNRSI(i,p,t) includes contribution from decay daughter radionuclides

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Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
As pCi/yr at t = 3.000E+02 years

| Radio-Nuclide | Water Independent Pathways (Inhalation w/o radon) |           |           |           |           | Water Dependent Pathways |           |           |           |           | Total Ingestion* |
|---------------|---|-----------|-----------|-----------|-----------|--------------------------|-----------|-----------|-----------|-----------|------------------|
|               | Inhalation  | Plant     | Meat      | Milk      | Soil      | Water                    | Fish      | Plant     | Meat      | Milk      |                  |
| Ac-227        | 1.512E-07   | 5.282E-03 | 0.000E+00 | 0.000E+00 | 2.860E-03 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 8.142E-03        |
| Pa-231        | 1.738E-07   | 2.418E-02 | 0.000E+00 | 0.000E+00 | 3.287E-03 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 2.747E-02        |
| Pb-210        | 5.555E-08   | 7.759E-03 | 0.000E+00 | 0.000E+00 | 1.050E-03 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 8.810E-03        |
| Ra-226        | 6.838E-08   | 3.804E-02 | 0.000E+00 | 0.000E+00 | 1.293E-03 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 3.934E-02        |
| Th-230        | 1.115E-06   | 1.553E-02 | 0.000E+00 | 0.000E+00 | 2.109E-02 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 3.662E-02        |
| U-234         | 3.709E-04   | 1.290E+01 | 0.000E+00 | 0.000E+00 | 7.014E+00 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 1.992E+01        |
| U-235         | 2.747E-05   | 9.558E-01 | 0.000E+00 | 0.000E+00 | 5.195E-01 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 1.475E+00        |
| U-238         | 3.709E-04   | 1.290E+01 | 0.000E+00 | 0.000E+00 | 7.014E+00 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 1.992E+01        |

\* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil  
and water-dependent water, fish, plant, meat, milk pathways

0 Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of  
Radon and its Decay Products as pCi/yr at t = 3.000E+02 years

| Radon Pathway | Rn-222    | Po-218    | Pb-214    | Bi-214    | Rn-220    | Po-216    | Pb-212    | Bi-212    |
|---------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| Water-ind.    | 0.000E+00 |
| Water-dep.    | 0.000E+00 |
| Total         | 0.000E+00 |

Water-ind. == Water-independent Water-dep. == Water-dependent

0 Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
and Fraction of Total Risk at t = 3.000E+02 years

| Radio-Nuclide | Water Independent Pathways (Inhalation excludes radon) |        |            |        |           |        |           |        |           |        |           |        |
|---------------|--|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|               | Ground   |        | Inhalation |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|               | risk   | fract. | risk       | fract. | risk      | fract. | risk      | fract. | risk      | fract. | risk      | fract. |
| Ac-227        | 2.081E-09  | 0.0031 | 9.884E-13  | 0.0000 | 1.080E-10 | 0.0002 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.040E-10 | 0.0002 |
| Pa-231        | 2.251E-10  | 0.0003 | 2.464E-13  | 0.0000 | 1.703E-10 | 0.0002 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.830E-11 | 0.0001 |
| Pb-210        | 2.346E-12  | 0.0000 | 2.558E-14  | 0.0000 | 8.858E-10 | 0.0013 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 9.270E-11 | 0.0001 |
| Ra-226        | 5.666E-09  | 0.0083 | 2.596E-14  | 0.0000 | 6.428E-10 | 0.0009 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.099E-11 | 0.0000 |
| Th-230        | 8.677E-12  | 0.0000 | 9.960E-13  | 0.0000 | 5.790E-11 | 0.0001 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.335E-10 | 0.0002 |
| U-234         | 8.458E-10  | 0.0012 | 1.255E-10  | 0.0002 | 3.657E-08 | 0.0536 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.289E-08 | 0.0482 |
| U-235         | 1.332E-07  | 0.1953 | 8.237E-12  | 0.0000 | 2.770E-09 | 0.0041 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.519E-09 | 0.0037 |
| U-238         | 3.728E-07  | 0.5466 | 1.029E-10  | 0.0002 | 4.619E-08 | 0.0677 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.372E-08 | 0.0641 |
| Total         | 5.148E-07  | 0.7549 | 2.389E-10  | 0.0004 | 8.740E-08 | 0.1281 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 7.953E-08 | 0.1166 |

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 $T_{1/2}$  Limit = 180 days

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Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
and Fraction of Total Risk at t= 3.000E+02 years

Water Dependent Pathways

| Radio-Nuclide | Water     |        | Fish      |        | Plant     |        | Meat      |        | Milk      |        | All Pathways** |        |
|---------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|----------------|--------|
|               | risk      | fract. | risk           | fract. |
| Ac-227        | 0.000E+00 | 0.0000 | 2.294E-09      | 0.0034 |
| Pa-231        | 0.000E+00 | 0.0000 | 4.339E-10      | 0.0006 |
| Pb-210        | 0.000E+00 | 0.0000 | 9.808E-10      | 0.0014 |
| Ra-226        | 0.000E+00 | 0.0000 | 6.340E-09      | 0.0093 |
| Th-230        | 0.000E+00 | 0.0000 | 2.011E-10      | 0.0003 |
| U-234         | 0.000E+00 | 0.0000 | 7.044E-08      | 0.1033 |
| U-235         | 0.000E+00 | 0.0000 | 1.385E-07      | 0.2031 |
| U-238         | 0.000E+00 | 0.0000 | 4.628E-07      | 0.6786 |
| Total         | 0.000E+00 | 0.0000 | 6.820E-07      | 1.0000 |

\*\* Sum of water independent ground, inhalation, plant, meat, milk, soil  
and water dependent water, fish, plant, meat, milk pathways

0

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of  
Radon and its Decay Products at t= 3.000E+02 years

| Radon Pathway | Rn-222    | Po-218    | Pb-214    | Bi-214    | Rn-220    | Po-216    | Pb-212    | Bi-212    |
|---------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| Water-ind.    | 0.000E+00 |
| Water-dep.    | 0.000E+00 |
| Total         | 0.000E+00 |

Water-ind. == Water-independent      Water-dep. == Water-dependent

0

Total Excess Cancer Risk CNRS(i,p,t)\*\*\* for Initially Existent Radionuclides (i) and Pathways (p)  
and Fraction of Total Risk at t= 3.000E+02 years

| Radio-Nuclide | Ground    |        | Inhalation |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|---------------|-----------|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|               | risk      | fract. | risk       | fract. | risk      | fract. | risk      | fract. | risk      | fract. | risk      | fract. | risk      | fract. |
| U-234         | 6.520E-09 | 0.0096 | 1.264E-10  | 0.0002 | 0.000E+00 | 0.0000 | 3.813E-08 | 0.0559 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.312E-08 | 0.0486 |
| U-235         | 1.355E-07 | 0.1987 | 9.471E-12  | 0.0000 | 0.000E+00 | 0.0000 | 3.048E-09 | 0.0045 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.661E-09 | 0.0039 |
| U-238         | 3.728E-07 | 0.5466 | 1.030E-10  | 0.0002 | 0.000E+00 | 0.0000 | 4.622E-08 | 0.0678 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.375E-08 | 0.0641 |
| Total         | 5.148E-07 | 0.7549 | 2.389E-10  | 0.0004 | 0.000E+00 | 0.0000 | 8.740E-08 | 0.1281 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 7.953E-08 | 0.1166 |

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Total Excess Cancer Risk CNRS(i,p,t)\*\*\* for Initially Existent Radionuclides (i) and Pathways (p)  
and Fraction of Total Risk at t= 3.000E+02 years

Water Dependent Pathways

| Radio-Nuclide | Water     |        | Fish      |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | All pathways |        |
|---------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|--------------|--------|
|               | risk      | fract. | risk         | fract. |
| U-234         | 0.000E+00 | 0.0000 | 7.789E-08    | 0.1142 |
| U-235         | 0.000E+00 | 0.0000 | 1.412E-07    | 0.2071 |
| U-238         | 0.000E+00 | 0.0000 | 4.629E-07    | 0.6787 |
| Total         | 0.000E+00 | 0.0000 | 6.820E-07    | 1.0000 |

\*\*\*CNRSI(i,p,t) includes contribution from decay daughter radionuclides

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Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
As pCi/yr at t= 1.000E+03 years

| Radio-Nuclide | Water Independent Pathways (Inhalation w/o radon) |           |           |           |           | Water Dependent Pathways |           |           |           |           | Total Ingestion* |
|---------------|---|-----------|-----------|-----------|-----------|--------------------------|-----------|-----------|-----------|-----------|------------------|
|               | Inhalation  | Plant     | Meat      | Milk      | Soil      | Water                    | Fish      | Plant     | Meat      | Milk      |                  |
| Ac-227        | 3.274E-07   | 1.143E-02 | 0.000E+00 | 0.000E+00 | 6.191E-03 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 1.762E-02        |
| Pa-231        | 3.487E-07   | 4.852E-02 | 0.000E+00 | 0.000E+00 | 6.595E-03 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 5.512E-02        |
| Pb-210        | 4.940E-07   | 6.897E-02 | 0.000E+00 | 0.000E+00 | 9.342E-03 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 7.831E-02        |
| Ra-226        | 5.243E-07   | 2.918E-01 | 0.000E+00 | 0.000E+00 | 9.915E-03 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 3.017E-01        |
| Th-230        | 2.940E-06   | 4.093E-02 | 0.000E+00 | 0.000E+00 | 5.560E-02 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 9.653E-02        |
| U-234         | 2.249E-04   | 7.824E+00 | 0.000E+00 | 0.000E+00 | 4.253E+00 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 1.208E+01        |
| U-235         | 1.666E-05   | 5.795E-01 | 0.000E+00 | 0.000E+00 | 3.150E-01 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 8.946E-01        |
| U-238         | 2.249E-04   | 7.824E+00 | 0.000E+00 | 0.000E+00 | 4.253E+00 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 1.208E+01        |

\* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil  
and water-dependent water, fish, plant, meat, milk pathways

0 Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of  
Radon and its Decay Products as pCi/yr at t= 1.000E+03 years

| Radon Pathway | Rn-222    | Po-218    | Pb-214    | Bi-214    | Rn-220    | Po-216    | Pb-212    | Bi-212    |
|---------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| Water-ind.    | 0.000E+00 |
| Water-dep.    | 0.000E+00 |
| Total         | 0.000E+00 |

Water-ind. == Water-independent      Water-dep. == Water-dependent

0 Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
and Fraction of Total Risk at t= 1.000E+03 years

| Radio-Nuclide | Water Independent Pathways (Inhalation excludes radon) |        |            |        |           |        |           |        |           |        |           |        |
|---------------|--|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|               | Ground   |        | Inhalation |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|               | risk   | fract. | risk       | fract. | risk      | fract. | risk      | fract. | risk      | fract. | risk      | fract. |
| Ac-227        | 4.335E-09  | 0.0093 | 2.058E-12  | 0.0000 | 2.249E-10 | 0.0005 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.167E-10 | 0.0005 |
| Pa-231        | 4.366E-10  | 0.0009 | 4.779E-13  | 0.0000 | 3.303E-10 | 0.0007 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 7.429E-11 | 0.0002 |
| Pb-210        | 1.932E-11  | 0.0000 | 2.106E-13  | 0.0000 | 7.290E-09 | 0.0156 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 7.633E-10 | 0.0016 |
| Ra-226        | 4.059E-08  | 0.0869 | 1.860E-13  | 0.0000 | 4.606E-09 | 0.0099 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.221E-10 | 0.0005 |
| Th-230        | 2.212E-11  | 0.0000 | 2.539E-12  | 0.0000 | 1.476E-10 | 0.0003 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.403E-10 | 0.0007 |
| U-234         | 5.129E-10  | 0.0011 | 7.609E-11  | 0.0002 | 2.218E-08 | 0.0475 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.994E-08 | 0.0427 |
| U-235         | 8.077E-08  | 0.1730 | 4.994E-12  | 0.0000 | 1.680E-09 | 0.0036 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.527E-09 | 0.0033 |
| U-238         | 2.260E-07  | 0.4841 | 6.241E-11  | 0.0001 | 2.801E-08 | 0.0600 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.651E-08 | 0.0568 |
| Total         | 3.527E-07  | 0.7554 | 1.490E-10  | 0.0003 | 6.446E-08 | 0.1380 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.960E-08 | 0.1062 |

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Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
 and Fraction of Total Risk at t= 1.000E+03 years

## Water Dependent Pathways

| Radio-Nuclide | Water     |        | Fish      |        | Plant     |        | Meat      |        | Milk      |        | All Pathways** |        |
|---------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|----------------|--------|
|               | risk      | fract. | risk           | fract. |
| Ac-227        | 0.000E+00 | 0.0000 | 4.779E-09      | 0.0102 |
| Pa-231        | 0.000E+00 | 0.0000 | 8.416E-10      | 0.0018 |
| Pb-210        | 0.000E+00 | 0.0000 | 8.072E-09      | 0.0173 |
| Ra-226        | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+0C | 0.0000 | 4.542E-08      | 0.0973 |
| Th-230        | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+0C | 0.0000 | 5.126E-10      | 0.0011 |
| U-234         | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+0C | 0.0000 | 4.271E-08      | 0.0915 |
| U-235         | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+0C | 0.0000 | 8.398E-08      | 0.1799 |
| U-238         | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+0C | 0.0000 | 2.806E-07      | 0.6010 |
| Total         | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+0C | 0.0000 | 4.669E-07      | 1.0000 |

\*\* Sum of water independent ground, inhalation, plant, meat, milk, soil  
 and water dependent water, fish, plant, meat, milk pathways

0

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of  
 Radon and its Decay Products at t= 1.000E+03 years

0

| Radon Pathway | Rn-222    | Po-218    | Pb-214    | Bi-214    | Rn-220    | Po-216    | Pb-212    | Bi-212    |
|---------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| Water-ind.    | 0.000E+00 | 0.000E-00 |
| Water-dep.    | 0.000E+00 | 0.000E-00 |
| Total         | 0.000E+00 | 0.000E-00 |

Water-ind. == Water-independent      Water-dep. == Water-dependent

0

Total Excess Cancer Risk CNRS(i,p,t)\*\*\* for Initially Existent Radionuclides (i) and Pathways (p)  
 and Fraction of Total Risk at t= 1.000E+03 years

0

## Water Independent Pathways (Inhalation excludes radon)

0

| Radio-Nuclide | Ground    |        | Inhalation |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|---------------|-----------|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|               | risk      | fract. | risk       | fract. | risk      | fract. | risk      | fract. | risk      | fract. | risk      | fract. | risk      | fract. |
| U-234         | 4.111E-08 | 0.0880 | 7.880E-11  | 0.0002 | 0.000E+00 | 0.0000 | 3.414E-08 | 0.0731 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.121E-08 | 0.0454 |
| U-235         | 8.554E-08 | 0.1832 | 7.531E-12  | 0.0000 | 0.000E+00 | 0.0000 | 2.235E-09 | 0.0048 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.818E-09 | 0.0039 |
| U-238         | 2.261E-07 | 0.4842 | 6.263E-11  | 0.0001 | 0.000E+00 | 0.0000 | 2.808E-08 | 0.0601 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.657E-08 | 0.0569 |
| Total         | 3.527E-07 | 0.7554 | 1.490E-10  | 0.0003 | 0.000E+00 | 0.0000 | 6.446E-08 | 0.1380 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.960E-08 | 0.1062 |

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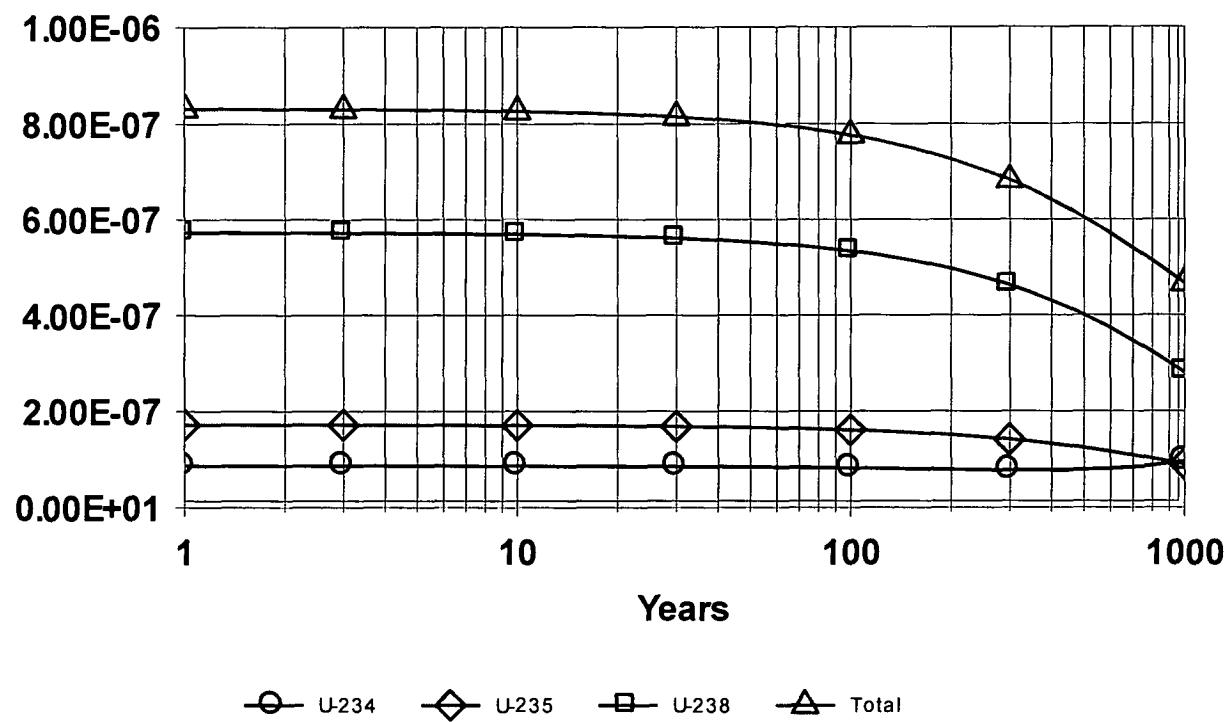
Total Excess Cancer Risk CNRS(i,p,t)\*\*\* for Initially Existent Radionuclides (i) and Pathways (p)  
and Fraction of Total Risk at t= 1.000E+03 years

## Water Dependent Pathways

| Radio-Nuclide | Water     |        | Fish      |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | All pathways |        |
|---------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|--------------|--------|
|               | risk      | fract. | risk         | fract. |
| U-234         | 0.000E+00 | 0.0000 | 9.654E-08    | 0.2068 |
| U-235         | 0.000E+00 | 0.0000 | 8.960E-08    | 0.1919 |
| U-238         | 0.000E+00 | 0.0000 | 2.808E-07    | 0.6014 |
| Total         | 0.000E+00 | 0.0000 | 4.669E-07    | 1.0000 |

\*\*\*CNRSI(i,p,t) includes contribution from decay daughter radionuclides

## EXCESS CANCER RISK: All Nuclides Summed, All Pathways Summed



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GRAPHICS.ASC Includes All Pathways

DT-34 Industrial Worker  
RESRAD Dose Summary

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Summary : DT-34-Industrial

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## Dose Conversion Factor (and Related) Parameter Summary

Dose Library: FGR 12 &amp; FGR 11

| 0<br>Menu | Parameter  | Current<br>Value# | Base<br>Case* | Parameter<br>Name |
|-----------|--|-------------------|---------------|-------------------|
| A-1       | DCF's for external ground radiation, (mrem/yr)/(pCi/g) |                   |               |                   |
| A-1       | Ac-227 (Source: FGR 12)                                | 4.951E-04         | 4.951E-04     | DCF1( 1)          |
| A-1       | At-218 (Source: FGR 12)                                | 5.847E-03         | 5.847E-03     | DCF1( 2)          |
| A-1       | Bi-210 (Source: FGR 12)                                | 3.606E-03         | 3.606E-03     | DCF1( 3)          |
| A-1       | Bi-211 (Source: FGR 12)                                | 2.559E-01         | 2.559E-01     | DCF1( 4)          |
| A-1       | Bi-214 (Source: FGR 12)                                | 9.808E+00         | 9.808E+00     | DCF1( 5)          |
| A-1       | Fr-223 (Source: FGR 12)                                | 1.980E-01         | 1.980E-01     | DCF1( 6)          |
| A-1       | Pa-231 (Source: FGR 12)                                | 1.906E-01         | 1.906E-01     | DCF1( 7)          |
| A-1       | Pa-234 (Source: FGR 12)                                | 1.155E+01         | 1.155E+01     | DCF1( 8)          |
| A-1       | Pa-234m (Source: FGR 12)                               | 8.967E-02         | 8.967E-02     | DCF1( 9)          |
| A-1       | Pb-210 (Source: FGR 12)                                | 2.447E-03         | 2.447E-03     | DCF1( 10)         |
| A-1       | Pb-211 (Source: FGR 12)                                | 3.064E-01         | 3.064E-01     | DCF1( 11)         |
| A-1       | Pb-214 (Source: FGR 12)                                | 1.341E+00         | 1.341E+00     | DCF1( 12)         |
| A-1       | Po-210 (Source: FGR 12)                                | 5.231E-05         | 5.231E-05     | DCF1( 13)         |
| A-1       | Po-211 (Source: FGR 12)                                | 4.764E-02         | 4.764E-02     | DCF1( 14)         |
| A-1       | Po-214 (Source: FGR 12)                                | 5.138E-04         | 5.138E-04     | DCF1( 15)         |
| A-1       | Po-215 (Source: FGR 12)                                | 1.016E-03         | 1.016E-03     | DCF1( 16)         |
| A-1       | Po-218 (Source: FGR 12)                                | 5.642E-05         | 5.642E-05     | DCF1( 17)         |
| A-1       | Ra-223 (Source: FGR 12)                                | 6.034E-01         | 6.034E-01     | DCF1( 18)         |
| A-1       | Ra-226 (Source: FGR 12)                                | 3.176E-02         | 3.176E-02     | DCF1( 19)         |
| A-1       | Rn-219 (Source: FGR 12)                                | 3.083E-01         | 3.083E-01     | DCF1( 20)         |
| A-1       | Rn-222 (Source: FGR 12)                                | 2.354E-03         | 2.354E-03     | DCF1( 21)         |
| A-1       | Th-227 (Source: FGR 12)                                | 5.212E-01         | 5.212E-01     | DCF1( 22)         |
| A-1       | Th-230 (Source: FGR 12)                                | 1.209E-03         | 1.209E-03     | DCF1( 23)         |
| A-1       | Th-231 (Source: FGR 12)                                | 3.643E-02         | 3.643E-02     | DCF1( 24)         |
| A-1       | Th-234 (Source: FGR 12)                                | 2.410E-02         | 2.410E-02     | DCF1( 25)         |
| A-1       | Tl-207 (Source: FGR 12)                                | 1.980E-02         | 1.980E-02     | DCF1( 26)         |
| A-1       | Tl-210 (Source: no data)                               | 0.000E+00         | -2.000E+00    | DCF1( 27)         |
| A-1       | U-234 (Source: FGR 12)                                 | 4.017E-04         | 4.017E-04     | DCF1( 28)         |
| A-1       | U-235 (Source: FGR 12)                                 | 7.211E-01         | 7.211E-01     | DCF1( 29)         |
| A-1       | U-238 (Source: FGR 12)                                 | 1.031E-04         | 1.031E-04     | DCF1( 30)         |
| B-1       | Dose conversion factors for inhalation, mrem/pCi:      |                   |               |                   |
| B-1       | Ac-227+D   | 6.724E+00         | 6.700E+00     | DCF2( 1)          |
| B-1       | Pa-231   | 1.280E+00         | 1.280E+00     | DCF2( 2)          |
| B-1       | Pb-210+D   | 2.320E-02         | 1.360E-02     | DCF2( 3)          |
| B-1       | Ra-226+D   | 8.594E-03         | 8.580E-03     | DCF2( 4)          |
| B-1       | Th-230   | 3.260E-01         | 3.260E-01     | DCF2( 5)          |
| B-1       | U-234  | 1.320E-01         | 1.320E-01     | DCF2( 6)          |
| B-1       | U-235+D  | 1.230E-01         | 1.230E-01     | DCF2( 7)          |
| B-1       | U-238  | 1.180E-01         | 1.180E-01     | DCF2( 8)          |
| B-1       | U-238+D  | 1.180E-01         | 1.180E-01     | DCF2( 9)          |
| D-1       | Dose conversion factors for ingestion, mrem/pCi:       |                   |               |                   |
| D-1       | Ac-227+D   | 1.480E-02         | 1.410E-02     | DCF3( 1)          |
| D-1       | Pa-231   | 1.060E-02         | 1.060E-02     | DCF3( 2)          |
| D-1       | Pb-210+D   | 7.276E-03         | 5.370E-03     | DCF3( 3)          |
| D-1       | Ra-226+D   | 1.321E-03         | 1.320E-03     | DCF3( 4)          |
| D-1       | Th-230   | 5.480E-04         | 5.480E-04     | DCF3( 5)          |
| D-1       | U-234  | 2.830E-04         | 2.830E-04     | DCF3( 6)          |

Dose Conversion Factor (and Related) Parameter Summary (continued)  
Dose Library: FGR 12 & FGR 11

| 0<br>Menu | Parameter  | Current<br>Value# | Base<br>Case* | Parameter<br>Name |
|-----------|--|-------------------|---------------|-------------------|
| D-1       | U-235+D  | 2.673E-04         | 2.660E-04     | DCF3( 7)          |
| D-1       | U-238  | 2.550E-04         | 2.550E-04     | DCF3( 8)          |
| D-1       | U-238+D  | 2.687E-04         | 2.550E-04     | DCF3( 9)          |
| D-34      | Food transfer factors:                                   |                   |               |                   |
| D-34      | Ac-227+D , plant/soil concentration ratio, dimensionless | 2.500E-03         | 2.500E-03     | RTF( 1,1)         |
| D-34      | Ac-227+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d) | 2.000E-05         | 2.000E-05     | RTF( 1,2)         |
| D-34      | Ac-227+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)  | 2.000E-05         | 2.000E-05     | RTF( 1,3)         |
| D-34      |  |                   |               |                   |
| D-34      | Pa-231 , plant/soil concentration ratio, dimensionless   | 1.000E-02         | 1.000E-02     | RTF( 2,1)         |
| D-34      | Pa-231 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)   | 5.000E-03         | 5.000E-03     | RTF( 2,2)         |
| D-34      | Pa-231 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)    | 5.000E-06         | 5.000E-06     | RTF( 2,3)         |
| D-34      |  |                   |               |                   |
| D-34      | Pb-210+D , plant/soil concentration ratio, dimensionless | 1.000E-02         | 1.000E-02     | RTF( 3,1)         |
| D-34      | Pb-210+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d) | 8.000E-04         | 8.000E-04     | RTF( 3,2)         |
| D-34      | Pb-210+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)  | 3.000E-04         | 3.000E-04     | RTF( 3,3)         |
| D-34      |  |                   |               |                   |
| D-34      | Ra-226+D , plant/soil concentration ratio, dimensionless | 4.000E-02         | 4.000E-02     | RTF( 4,1)         |
| D-34      | Ra-226+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d) | 1.000E-03         | 1.000E-03     | RTF( 4,2)         |
| D-34      | Ra-226+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)  | 1.000E-03         | 1.000E-03     | RTF( 4,3)         |
| D-34      |  |                   |               |                   |
| D-34      | Th-230 , plant/soil concentration ratio, dimensionless   | 1.000E-03         | 1.000E-03     | RTF( 5,1)         |
| D-34      | Th-230 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)   | 1.000E-04         | 1.000E-04     | RTF( 5,2)         |
| D-34      | Th-230 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)    | 5.000E-06         | 5.000E-06     | RTF( 5,3)         |
| D-34      |  |                   |               |                   |
| D-34      | U-234 , plant/soil concentration ratio, dimensionless    | 2.500E-03         | 2.500E-03     | RTF( 6,1)         |
| D-34      | U-234 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)    | 3.400E-04         | 3.400E-04     | RTF( 6,2)         |
| D-34      | U-234 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)     | 6.000E-04         | 6.000E-04     | RTF( 6,3)         |
| D-34      |  |                   |               |                   |
| D-34      | U-235+D , plant/soil concentration ratio, dimensionless  | 2.500E-03         | 2.500E-03     | RTF( 7,1)         |
| D-34      | U-235+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)  | 3.400E-04         | 3.400E-04     | RTF( 7,2)         |
| D-34      | U-235+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)   | 6.000E-04         | 6.000E-04     | RTF( 7,3)         |
| D-34      |  |                   |               |                   |
| D-34      | U-238 , plant/soil concentration ratio, dimensionless    | 2.500E-03         | 2.500E-03     | RTF( 8,1)         |
| D-34      | U-238 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)    | 3.400E-04         | 3.400E-04     | RTF( 8,2)         |
| D-34      | U-238 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)     | 6.000E-04         | 6.000E-04     | RTF( 8,3)         |
| D-34      |  |                   |               |                   |
| D-34      | U-238+D , plant/soil concentration ratio, dimensionless  | 2.500E-03         | 2.500E-03     | RTF( 9,1)         |
| D-34      | U-238+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)  | 3.400E-04         | 3.400E-04     | RTF( 9,2)         |
| D-34      | U-238+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)   | 6.000E-04         | 6.000E-04     | RTF( 9,3)         |
| D-5       | Bioaccumulation factors, fresh water, L/kg:              |                   |               |                   |
| D-5       | Ac-227+D , fish  | 1.500E+01         | 1.500E+01     | BIOFAC( 1,1)      |
| D-5       | Ac-227+D , crustacea and mollusks                        | 1.000E+03         | 1.000E+03     | BIOFAC( 1,2)      |
| D-5       |  |                   |               |                   |
| D-5       | Pa-231 , fish  | 1.000E+01         | 1.000E+01     | BIOFAC( 2,1)      |
| D-5       | Pa-231 , crustacea and mollusks                          | 1.100E+02         | 1.100E+02     | BIOFAC( 2,2)      |
| D-5       |  |                   |               |                   |
| D-5       | Pb-210+D , fish  | 3.000E+02         | 3.000E+02     | BIOFAC( 3,1)      |
| D-5       | Pb-210+D , crustacea and mollusks                        | 1.000E+02         | 1.000E+02     | BIOFAC( 3,2)      |

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Summary : DT-34-Industrial

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\DT-34-INDUSTRIAL 2011.RAD

Dose Conversion Factor (and Related) Parameter Summary (continued)  
Dose Library: FGR 12 & FGR 11

| 0<br>Menu | Parameter                         | Current<br>Value# | Base<br>Case* | Parameter<br>Name |
|-----------|-----------------------------------|-------------------|---------------|-------------------|
| D-5       | Ra-226+D , fish                   | 5.000E+01         | 5.000E+01     | BIOFAC( 4,1)      |
| D-5       | Ra-226+D , crustacea and mollusks | 2.500E+02         | 2.500E+02     | BIOFAC( 4,2)      |
| D-5       |                                   |                   |               |                   |
| D-5       | Th-230 , fish                     | 1.000E+02         | 1.000E+02     | BIOFAC( 5,1)      |
| D-5       | Th-230 , crustacea and mollusks   | 5.000E+02         | 5.000E+02     | BIOFAC( 5,2)      |
| D-5       |                                   |                   |               |                   |
| D-5       | U-234 , fish                      | 1.000E+01         | 1.000E+01     | BIOFAC( 6,1)      |
| D-5       | U-234 , crustacea and mollusks    | 6.000E+01         | 6.000E+01     | BIOFAC( 6,2)      |
| D-5       |                                   |                   |               |                   |
| D-5       | U-235+D , fish                    | 1.000E+01         | 1.000E+01     | BIOFAC( 7,1)      |
| D-5       | U-235+D , crustacea and mollusks  | 6.000E+01         | 6.000E+01     | BIOFAC( 7,2)      |
| D-5       |                                   |                   |               |                   |
| D-5       | U-238 , fish                      | 1.000E+01         | 1.000E+01     | BIOFAC( 8,1)      |
| D-5       | U-238 , crustacea and mollusks    | 6.000E+01         | 6.000E+01     | BIOFAC( 8,2)      |
| D-5       |                                   |                   |               |                   |
| D-5       | U-238+D , fish                    | 1.000E+01         | 1.000E+01     | BIOFAC( 9,1)      |
| D-5       | U-238+D , crustacea and mollusks  | 6.000E+01         | 6.000E+01     | BIOFAC( 9,2)      |

#For DCF1(xxx) only, factors are for infinite depth &amp; area. See ETFG table in Ground Pathway of Detailed Report.

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

## Site-Specific Parameter Summary

| 0<br>Menu | Parameter                                       | User<br>Input | Default   | Used by RESRAD<br>(If different from user input) | Parameter<br>Name |
|-----------|---|---------------|-----------|--|-------------------|
| R011      | Area of contaminated zone (m**2)                | 9.846E+03     | 1.000E+04 | ---  | AREA              |
| R011      | Thickness of contaminated zone (m)              | 2.000E+00     | 2.000E+00 | ---  | THICK0            |
| R011      | Fraction of contamination that is submerged     | 0.000E+00     | 0.000E+00 | ---  | SUBMFRACT         |
| R011      | Length parallel to aquifer flow (m)             | not used      | 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                |
| 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) : U-234  | 2.700E-01     | 0.000E+00 | ---  | S1(6)             |
| R012      | Initial principal radionuclide (pCi/g) : U-235  | 2.000E-02     | 0.000E+00 | ---  | S1(7)             |
| R012      | Initial principal radionuclide (pCi/g) : U-238  | 2.700E-01     | 0.000E+00 | ---  | S1(8)             |
| R012      | Concentration in groundwater (pCi/L) : U-234    | not used      | 0.000E+00 | ---  | W1( 6)            |
| R012      | Concentration in groundwater (pCi/L) : U-235    | not used      | 0.000E+00 | ---  | W1( 7)            |
| R012      | Concentration in groundwater (pCi/L) : U-238    | not used      | 0.000E+00 | ---  | W1( 8)            |
| 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)          | 1.280E+00     | 1.500E+00 | ---  | DENSCZ            |
| R013      | Contaminated zone erosion rate (m/yr)           | 6.000E-05     | 1.000E-03 | ---  | VCZ               |
| R013      | Contaminated zone total porosity                | 4.200E-01     | 4.000E-01 | ---  | TPCZ              |
| R013      | Contaminated zone field capacity                | 3.600E-01     | 2.000E-01 | ---  | FCCZ              |
| R013      | Contaminated zone hydraulic conductivity (m/yr) | 3.048E+00     | 1.000E+01 | ---  | HCCZ              |
| R013      | Contaminated zone b parameter                   | 1.040E+01     | 5.300E+00 | ---  | BCZ               |
| R013      | Average annual wind speed (m/sec)               | 4.170E+00     | 2.000E+00 | ---  | WIND              |
| R013      | Humidity in air (g/m**3)                        | not used      | 8.000E+00 | ---  | HUMID             |
| R013      | Evapotranspiration coefficient                  | 5.000E-01     | 5.000E-01 | ---  | EVAPTR            |
| R013      | Precipitation (m/yr)                            | 9.200E-01     | 1.000E+00 | ---  | PRECIP            |
| R013      | Irrigation (m/yr)                               | 0.000E+00     | 2.000E-01 | ---  | RI                |
| R013      | Irrigation mode                                 | overhead      | overhead  | ---  | IDITCH            |
| R013      | Runoff coefficient                              | 8.000E-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              |
| R014      | Saturated zone field capacity                   | not used      | 2.000E-01 | ---  | FCSZ              |
| R014      | Saturated zone hydraulic conductivity (m/yr)    | not used      | 1.000E+02 | ---  | HCSZ              |
| R014      | Saturated zone hydraulic gradient               | not used      | 2.000E-02 | ---  | HGWT              |
| R014      | Saturated zone b parameter                      | not used      | 5.300E+00 | ---  | BSZ               |
| R014      | Water table drop rate (m/yr)                    | not used      | 1.000E-03 | ---  | VWT               |

## Site-Specific Parameter Summary (continued)

| 0<br>Menu | Parameter                                      | User<br>Input | Default   | Used by RESRAD<br>(If different from user input) | Parameter<br>Name |
|-----------|--|---------------|-----------|--|-------------------|
| R014      | Well pump intake depth (m below water table)   | not used      | 1.000E+01 | ---  | DWIBWT            |
| R014      | Model: Nondispersion (ND) or Mass-Balance (MB) | not used      | ND        | ---  | MODEL             |
| R014      | Well pumping rate (m**3/yr)                    | not used      | 2.500E+02 | ---  | UW                |
| R015      | Number of unsaturated zone strata              | not used      | 1         | ---  | NS                |
| R015      | Unsat. zone 1, thickness (m)                   | not used      | 4.000E+00 | ---  | H(1)              |
| R015      | Unsat. zone 1, soil density (g/cm**3)          | not used      | 1.500E+00 | ---  | DENSUZ(1)         |
| R015      | Unsat. zone 1, total porosity                  | not used      | 4.000E-01 | ---  | TPUZ(1)           |
| R015      | Unsat. zone 1, effective porosity              | not used      | 2.000E-01 | ---  | EPUZ(1)           |
| R015      | Unsat. zone 1, field capacity                  | not used      | 2.000E-01 | ---  | FCUZ(1)           |
| R015      | Unsat. zone 1, soil-specific b parameter       | not used      | 5.300E+00 | ---  | BUZ(1)            |
| R015      | Unsat. zone 1, hydraulic conductivity (m/yr)   | not used      | 1.000E+01 | ---  | HCUZ(1)           |
| R016      | Distribution coefficients for U-234            |               |           |  |                   |
| R016      | Contaminated zone (cm**3/g)                    | 5.000E+01     | 5.000E+01 | ---  | DCNUCC( 6)        |
| R016      | Unsaturated zone 1 (cm**3/g)                   | not used      | 5.000E+01 | ---  | DCNUCU( 6,1)      |
| R016      | Saturated zone (cm**3/g)                       | not used      | 5.000E+01 | ---  | DCNUCS( 6)        |
| R016      | Leach rate (/yr)                               | 0.000E+00     | 0.000E+00 | 7.147E-04  | ALEACH( 6)        |
| R016      | Solubility constant                            | 0.000E+00     | 0.000E+00 | not used   | SOLUBK( 6)        |
| R016      | Distribution coefficients for U-235            |               |           |  |                   |
| R016      | Contaminated zone (cm**3/g)                    | 5.000E+01     | 5.000E+01 | ---  | DCNUCC( 7)        |
| R016      | Unsaturated zone 1 (cm**3/g)                   | not used      | 5.000E+01 | ---  | DCNUCU( 7,1)      |
| R016      | Saturated zone (cm**3/g)                       | not used      | 5.000E+01 | ---  | DCNUCS( 7)        |
| R016      | Leach rate (/yr)                               | 0.000E+00     | 0.000E+00 | 7.147E-04  | ALEACH( 7)        |
| R016      | Solubility constant                            | 0.000E+00     | 0.000E+00 | not used   | SOLUBK( 7)        |
| R016      | Distribution coefficients for U-238            |               |           |  |                   |
| R016      | Contaminated zone (cm**3/g)                    | 5.000E+01     | 5.000E+01 | ---  | DCNUCC( 8)        |
| R016      | Unsaturated zone 1 (cm**3/g)                   | not used      | 5.000E+01 | ---  | DCNUCU( 8,1)      |
| R016      | Saturated zone (cm**3/g)                       | not used      | 5.000E+01 | ---  | DCNUCS( 8)        |
| R016      | Leach rate (/yr)                               | 0.000E+00     | 0.000E+00 | 7.147E-04  | ALEACH( 8)        |
| R016      | Solubility constant                            | 0.000E+00     | 0.000E+00 | not used   | SOLUBK( 8)        |
| R016      | Distribution coefficients for daughter Ac-227  |               |           |  |                   |
| R016      | Contaminated zone (cm**3/g)                    | 2.000E+01     | 2.000E+01 | ---  | DCNUCC( 1)        |
| R016      | Unsaturated zone 1 (cm**3/g)                   | not used      | 2.000E+01 | ---  | DCNUCU( 1,1)      |
| R016      | Saturated zone (cm**3/g)                       | not used      | 2.000E+01 | ---  | DCNUCS( 1)        |
| R016      | Leach rate (/yr)                               | 0.000E+00     | 0.000E+00 | 1.772E-03  | ALEACH( 1)        |
| R016      | Solubility constant                            | 0.000E+00     | 0.000E+00 | not used   | SOLUBK( 1)        |
| R016      | Distribution coefficients for daughter Pa-231  |               |           |  |                   |
| R016      | Contaminated zone (cm**3/g)                    | 5.000E+01     | 5.000E+01 | ---  | DCNUCC( 2)        |
| R016      | Unsaturated zone 1 (cm**3/g)                   | not used      | 5.000E+01 | ---  | DCNUCU( 2,1)      |
| R016      | Saturated zone (cm**3/g)                       | not used      | 5.000E+01 | ---  | DCNUCS( 2)        |
| R016      | Leach rate (/yr)                               | 0.000E+00     | 0.000E+00 | 7.147E-04  | ALEACH( 2)        |
| R016      | Solubility constant                            | 0.000E+00     | 0.000E+00 | not used   | SOLUBK( 2)        |

## Site-Specific Parameter Summary (continued)

| 0<br>Menu | Parameter                                      | User<br>Input | Default   | Used by RESRAD<br>(If different from user input) | Parameter<br>Name |
|-----------|--|---------------|-----------|--|-------------------|
| R016      | Distribution coefficients for daughter Pb-210  |               |           |  |                   |
| R016      | Contaminated zone (cm**3/g)                    | 1.000E+02     | 1.000E+02 | ---  | DCNUCC( 3)        |
| R016      | Unsaturated zone 1 (cm**3/g)                   | not used      | 1.000E+02 | ---  | DCNUCU( 3,1)      |
| R016      | Saturated zone (cm**3/g)                       | not used      | 1.000E+02 | ---  | DCNUCS( 3)        |
| R016      | Leach rate (/yr)                               | 0.000E+00     | 0.000E+00 | 3.584E-04  | ALEACH( 3)        |
| R016      | Solubility constant                            | 0.000E+00     | 0.000E+00 | not used   | SOLUBK( 3)        |
| R016      | Distribution coefficients for daughter Ra-226  |               |           |  |                   |
| R016      | Contaminated zone (cm**3/g)                    | 7.000E+01     | 7.000E+01 | ---  | DCNUCC( 4)        |
| R016      | Unsaturated zone 1 (cm**3/g)                   | not used      | 7.000E+01 | ---  | DCNUCU( 4,1)      |
| R016      | Saturated zone (cm**3/g)                       | not used      | 7.000E+01 | ---  | DCNUCS( 4)        |
| R016      | Leach rate (/yr)                               | 0.000E+00     | 0.000E+00 | 5.113E-04  | ALEACH( 4)        |
| R016      | Solubility constant                            | 0.000E+00     | 0.000E+00 | not used   | SOLUBK( 4)        |
| R016      | Distribution coefficients for daughter Th-230  |               |           |  |                   |
| R016      | Contaminated zone (cm**3/g)                    | 6.000E+04     | 6.000E+04 | ---  | DCNUCC( 5)        |
| R016      | Unsaturated zone 1 (cm**3/g)                   | not used      | 6.000E+04 | ---  | DCNUCU( 5,1)      |
| R016      | Saturated zone (cm**3/g)                       | not used      | 6.000E+04 | ---  | DCNUCS( 5)        |
| R016      | Leach rate (/yr)                               | 0.000E+00     | 0.000E+00 | 5.990E-07  | ALEACH( 5)        |
| R016      | Solubility constant                            | 0.000E+00     | 0.000E+00 | not used   | SOLUBK( 5)        |
| R017      | Inhalation rate (m**3/yr)                      | 1.055E+04     | 8.400E+03 | ---  | INHALR            |
| R017      | Mass loading for inhalation (g/m**3)           | 2.000E-04     | 1.000E-04 | ---  | MLINH             |
| R017      | Exposure duration                              | 2.500E+01     | 3.000E+01 | ---  | ED                |
| R017      | Shielding factor, inhalation                   | 5.000E-01     | 4.000E-01 | ---  | SHF3              |
| R017      | Shielding factor, external gamma               | 7.000E-01     | 7.000E-01 | ---  | SHF1              |
| R017      | Fraction of time spent indoors                 | 1.969E-01     | 5.000E-01 | ---  | FIND              |
| R017      | Fraction of time spent outdoors (on site)      | 4.566E-02     | 2.500E-01 | ---  | FOTD              |
| R017      | Shape factor flag, external gamma              | 1.000E+00     | 1.000E+00 | >0 shows circular AREA.                          | FS                |
| R017      | Radii of shape factor array (used if FS = -1): |               |           |  |                   |
| R017      | Outer annular radius (m), ring 1:              | not used      | 5.000E+01 | ---  | RAD_SHAPE( 1)     |
| R017      | Outer annular radius (m), ring 2:              | not used      | 7.071E+01 | ---  | RAD_SHAPE( 2)     |
| R017      | Outer annular radius (m), ring 3:              | not used      | 0.000E+00 | ---  | RAD_SHAPE( 3)     |
| R017      | Outer annular radius (m), ring 4:              | not used      | 0.000E+00 | ---  | RAD_SHAPE( 4)     |
| R017      | Outer annular radius (m), ring 5:              | not used      | 0.000E+00 | ---  | RAD_SHAPE( 5)     |
| R017      | Outer annular radius (m), ring 6:              | not used      | 0.000E+00 | ---  | RAD_SHAPE( 6)     |
| R017      | Outer annular radius (m), ring 7:              | not used      | 0.000E+00 | ---  | RAD_SHAPE( 7)     |
| R017      | Outer annular radius (m), ring 8:              | not used      | 0.000E+00 | ---  | RAD_SHAPE( 8)     |
| R017      | Outer annular radius (m), ring 9:              | not used      | 0.000E+00 | ---  | RAD_SHAPE( 9)     |
| R017      | Outer annular radius (m), ring 10:             | not used      | 0.000E+00 | ---  | RAD_SHAPE(10)     |
| R017      | Outer annular radius (m), ring 11:             | not used      | 0.000E+00 | ---  | RAD_SHAPE(11)     |
| R017      | Outer annular radius (m), ring 12:             | not used      | 0.000E+00 | ---  | RAD_SHAPE(12)     |

## Site-Specific Parameter Summary (continued)

| 0<br>Menu | Parameter  | User<br>Input | Default   | Used by RESRAD<br>(If different from user input) | Parameter<br>Name |
|-----------|--|---------------|-----------|--|-------------------|
| R017      | Fractions of annular areas within AREA:          |               |           |  |                   |
| R017      | Ring 1   | not used      | 1.000E+00 | ---  | FRACA( 1)         |
| R017      | Ring 2   | not used      | 2.732E-01 | ---  | FRACA( 2)         |
| R017      | Ring 3   | not used      | 0.000E+00 | ---  | FRACA( 3)         |
| R017      | Ring 4   | not used      | 0.000E+00 | ---  | FRACA( 4)         |
| R017      | Ring 5   | not used      | 0.000E+00 | ---  | FRACA( 5)         |
| R017      | Ring 6   | not used      | 0.000E+00 | ---  | FRACA( 6)         |
| R017      | Ring 7   | not used      | 0.000E+00 | ---  | FRACA( 7)         |
| R017      | Ring 8   | not used      | 0.000E+00 | ---  | FRACA( 8)         |
| R017      | Ring 9   | not used      | 0.000E+00 | ---  | FRACA( 9)         |
| R017      | Ring 10  | not used      | 0.000E+00 | ---  | FRACA(10)         |
| R017      | Ring 11  | not used      | 0.000E+00 | ---  | FRACA(11)         |
| R017      | Ring 12  | not used      | 0.000E+00 | ---  | FRACA(12)         |
| R018      | Fruits, vegetables and grain consumption (kg/yr) | not used      | 1.600E+02 | ---  | DIET(1)           |
| R018      | Leafy vegetable consumption (kg/yr)              | not used      | 1.400E+01 | ---  | DIET(2)           |
| R018      | Milk consumption (L/yr)                          | not used      | 9.200E+01 | ---  | DIET(3)           |
| R018      | Meat and poultry consumption (kg/yr)             | not used      | 6.300E+01 | ---  | DIET(4)           |
| R018      | Fish consumption (kg/yr)                         | not used      | 5.400E+00 | ---  | DIET(5)           |
| R018      | Other seafood consumption (kg/yr)                | not used      | 9.000E-01 | ---  | DIET(6)           |
| R018      | Soil ingestion rate (g/yr)                       | 4.964E+01     | 3.650E+01 | ---  | SOIL              |
| R018      | Drinking water intake (L/yr)                     | not used      | 5.100E+02 | ---  | DWI               |
| R018      | Contamination fraction of drinking water         | not used      | 1.000E+00 | ---  | FDW               |
| R018      | Contamination fraction of household water        | not used      | 1.000E+00 | ---  | FHHW              |
| R018      | Contamination fraction of livestock water        | not used      | 1.000E+00 | ---  | FLW               |
| R018      | Contamination fraction of irrigation water       | not used      | 1.000E+00 | ---  | FIRW              |
| R018      | Contamination fraction of aquatic food           | not used      | 5.000E-01 | ---  | FR9               |
| R018      | Contamination fraction of plant food             | not used      | -1        | ---  | FPLANT            |
| R018      | Contamination fraction of meat                   | not used      | -1        | ---  | FMEAT             |
| R018      | Contamination fraction of milk                   | not used      | -1        | ---  | FMILK             |
| R019      | Livestock fodder intake for meat (kg/day)        | not used      | 6.800E+01 | ---  | LFI5              |
| R019      | Livestock fodder intake for milk (kg/day)        | not used      | 5.500E+01 | ---  | LFI6              |
| R019      | Livestock water intake for meat (L/day)          | not used      | 5.000E+01 | ---  | LWI5              |
| R019      | Livestock water intake for milk (L/day)          | not used      | 1.600E+02 | ---  | LWI6              |
| R019      | Livestock soil intake (kg/day)                   | not used      | 5.000E-01 | ---  | LSI               |
| 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)             |

## Site-Specific Parameter Summary (continued)

| 0<br>Menu | Parameter  | User<br>Input | Default    | Used by RESRAD<br>(If different from user input) | Parameter<br>Name |
|-----------|--|---------------|------------|--|-------------------|
| 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)            | not used      | 2.000E-05  | ---  | C12WTR            |
| C14       | C-12 concentration in contaminated soil (g/g)    | not used      | 3.000E-02  | ---  | C12CZ             |
| C14       | Fraction of vegetation carbon from soil          | not used      | 2.000E-02  | ---  | CSOIL             |
| C14       | Fraction of vegetation carbon from air           | not used      | 9.800E-01  | ---  | CAIR              |
| C14       | C-14 evasion layer thickness in soil (m)         | not used      | 3.000E-01  | ---  | DMC               |
| C14       | C-14 evasion flux rate from soil (1/sec)         | not used      | 7.000E-07  | ---  | EVSN              |
| C14       | C-12 evasion flux rate from soil (1/sec)         | not used      | 1.000E-10  | ---  | REVSN             |
| C14       | Fraction of grain in beef cattle feed            | not used      | 8.000E-01  | ---  | AVFG4             |
| C14       | Fraction of grain in milk cow feed               | not used      | 2.000E-01  | ---  | AVFG5             |
| 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                                       | 1.000E+00     | 1.000E+00  | ---  | STOR_T(7)         |
| STOR      | Surface water                                    | 1.000E+00     | 1.000E+00  | ---  | STOR_T(8)         |
| STOR      | Livestock fodder                                 | 4.500E+01     | 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  | ---  | DENSL             |
| R021      | Total porosity of the cover material             | not used      | 4.000E-01  | ---  | TPCV              |
| R021      | Total porosity of the building foundation        | not used      | 1.000E-01  | ---  | TPFL              |
| R021      | Volumetric water content of the cover material   | not used      | 5.000E-02  | ---  | PH2OCV            |
| R021      | Volumetric water content of the foundation       | not used      | 3.000E-02  | ---  | PH2OFL            |
| R021      | Diffusion coefficient for radon gas (m/sec):     |               |            |  |                   |
| R021      | in cover material                                | not used      | 2.000E-06  | ---  | DIFCV             |
| R021      | in foundation material                           | not used      | 3.000E-07  | ---  | DIFFL             |
| R021      | in contaminated zone soil                        | not used      | 2.000E-06  | ---  | DIFCZ             |
| R021      | Radon vertical dimension of mixing (m)           | not used      | 2.000E+00  | ---  | HMIX              |
| R021      | Average building air exchange rate (1/hr)        | not used      | 5.000E-01  | ---  | REXG              |
| R021      | Height of the building (room) (m)                | not used      | 2.500E+00  | ---  | HRM               |
| R021      | Building interior area factor                    | not used      | 0.000E+00  | ---  | FAI               |
| R021      | Building depth below ground surface (m)          | not used      | -1.000E+00 | ---  | DMFL              |
| R021      | Emanating power of Rn-222 gas                    | not used      | 2.500E-01  | ---  | EMANA(1)          |
| R021      | Emanating power of Rn-220 gas                    | not used      | 1.500E-01  | ---  | EMANA(2)          |
| TITL      | Number of graphical time points                  | 32            | --         | ---  | NPTS              |

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Site-Specific Parameter Summary (continued)

| 0<br>Menu | Parameter                                     | User<br>Input | Default | Used by RESRAD<br>(If different from user input) | Parameter<br>Name |
|-----------|---|---------------|---------|--|-------------------|
| TITL      | Maximum number of integration points for dose | 17            | ---     | ---  | LYMAX             |
| TITL      | 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         |

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Contaminated Zone Dimensions

Initial Soil Concentrations, pCi/g

Area: 9846.00 square meters

U-234 2.700E-01

Thickness: 2.00 meters

U-235 2.000E-02

Cover Depth: 0.00 meters

U-238 2.700E-01

0

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): 1.340E-02 1.339E-02 1.337E-02 1.331E-02 1.312E-02 1.252E-02 1.099E-02 7.383E-03

M(t): 5.360E-04 5.356E-04 5.349E-04 5.323E-04 5.249E-04 5.006E-04 4.395E-04 2.953E-04

Maximum TDOSE(t): 1.340E-02 mrem/yr at t = 0.000E+00 years

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## 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. |
| U-234         | 1.918E-05 | 0.0014 | 9.133E-04  | 0.0682 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 9.197E-04 | 0.0686 |
| U-235         | 2.646E-03 | 0.1974 | 6.304E-05  | 0.0047 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.439E-05 | 0.0048 |
| U-238         | 7.085E-03 | 0.5287 | 8.166E-04  | 0.0609 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 8.732E-04 | 0.0652 |
| Total         | 9.750E-03 | 0.7276 | 1.793E-03  | 0.1338 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.857E-03 | 0.1386 |

## 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. |
| U-234         | 0.000E+00 | 0.0000 | 1.852E-03     | 0.1382 |
| U-235         | 0.000E+00 | 0.0000 | 2.773E-03     | 0.2069 |
| U-238         | 0.000E+00 | 0.0000 | 8.775E-03     | 0.6548 |
| Total         | 0.000E+00 | 0.0000 | 1.340E-02     | 1.0000 |

\*Sum of all water independent and dependent pathways.

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T½ Limit = 180 days

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## 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. |
| U-234         | 1.917E-05 | 0.0014 | 9.126E-04  | 0.0682 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 9.191E-04 | 0.0686 |
| U-235         | 2.644E-03 | 0.1974 | 6.301E-05  | 0.0047 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.440E-05 | 0.0048 |
| U-238         | 7.080E-03 | 0.5287 | 8.160E-04  | 0.0609 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 8.726E-04 | 0.0652 |
| Total         | 9.743E-03 | 0.7276 | 1.792E-03  | 0.1338 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.856E-03 | 0.1386 |

## 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. |
| U-234         | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+0C | 0.0000 | 0.000E+00 | 0.0000 | 1.851E-03     | 0.1382 |
| U-235         | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+0C | 0.0000 | 0.000E+00 | 0.0000 | 2.771E-03     | 0.2070 |
| U-238         | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+0C | 0.0000 | 0.000E+00 | 0.0000 | 8.769E-03     | 0.6548 |
| Total         | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+0C | 0.0000 | 0.000E+00 | 0.0000 | 1.339E-02     | 1.0000 |

\*Sum of all water independent and dependent pathways.

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T<sub>1/2</sub> Limit = 180 days

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## 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. |
| U-234         | 1.915E-05 | 0.0014 | 9.113E-04  | 0.0682 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 9.178E-04 | 0.0686 |
| U-235         | 2.640E-03 | 0.1974 | 6.296E-05  | 0.0047 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.442E-05 | 0.0048 |
| U-238         | 7.070E-03 | 0.5287 | 8.149E-04  | 0.0609 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 8.714E-04 | 0.0652 |
| Total         | 9.729E-03 | 0.7276 | 1.789E-03  | 0.1338 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.854E-03 | 0.1386 |

## 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. |
| U-234         | 0.000E+00 | 0.0000 | 1.848E-03     | 0.1382 |
| U-235         | 0.000E+00 | 0.0000 | 2.767E-03     | 0.2070 |
| U-238         | 0.000E+00 | 0.0000 | 8.756E-03     | 0.6548 |
| Total         | 0.000E+00 | 0.0000 | 1.337E-02     | 1.0000 |

\*Sum of all water independent and dependent pathways.

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T<sub>1/2</sub> Limit = 180 days

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## 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)

| 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. |
| U-234         | 1.916E-05 | 0.0014 | 9.069E-04  | 0.0682 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 9.133E-04 | 0.0686 |
| U-235         | 2.627E-03 | 0.1974 | 6.285E-05  | 0.0047 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.458E-05 | 0.0049 |
| U-238         | 7.035E-03 | 0.5287 | 8.108E-04  | 0.0609 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 8.671E-04 | 0.0652 |
| Total         | 9.681E-03 | 0.7275 | 1.781E-03  | 0.1338 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.845E-03 | 0.1386 |

## 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

| Radio-Nuclide | Water     |        | Fish      |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | All Pathways* |        |
|---------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|---------------|--------|
|               | mrem/yr   | fract. | mrem/yr       | fract. |
| U-234         | 0.000E+00 | 0.0000 | 1.839E-03     | 0.1382 |
| U-235         | 0.000E+00 | 0.0000 | 2.755E-03     | 0.2070 |
| U-238         | 0.000E+00 | 0.0000 | 8.712E-03     | 0.6548 |
| Total         | 0.000E+00 | 0.0000 | 1.331E-02     | 1.0000 |

\*Sum of all water independent and dependent pathways.

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## 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. |
| U-234         | 1.971E-05 | 0.0015 | 8.944E-04  | 0.0682 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 9.006E-04 | 0.0686 |
| U-235         | 2.592E-03 | 0.1975 | 6.289E-05  | 0.0048 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.541E-05 | 0.0050 |
| U-238         | 6.935E-03 | 0.5284 | 7.994E-04  | 0.0609 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 8.548E-04 | 0.0651 |
| Total         | 9.546E-03 | 0.7274 | 1.757E-03  | 0.1339 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.821E-03 | 0.1387 |

## 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. |
| U-234         | 0.000E+00 | 0.0000 | 1.815E-03     | 0.1383 |
| U-235         | 0.000E+00 | 0.0000 | 2.720E-03     | 0.2073 |
| U-238         | 0.000E+00 | 0.0000 | 8.589E-03     | 0.6545 |
| Total         | 0.000E+00 | 0.0000 | 1.312E-02     | 1.0000 |

\*Sum of all water independent and dependent pathways.

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 $T_{1/2}$  Limit = 180 days

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## 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)

| 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. |
| U-234         | 2.761E-05 | 0.0022 | 8.520E-04  | 0.0681 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 8.579E-04 | 0.0685 |
| U-235         | 2.474E-03 | 0.1977 | 6.466E-05  | 0.0052 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.980E-05 | 0.0056 |
| U-238         | 6.596E-03 | 0.5270 | 7.605E-04  | 0.0608 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 8.133E-04 | 0.0650 |
| Total         | 9.098E-03 | 0.7269 | 1.677E-03  | 0.1340 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.741E-03 | 0.1391 |

## 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

| Radio-Nuclide | Water     |        | Fish      |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | All Pathways* |        |
|---------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|---------------|--------|
|               | mrem/yr   | fract. | mrem/yr       | fract. |
| U-234         | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+0C | 0.0000 | 0.000E+00 | 0.0000 | 1.737E-03     | 0.1388 |
| U-235         | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+0C | 0.0000 | 0.000E+00 | 0.0000 | 2.608E-03     | 0.2084 |
| U-238         | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+0C | 0.0000 | 0.000E+00 | 0.0000 | 8.170E-03     | 0.6528 |
| Total         | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+0C | 0.0000 | 0.000E+00 | 0.0000 | 1.252E-02     | 1.0000 |

\*Sum of all water independent and dependent pathways.

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T<sub>1/2</sub> Limit = 180 days

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## 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. |
| U-234         | 9.338E-05 | 0.0085 | 7.419E-04  | 0.0675 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 7.494E-04 | 0.0682 |
| U-235         | 2.170E-03 | 0.1975 | 6.956E-05  | 0.0063 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 8.084E-05 | 0.0074 |
| U-238         | 5.718E-03 | 0.5204 | 6.597E-04  | 0.0600 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 7.054E-04 | 0.0642 |
| Total         | 7.981E-03 | 0.7263 | 1.471E-03  | 0.1339 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.536E-03 | 0.1398 |

## 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. |
| U-234         | 0.000E+00 | 0.0000 | 1.585E-03     | 0.1442 |
| U-235         | 0.000E+00 | 0.0000 | 2.320E-03     | 0.2112 |
| U-238         | 0.000E+00 | 0.0000 | 7.083E-03     | 0.6446 |
| Total         | 0.000E+00 | 0.0000 | 1.099E-02     | 1.0000 |

\*Sum of all water independent and dependent pathways.

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T½ Limit = 180 days

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## 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)

| 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. |
| U-234         | 6.044E-04 | 0.0819 | 4.603E-04  | 0.0623 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.905E-04 | 0.0664 |
| U-235         | 1.369E-03 | 0.1854 | 7.073E-05  | 0.0096 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 9.192E-05 | 0.0124 |
| U-238         | 3.468E-03 | 0.4696 | 4.009E-04  | 0.0543 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.286E-04 | 0.0581 |
| Total         | 5.441E-03 | 0.7369 | 9.319E-04  | 0.1262 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.011E-03 | 0.1369 |

## 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

| Radio-Nuclide | Water     |        | Fish      |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | All Pathways* |        |
|---------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|---------------|--------|
|               | mrem/yr   | fract. | mrem/yr       | fract. |
| U-234         | 0.000E+00 | 0.0000 | 1.555E-03     | 0.2106 |
| U-235         | 0.000E+00 | 0.0000 | 1.531E-03     | 0.2074 |
| U-238         | 0.000E+00 | 0.0000 | 4.297E-03     | 0.5820 |
| Total         | 0.000E+00 | 0.0000 | 7.383E-03     | 1.0000 |

\*Sum of all water independent and dependent pathways.

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T<sub>1/2</sub> Limit = 180 days

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## Dose/Source Ratios Summed Over All Pathways

| 0        | Parent<br>(i)   | Product<br>(j) | Thread<br>Fraction | Parent and Progeny Principal Radionuclide Contributions Indicated |                   |           |           |           |           |           |           |           |
|----------|-----------------|----------------|--------------------|---|-------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
|          |                 |                |                    | 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 |
| U-234    | U-234           | 1.000E+00      | 6.860E-03          | 6.855E-03   | 6.845E-03         | 6.811E-03 | 6.714E-03 | 6.385E-03 | 5.531E-03 | 3.347E-03 |           |           |
| U-234    | Th-230          | 1.000E+00      | 6.825E-08          | 2.047E-07   | 4.773E-07         | 1.428E-06 | 4.118E-06 | 1.323E-05 | 3.685E-05 | 9.695E-05 |           |           |
| U-234    | Ra-226+D        | 1.000E+00      | 1.264E-09          | 8.845E-09   | 4.670E-08         | 4.162E-07 | 3.471E-06 | 3.624E-05 | 2.903E-04 | 2.220E-03 |           |           |
| U-234    | Pb-210+D        | 1.000E+00      | 4.480E-13          | 6.672E-12   | 7.663E-11         | 1.922E-09 | 4.040E-08 | 9.270E-07 | 1.083E-05 | 9.596E-05 |           |           |
| U-234    | $\Sigma$ DSR(j) |                | 6.860E-03          | 6.855E-03   | 6.845E-03         | 6.812E-03 | 6.721E-03 | 6.435E-03 | 5.869E-03 | 5.760E-03 |           |           |
| OU-235+D | U-235+D         | 1.000E+00      | 1.387E-01          | 1.386E-01   | 1.384E-01         | 1.377E-01 | 1.357E-01 | 1.291E-01 | 1.119E-01 | 6.785E-02 |           |           |
| U-235+D  | Pa-231          | 1.000E+00      | 2.046E-06          | 6.134E-06   | 1.429E-05         | 4.266E-05 | 1.221E-04 | 3.825E-04 | 9.894E-04 | 1.983E-03 |           |           |
| U-235+D  | Ac-227+D        | 1.000E+00      | 7.792E-08          | 5.400E-07   | 2.791E-06         | 2.308E-05 | 1.577E-04 | 9.494E-04 | 3.115E-03 | 6.734E-03 |           |           |
| U-235+D  | $\Sigma$ DSR(j) |                | 1.387E-01          | 1.386E-01   | 1.384E-01         | 1.377E-01 | 1.360E-01 | 1.304E-01 | 1.160E-01 | 7.657E-02 |           |           |
| OU-238   | U-238           | 5.400E-05      | 3.300E-07          | 3.298E-07   | 3.293E-07         | 3.277E-07 | 3.230E-07 | 3.073E-07 | 2.663E-07 | 1.615E-07 |           |           |
| OU-238+D | U-238+D         | 9.999E-01      | 3.250E-02          | 3.248E-02   | 3.243E-02         | 3.227E-02 | 3.181E-02 | 3.026E-02 | 2.623E-02 | 1.590E-02 |           |           |
| U-238+D  | U-234           | 9.999E-01      | 9.722E-09          | 2.915E-08   | 6.791E-08         | 2.027E-07 | 5.805E-07 | 1.819E-06 | 4.714E-06 | 9.507E-06 |           |           |
| U-238+D  | Th-230          | 9.999E-01      | 6.449E-14          | 4.512E-13   | 2.383E-12         | 2.124E-11 | 1.774E-10 | 1.863E-09 | 1.514E-08 | 1.215E-07 |           |           |
| U-238+D  | Ra-226+D        | 9.999E-01      | 8.959E-16          | 1.343E-14   | 1.565E-13         | 4.134E-12 | 9.992E-11 | 3.428E-09 | 8.141E-08 | 2.002E-06 |           |           |
| U-238+D  | Pb-210+D        | 9.999E-01      | 2.543E-19          | 7.836E-18   | 1.949E-16         | 1.456E-14 | 9.105E-13 | 7.359E-11 | 2.780E-09 | 8.408E-08 |           |           |
| U-238+D  | $\Sigma$ DSR(j) |                | 3.250E-02          | 3.248E-02   | 3.243E-02         | 3.227E-02 | 3.181E-02 | 3.026E-02 | 2.623E-02 | 1.591E-02 |           |           |

The DSR includes contributions from associated (half-life ≤ 180 days) daughters.

0

Single Radionuclide Soil Guidelines G(i,t) in pCi/g  
Basic Radiation Dose Limit = 2.500E+01 mrem/yr

| ONuclide<br>(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 |
|-----------------|--------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| U-234           | 3.644E+03    | 3.647E+03 | 3.652E+03 | 3.670E+03 | 3.720E+03 | 3.885E+03 | 4.260E+03 | 4.340E+03 |
| U-235           | 1.803E+02    | 1.804E+02 | 1.807E+02 | 1.815E+02 | 1.838E+02 | 1.917E+02 | 2.155E+02 | 3.265E+02 |
| U-238           | 7.692E+02    | 7.698E+02 | 7.709E+02 | 7.748E+02 | 7.859E+02 | 8.262E+02 | 9.530E+02 | 1.571E+03 |

0

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 = 0.000E+00 years

| ONuclide<br>(i) | Initial<br>(pCi/g) | tmin<br>(years) | DSR(i,tmin) | G(i,tmin) | DSR(i,tmax) | G(i,tmax) |
|-----------------|--------------------|-----------------|-------------|-----------|-------------|-----------|
| U-234           | 2.700E-01          | 0.000E+00       | 6.860E-03   | 3.644E+03 | 6.860E-03   | 3.644E+03 |
| U-235           | 2.000E-02          | 0.000E+00       | 1.387E-01   | 1.803E+02 | 1.387E-01   | 1.803E+02 |
| U-238           | 2.700E-01          | 0.000E+00       | 3.250E-02   | 7.692E+02 | 3.250E-02   | 7.692E+02 |

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

| ONuclide | Parent           | THF(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 |
|----------|------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| U-234    | U-234            | 1.000E+00 | 1.852E-03 | 1.851E-03 | 1.848E-03 | 1.839E-03 | 1.813E-03 | 1.724E-03 | 1.493E-03 | 9.037E-04 |           |
| U-234    | U-238            | 9.999E-01 | 2.625E-09 | 7.870E-09 | 1.834E-08 | 5.474E-08 | 1.567E-07 | 4.912E-07 | 1.273E-06 | 2.567E-06 |           |
| U-234    | $\Sigma$ DOSE(j) |           | 1.852E-03 | 1.851E-03 | 1.848E-03 | 1.839E-03 | 1.813E-03 | 1.724E-03 | 1.495E-03 | 9.063E-04 |           |
| OTh-230  | U-234            | 1.000E+00 | 1.843E-08 | 5.527E-08 | 1.289E-07 | 3.856E-07 | 1.112E-06 | 3.573E-06 | 9.950E-06 | 2.618E-05 |           |
| Th-230   | U-238            | 9.999E-01 | 1.741E-14 | 1.218E-13 | 6.433E-13 | 5.736E-12 | 4.790E-11 | 5.029E-10 | 4.089E-09 | 3.280E-08 |           |
| Th-230   | $\Sigma$ DOSE(j) |           | 1.843E-08 | 5.527E-08 | 1.289E-07 | 3.856E-07 | 1.112E-06 | 3.573E-06 | 9.954E-06 | 2.621E-05 |           |
| ORa-226  | U-234            | 1.000E+00 | 3.413E-10 | 2.388E-09 | 1.261E-08 | 1.124E-07 | 9.370E-07 | 9.786E-06 | 7.839E-05 | 5.993E-04 |           |
| Ra-226   | U-238            | 9.999E-01 | 2.419E-16 | 3.627E-15 | 4.226E-14 | 1.116E-12 | 2.698E-11 | 9.256E-10 | 2.198E-08 | 5.406E-07 |           |
| Ra-226   | $\Sigma$ DOSE(j) |           | 3.413E-10 | 2.388E-09 | 1.261E-08 | 1.124E-07 | 9.371E-07 | 9.787E-06 | 7.841E-05 | 5.998E-04 |           |
| OPb-210  | U-234            | 1.000E+00 | 1.209E-13 | 1.802E-12 | 2.069E-11 | 5.189E-10 | 1.091E-08 | 2.503E-07 | 2.923E-06 | 2.591E-05 |           |
| Pb-210   | U-238            | 9.999E-01 | 6.865E-20 | 2.116E-18 | 5.263E-17 | 3.930E-15 | 2.458E-13 | 1.987E-11 | 7.506E-10 | 2.270E-08 |           |
| Pb-210   | $\Sigma$ DOSE(j) |           | 1.210E-13 | 1.802E-12 | 2.069E-11 | 5.189E-10 | 1.091E-08 | 2.503E-07 | 2.924E-06 | 2.593E-05 |           |
| OU-235   | U-235            | 1.000E+00 | 2.773E-03 | 2.771E-03 | 2.767E-03 | 2.753E-03 | 2.714E-03 | 2.582E-03 | 2.238E-03 | 1.357E-03 |           |
| OPa-231  | U-235            | 1.000E+00 | 4.092E-08 | 1.227E-07 | 2.859E-07 | 8.532E-07 | 2.443E-06 | 7.651E-06 | 1.979E-05 | 3.965E-05 |           |
| OAc-227  | U-235            | 1.000E+00 | 1.558E-09 | 1.080E-08 | 5.582E-08 | 4.617E-07 | 3.155E-06 | 1.899E-05 | €.230E-05 | 1.347E-04 |           |
| OU-238   | U-238            | 5.400E-05 | 8.911E-08 | 8.904E-08 | 8.892E-08 | 8.847E-08 | 8.722E-08 | 8.296E-08 | 7.191E-08 | 4.360E-08 |           |
| U-238    | U-238            | 9.999E-01 | 8.775E-03 | 8.768E-03 | 8.756E-03 | 8.712E-03 | 8.589E-03 | 8.170E-03 | 7.081E-03 | 4.294E-03 |           |
| U-238    | $\Sigma$ DOSE(j) |           | 8.775E-03 | 8.769E-03 | 8.756E-03 | 8.712E-03 | 8.589E-03 | 8.170E-03 | 7.081E-03 | 4.294E-03 |           |

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

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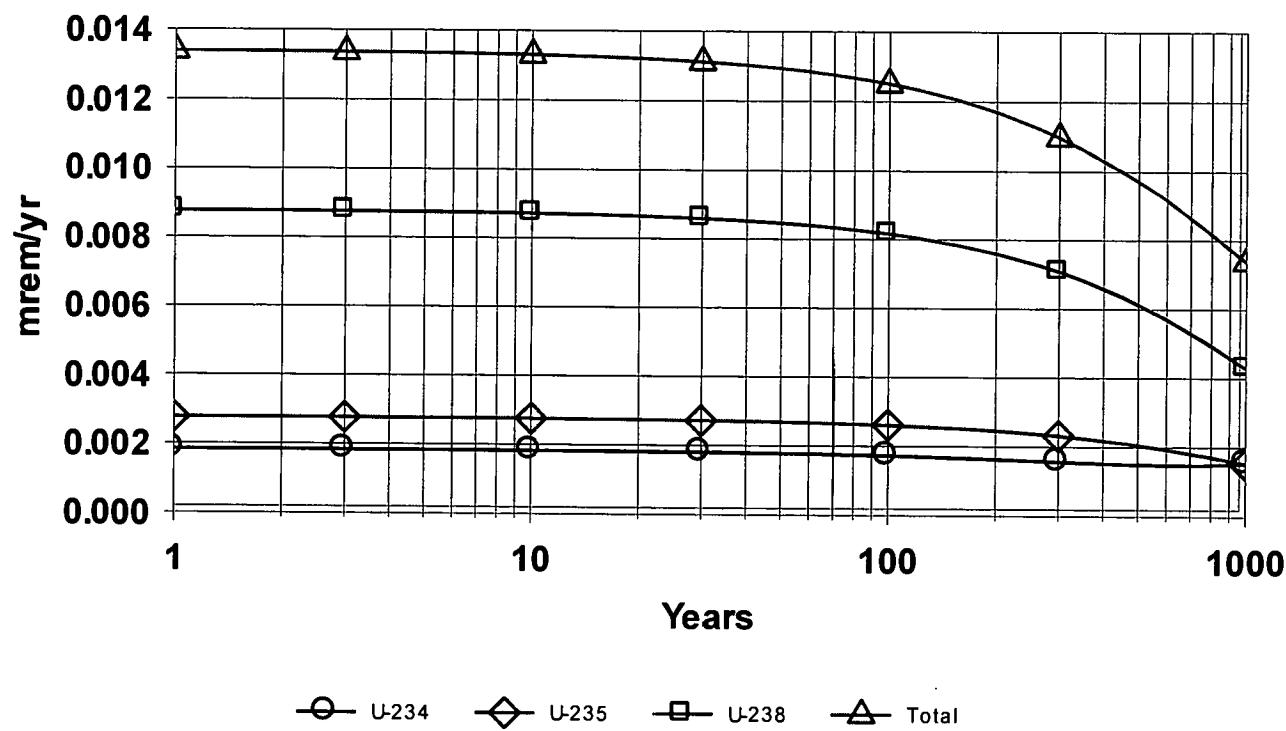
Individual Nuclide Soil Concentration  
Parent Nuclide and Branch Fraction Indicated

| ONuclide | Parent | THF(i)       | S(j,t), pCi/g |           |           |           |           |           |           |           |
|----------|--------|--------------|---------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| (j)      | (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 |           |
| U-234    | U-234  | 1.000E+00    | 2.700E-01     | 2.698E-01 | 2.694E-01 | 2.681E-01 | 2.643E-01 | 2.513E-01 | 2.177E-01 | 1.317E-01 |
| U-234    | U-238  | 9.999E-01    | 0.000E+00     | 7.648E-07 | 2.291E-06 | 7.599E-06 | 2.247E-05 | 7.125E-05 | 1.852E-04 | 3.740E-04 |
| U-234    | ΣS(j): |              | 2.700E-01     | 2.698E-01 | 2.694E-01 | 2.681E-01 | 2.643E-01 | 2.514E-01 | 2.179E-01 | 1.321E-01 |
| OTh-230  | U-234  | 1.000E+00    | 0.000E+00     | 2.430E-06 | 7.284E-06 | 2.422E-05 | 7.213E-05 | 2.344E-04 | 6.550E-04 | 1.725E-03 |
| Th-230   | U-238  | 9.999E-01    | 0.000E+00     | 3.443E-12 | 3.096E-11 | 3.429E-10 | 3.056E-09 | 3.284E-08 | 2.688E-07 | 2.161E-06 |
| Th-230   | ΣS(j): |              | 0.000E+00     | 2.430E-06 | 7.284E-06 | 2.422E-05 | 7.213E-05 | 2.345E-04 | 6.553E-04 | 1.727E-03 |
| 0Ra-226  | U-234  | 1.000E+00    | 0.000E+00     | 5.262E-10 | 4.730E-09 | 5.235E-08 | 4.660E-07 | 4.980E-06 | 4.016E-05 | 3.078E-04 |
| Ra-226   | U-238  | 9.999E-01    | 0.000E+00     | 4.972E-16 | 1.341E-14 | 4.945E-13 | 1.319E-11 | 4.687E-10 | 1.124E-08 | 2.775E-07 |
| Ra-226   | ΣS(j): |              | 0.000E+00     | 5.262E-10 | 4.730E-09 | 5.236E-08 | 4.660E-07 | 4.981E-06 | 4.017E-05 | 3.080E-04 |
| 0Pb-210  | U-234  | 1.000E+00    | 0.000E+00     | 5.410E-12 | 1.437E-10 | 5.030E-09 | 1.167E-07 | 2.769E-06 | 3.263E-05 | 2.900E-04 |
| Pb-210   | U-238  | 9.999E-01    | 0.000E+00     | 3.840E-18 | 3.069E-16 | 3.617E-14 | 2.584E-12 | 2.187E-10 | 8.364E-09 | 2.539E-07 |
| Pb-210   | ΣS(j): |              | 0.000E+00     | 5.410E-12 | 1.437E-10 | 5.030E-09 | 1.167E-07 | 2.770E-06 | 3.263E-05 | 2.902E-04 |
| 0U-235   | U-235  | 1.000E+00    | 2.000E-02     | 1.999E-02 | 1.996E-02 | 1.986E-02 | 1.958E-02 | 1.862E-02 | 1.614E-02 | 9.787E-03 |
| 0Pa-231  | U-235  | 1.000E+00    | 0.000E+00     | 4.229E-07 | 1.267E-06 | 4.201E-06 | 1.242E-05 | 3.936E-05 | 1.021E-04 | 2.049E-04 |
| 0Ac-227  | U-235  | 1.000E+00    | 0.000E+00     | 6.658E-09 | 5.855E-08 | 6.011E-07 | 4.381E-06 | 2.695E-05 | 8.885E-05 | 1.923E-04 |
| 0U-238   | U-238  | 5.400E-05    | 1.458E-05     | 1.457E-05 | 1.455E-05 | 1.448E-05 | 1.427E-05 | 1.357E-05 | 1.177E-05 | 7.135E-06 |
| U-238    | U-238  | 9.999E-01    | 2.700E-01     | 2.698E-01 | 2.694E-01 | 2.681E-01 | 2.643E-01 | 2.514E-01 | 2.179E-01 | 1.321E-01 |
| U-238    | ΣS(j): |              | 2.700E-01     | 2.698E-01 | 2.694E-01 | 2.681E-01 | 2.643E-01 | 2.514E-01 | 2.179E-01 | 1.321E-01 |

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

ORESCALC.EXE execution time = 3.05 seconds

**DOSE: All Nuclides Summed, All Pathways Summed**



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Includes All Pathways

DT-34 Industrial Worker  
RESRAD Risk Summary

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Cancer Risk Slope Factors Summary Table  
Risk Library: HEAST 2001 Morbidity

| 0<br>Menu | Parameter  | Current Value | Base Case* | Parameter Name |
|-----------|--|---------------|------------|----------------|
| Sf-1      | Ground external radiation slope factors, 1/yr per (pCi/g): |               |            |                |
| Sf-1      | Ac-227+D   | 1.47E-06      | 3.48E-10   | SLPF( 1,1)     |
| Sf-1      | Pa-231   | 1.39E-07      | 1.39E-07   | SLPF( 2,1)     |
| Sf-1      | Pb-210+D   | 4.21E-09      | 1.41E-09   | SLPF( 3,1)     |
| Sf-1      | Ra-226+D   | 8.49E-06      | 2.29E-08   | SLPF( 4,1)     |
| Sf-1      | Th-230   | 8.19E-10      | 8.19E-10   | SLPF( 5,1)     |
| Sf-1      | U-234  | 2.52E-10      | 2.52E-10   | SLPF( 6,1)     |
| Sf-1      | U-235+D  | 5.43E-07      | 5.18E-07   | SLPF( 7,1)     |
| Sf-1      | U-238  | 4.99E-11      | 4.99E-11   | SLPF( 8,1)     |
| Sf-1      | U-238+D  | 1.14E-07      | 4.99E-11   | SLPF( 9,1)     |
| Sf-2      | Inhalation, slope factors, 1/(pCi):                        |               |            |                |
| Sf-2      | Ac-227+D   | 2.09E-07      | 1.49E-07   | SLPF( 1,2)     |
| Sf-2      | Pa-231   | 4.55E-08      | 4.55E-08   | SLPF( 2,2)     |
| Sf-2      | Pb-210+D   | 1.39E-08      | 2.77E-09   | SLPF( 3,2)     |
| Sf-2      | Ra-226+D   | 1.16E-08      | 1.15E-08   | SLPF( 4,2)     |
| Sf-2      | Th-230   | 2.85E-08      | 2.85E-08   | SLPF( 5,2)     |
| Sf-2      | U-234  | 1.14E-08      | 1.14E-08   | SLPF( 6,2)     |
| Sf-2      | U-235+D  | 1.01E-08      | 1.01E-08   | SLPF( 7,2)     |
| Sf-2      | U-238  | 9.32E-09      | 9.32E-09   | SLPF( 8,2)     |
| Sf-2      | U-238+D  | 9.35E-09      | 9.32E-09   | SLPF( 9,2)     |
| Sf-3      | Food ingestion, slope factors, 1/(pCi):                    |               |            |                |
| Sf-3      | Ac-227+D   | 6.53E-10      | 2.45E-10   | SLPF( 1,3)     |
| Sf-3      | Pa-231   | 2.26E-10      | 2.26E-10   | SLPF( 2,3)     |
| Sf-3      | Pb-210+D   | 3.44E-09      | 1.18E-09   | SLPF( 3,3)     |
| Sf-3      | Ra-226+D   | 5.15E-10      | 5.14E-10   | SLPF( 4,3)     |
| Sf-3      | Th-230   | 1.19E-10      | 1.19E-10   | SLPF( 5,3)     |
| Sf-3      | U-234  | 9.55E-11      | 9.55E-11   | SLPF( 6,3)     |
| Sf-3      | U-235+D  | 9.76E-11      | 9.44E-11   | SLPF( 7,3)     |
| Sf-3      | U-238  | 8.66E-11      | 8.66E-11   | SLPF( 8,3)     |
| Sf-3      | U-238+D  | 1.21E-10      | 8.66E-11   | SLPF( 9,3)     |
| Sf-3      | Water ingestion, slope factors, 1/(pCi):                   |               |            |                |
| Sf-3      | Ac-227+D   | 4.86E-10      | 2.01E-10   | SLPF( 1,4)     |
| Sf-3      | Pa-231   | 1.73E-10      | 1.73E-10   | SLPF( 2,4)     |
| Sf-3      | Pb-210+D   | 1.27E-09      | 8.81E-10   | SLPF( 3,4)     |
| Sf-3      | Ra-226+D   | 3.86E-10      | 3.85E-10   | SLPF( 4,4)     |
| Sf-3      | Th-230   | 9.10E-11      | 9.10E-11   | SLPF( 5,4)     |
| Sf-3      | U-234  | 7.07E-11      | 7.07E-11   | SLPF( 6,4)     |
| Sf-3      | U-235+D  | 7.18E-11      | 6.96E-11   | SLPF( 7,4)     |
| Sf-3      | U-238  | 6.40E-11      | 6.40E-11   | SLPF( 8,4)     |
| Sf-3      | U-238+D  | 8.71E-11      | 6.40E-11   | SLPF( 9,4)     |
| Sf-3      | Soil ingestion, slope factors, 1/(pCi):                    |               |            |                |
| Sf-3      | Ac-227+D   | 1.16E-09      | 3.81E-10   | SLPF( 1,5)     |
| Sf-3      | Pa-231   | 3.74E-10      | 3.74E-10   | SLPF( 2,5)     |
| Sf-3      | Pb-210+D   | 2.66E-09      | 1.84E-09   | SLPF( 3,5)     |
| Sf-3      | Ra-226+D   | 7.30E-10      | 7.29E-10   | SLPF( 4,5)     |
| Sf-3      | Th-230   | 2.02E-10      | 2.02E-10   | SLPF( 5,5)     |

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Cancer Risk Slope Factors Summary Table (continued)  
Risk Library: HEAST 2001 Morbidity

| 0<br>Menu | Parameter                                | Current Value | Base Case* | Parameter Name |
|-----------|--|---------------|------------|----------------|
| Sf-3      | U-234                                    | 1.58E-10      | 1.58E-10   | SLPF( 6,5)     |
| Sf-3      | U-235+D                                  | 1.63E-10      | 1.57E-10   | SLPF( 7,5)     |
| Sf-3      | U-238                                    | 1.43E-10      | 1.43E-10   | SLPF( 8,5)     |
| Sf-3      | U-238+D                                  | 2.10E-10      | 1.43E-10   | SLPF( 9,5)     |
| Sf-Rn     | Radon Inhalation slope factors, 1/(pCi): |               |            |                |
| Sf-Rn     | Rn-222                                   | 1.80E-12      | 1.80E-12   | SLPFRN(1,1)    |
| Sf-Rn     | Po-218                                   | 3.70E-12      | 3.70E-12   | SLPFRN(1,2)    |
| Sf-Rn     | Pb-214                                   | 6.20E-12      | 6.20E-12   | SLPFRN(1,3)    |
| Sf-Rn     | Bi-214                                   | 1.50E-11      | 1.50E-11   | SLPFRN(1,4)    |
| Sf-Rn     | Radon K factors, (mrem/WLM):             |               |            |                |
| Sf-Rn     | Rn-222 Indoor                            | 7.60E+02      | 7.60E+02   | KFACTR(1,1)    |
| Sf-Rn     | Rn-222 Outdoor                           | 5.70E+02      | 5.70E+02   | KFACTR(1,2)    |

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

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| ONuclide<br>(i) | Risk Slope and Environmental Transport Factors for the Ground Pathway |           |           |           |           |           |           |           |   |  |
|-----------------|---|-----------|-----------|-----------|-----------|-----------|-----------|-----------|---|--|
|                 | Slope(i)*<br>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 | ETFG(i,t) At Time in Years<br>(dimensionless) |  |
| Ac-227          | 3.480E-10   | 1.755E-01                                     |  |
| At-218          | 3.570E-09   | 1.780E-01                                     |  |
| Bi-210          | 2.760E-09   | 1.733E-01                                     |  |
| Bi-211          | 1.880E-07   | 1.734E-01                                     |  |
| Bi-214          | 7.480E-06   | 1.724E-01                                     |  |
| Fr-223          | 1.400E-07   | 1.743E-01                                     |  |
| Pa-231          | 1.390E-07   | 1.734E-01                                     |  |
| Pa-234          | 8.710E-06   | 1.724E-01                                     |  |
| Pa-234m         | 6.870E-08   | 1.723E-01                                     |  |
| Pb-210          | 1.410E-09   | 1.800E-01                                     |  |
| Pb-211          | 2.290E-07   | 1.724E-01                                     |  |
| Pb-214          | 9.820E-07   | 1.734E-01                                     |  |
| Po-210          | 3.950E-11   | 1.722E-01                                     |  |
| Po-211          | 3.580E-08   | 1.717E-01                                     |  |
| Po-214          | 3.860E-10   | 1.717E-01                                     |  |
| Po-215          | 7.480E-10   | 1.726E-01                                     |  |
| Po-218          | 4.260E-11   | 1.722E-01                                     |  |
| Ra-223          | 4.340E-07   | 1.742E-01                                     |  |
| Ra-226          | 2.290E-08   | 1.747E-01                                     |  |
| Rn-219          | 2.250E-07   | 1.735E-01                                     |  |
| Rn-222          | 1.740E-09   | 1.719E-01                                     |  |
| Th-227          | 3.780E-07   | 1.744E-01                                     |  |
| Th-230          | 8.190E-10   | 1.759E-01                                     |  |
| Th-231          | 2.450E-08   | 1.761E-01                                     |  |
| Th-234          | 1.630E-08   | 1.763E-01                                     |  |
| Tl-207          | 1.520E-08   | 1.725E-01                                     |  |
| Tl-210          | 0.000E+00   | 1.835E-01                                     |  |
| U-234           | 2.520E-10   | 1.769E-01                                     |  |
| U-235           | 5.180E-07   | 1.746E-01                                     |  |
| U-238           | 4.990E-11   | 1.818E-01                                     |  |

\* - Units are 1/yr per (pCi/g) at infinite depth and area. Multiplication by ETFG(i,t) converts to site conditions.

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T<sub>1/2</sub> Limit = 180 days

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Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
As pCi/yr at t= 0.000E+00 years

| Radio-Nuclide | Water Independent Pathways (Inhalation w/o radon) |           |           |           |           | Water Dependent Pathways |           |           |           |           | Total Ingestion* |
|---------------|---|-----------|-----------|-----------|-----------|--------------------------|-----------|-----------|-----------|-----------|------------------|
|               | Inhalation  | Plant     | Meat      | Milk      | Soil      | Water                    | Fish      | Plant     | Meat      | Milk      |                  |
| Ac-227        | 0.000E+00   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00        |
| Pa-231        | 0.000E+00   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00        |
| Pb-210        | 0.000E+00   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00        |
| Ra-226        | 0.000E+00   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00        |
| Th-230        | 0.000E+00   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00        |
| U-234         | 6.921E-03   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 3.251E+00 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 3.251E+00        |
| U-235         | 5.127E-04   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 2.408E-01 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 2.408E-01        |
| U-238         | 6.921E-03   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 3.251E+00 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 3.251E+00        |

\* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil  
and water-dependent water, fish, plant, meat, milk pathways

0 Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of  
Radon and its Decay Products as pCi/yr at t= 0.000E+00 years

| Radon Pathway | Rn-222    | Po-218    | Pb-214    | Bi-214    | Rn-220    | Po-216    | Pb-212    | Bi-212    |
|---------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| Water-ind.    | 0.000E+00 |
| Water-dep.    | 0.000E+00 |
| Total         | 0.000E+00 |

Water-ind. == Water-independent      Water-dep. == Water-dependent

0 Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
and Fraction of Total Risk at t= 0.000E+00 years

| Radio-Nuclide | Water Independent Pathways (Inhalation excludes radon) |        |            |        |           |        |           |        |           |        |           |        |
|---------------|--|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|               | Ground   |        | Inhalation |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|               | risk   | fract. | risk       | fract. | risk      | fract. | risk      | fract. | risk      | fract. | risk      | fract. |
| Ac-227        | 7.272E-12  | 0.0000 | 1.526E-13  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.989E-13 | 0.0000 |
| Pa-231        | 3.150E-12  | 0.0000 | 1.524E-13  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 5.884E-13 | 0.0000 |
| Pb-210        | 3.362E-16  | 0.0000 | 1.619E-16  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.458E-14 | 0.0000 |
| Ra-226        | 3.974E-12  | 0.0000 | 8.045E-16  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.386E-14 | 0.0000 |
| Th-230        | 1.087E-13  | 0.0000 | 5.515E-13  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.836E-12 | 0.0000 |
| U-234         | 2.982E-10  | 0.0014 | 1.955E-09  | 0.0092 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.273E-08 | 0.0597 |
| U-235         | 4.696E-08  | 0.2205 | 1.283E-10  | 0.0006 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 9.747E-10 | 0.0046 |
| U-238         | 1.314E-07  | 0.6170 | 1.604E-09  | 0.0075 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.692E-08 | 0.0794 |
| Total         | 1.787E-07  | 0.8389 | 3.688E-09  | 0.0173 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.062E-08 | 0.1438 |

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Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
and Fraction of Total Risk at t= 0.000E+00 years

## Water Dependent Pathways

| Radio-Nuclide | Water     |        | Fish      |        | Plant     |        | Meat      |        | Milk      |        | All Pathways** |        |
|---------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|----------------|--------|
|               | risk      | fract. | risk           | fract. |
| Ac-227        | 0.000E+00 | 0.0000 | 7.823E-12      | 0.0000 |
| Pa-231        | 0.000E+00 | 0.0000 | 3.891E-12      | 0.0000 |
| Pb-210        | 0.000E+00 | 0.0000 | 1.508E-14      | 0.0000 |
| Ra-226        | 0.000E+00 | 0.0000 | 3.999E-12      | 0.0000 |
| Th-230        | 0.000E+00 | 0.0000 | 2.497E-12      | 0.0000 |
| U-234         | 0.000E+00 | 0.0000 | 1.498E-08      | 0.0703 |
| U-235         | 0.000E+00 | 0.0000 | 4.807E-08      | 0.2256 |
| U-238         | 0.000E+00 | 0.0000 | 1.500E-07      | 0.7039 |
| Total         | 0.000E+00 | 0.0000 | 2.130E-07      | 1.0000 |

\*\* Sum of water independent ground, inhalation, plant, meat, milk, soil  
and water dependent water, fish, plant, meat, milk pathways

0

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of  
Radon and its Decay Products at t= 0.000E+00 years  
Radionuclides

| Radon Pathway | Rn-222    | Po-218    | Pb-214    | Bi-214    | Rn-220    | Po-216    | Pb-212    | Bi-212    |
|---------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| Water-ind.    | 0.000E+00 |
| Water-dep.    | 0.000E+00 |
| Total         | 0.000E+00 |

Water-ind. == Water-independent      Water-dep. == Water-dependent

0

Total Excess Cancer Risk CNRS(i,p,t)\*\*\* for Initially Existent Radionuclides (i) and Pathways (p)  
and Fraction of Total Risk at t= 0.000E+00 years

| Radio-Nuclide | Ground    |        | Inhalation |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|---------------|-----------|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|               | risk      | fract. | risk       | fract. | risk      | fract. | risk      | fract. | risk      | fract. | risk      | fract. | risk      | fract. |
| U-234         | 3.023E-10 | 0.0014 | 1.955E-09  | 0.0092 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.273E-08 | 0.0598 |
| U-235         | 4.697E-08 | 0.2205 | 1.286E-10  | 0.0006 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 9.757E-10 | 0.0046 |
| U-238         | 1.314E-07 | 0.6170 | 1.604E-09  | 0.0075 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.692E-08 | 0.0794 |
| Total         | 1.787E-07 | 0.8389 | 3.688E-09  | 0.0173 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.062E-08 | 0.1438 |

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Total Excess Cancer Risk CNRS(i,p,t)\*\*\* for Initially Existent Radionuclides (i) and Pathways (p)  
and Fraction of Total Risk at t= 0.000E+00 years

Water Dependent Pathways

| Radio-Nuclide | Water      |        | Fish       |        | Radon      |        | Plant      |        | Meat       |        | Milk       |        | All pathways |        |
|---------------|------------|--------|------------|--------|------------|--------|------------|--------|------------|--------|------------|--------|--------------|--------|
|               | risk       | fract. | risk         | fract. |
| U-234         | 0.0000E+00 | 0.0000 | 1.499E-08    | 0.0704 |
| U-235         | 0.0000E+00 | 0.0000 | 4.808E-08    | 0.2257 |
| U-238         | 0.0000E+00 | 0.0000 | 1.500E-07    | 0.7039 |
| Total         | 0.0000E+00 | 0.0000 | 2.130E-07    | 1.0000 |

\*\*\*CNRSI(i,p,t) includes contribution from decay daughter radionuclides

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Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
As pCi/yr at t= 1.000E+00 years

| Radio-Nuclide | Water Independent Pathways (Inhalation w/o radon) |           |           |           |           | Water Dependent Pathways |           |           |           |           | Total Ingestion* |
|---------------|---|-----------|-----------|-----------|-----------|--------------------------|-----------|-----------|-----------|-----------|------------------|
|               | Inhalation  | Plant     | Meat      | Milk      | Soil      | Water                    | Fish      | Plant     | Meat      | Milk      |                  |
| Ac-227        | 1.707E-10   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 8.016E-08 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 8.016E-08        |
| Pa-231        | 1.084E-08   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 5.092E-06 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 5.092E-06        |
| Pb-210        | 1.387E-13   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 6.514E-11 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 6.514E-11        |
| Ra-226        | 1.349E-11   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 6.336E-09 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 6.336E-09        |
| Th-230        | 6.228E-08   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 2.925E-05 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 2.925E-05        |
| U-234         | 6.916E-03   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 3.249E+00 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 3.249E+00        |
| U-235         | 5.123E-04   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 2.406E-01 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 2.406E-01        |
| U-238         | 6.916E-03   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 3.249E+00 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 3.249E+00        |

\* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil  
and water-dependent water, fish, plant, meat, milk pathways

0 Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of  
Radon and its Decay Products as pCi/yr at t= 1.000E+00 years

| Radon Pathway | Rn-222    | Po-218    | Pb-214    | Bi-214    | Rn-220    | Po-216    | Pb-212    | Bi-212    |
|---------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| Water-ind.    | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.C00E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 |
| Water-dep.    | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.C00E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 |
| Total         | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.C00E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 |

Water-ind. == Water-independent      Water-dep. == Water-dependent

0 Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
and Fraction of Total Risk at t= 1.000E+00 years

| Radio-Nuclide | Water Independent Pathways (Inhalation excludes radon) |        |            |        |           |        |           |        |           |        |           |        |
|---------------|--|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|               | Ground   |        | Inhalation |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|               | risk   | fract. | risk       | fract. | risk      | fract. | risk      | fract. | risk      | fract. | risk      | fract. |
| Ac-227        | 8.115E-12  | 0.0000 | 1.703E-13  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.452E-13 | 0.0000 |
| Pa-231        | 3.400E-12  | 0.0000 | 1.645E-13  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.351E-13 | 0.0000 |
| Pb-210        | 3.909E-16  | 0.0000 | 1.883E-16  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.695E-14 | 0.0000 |
| Ra-226        | 4.468E-12  | 0.0000 | 9.045E-16  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.683E-14 | 0.0000 |
| Th-230        | 1.174E-13  | 0.0000 | 5.955E-13  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.983E-12 | 0.0000 |
| U-234         | 2.980E-10  | 0.0014 | 1.954E-09  | 0.0092 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.272E-08 | 0.0597 |
| U-235         | 4.693E-08  | 0.2205 | 1.282E-10  | 0.0006 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 9.741E-10 | 0.0046 |
| U-238         | 1.313E-07  | 0.6170 | 1.602E-09  | 0.0075 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.691E-08 | 0.0794 |
| Total         | 1.786E-07  | 0.8389 | 3.685E-09  | 0.0173 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.060E-08 | 0.1438 |

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Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
and Fraction of Total Risk at t= 1.000E+00 years

Water Dependent Pathways

| Radio-Nuclide | Water     |        | Fish      |        | Plant     |        | Meat      |        | Milk      |        | All Pathways** |        |
|---------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|----------------|--------|
|               | risk      | fract. | risk           | fract. |
| Ac-227        | 0.000E+00 | 0.0000 | 8.731E-12      | 0.0000 |
| Pa-231        | 0.000E+00 | 0.0000 | 4.200E-12      | 0.0000 |
| Pb-210        | 0.000E+00 | 0.0000 | 1.753E-14      | 0.0000 |
| Ra-226        | 0.000E+00 | 0.0000 | 4.496E-12      | 0.0000 |
| Th-230        | 0.000E+00 | 0.0000 | 2.696E-12      | 0.0000 |
| U-234         | 0.000E+00 | 0.0000 | 1.497E-08      | 0.0703 |
| U-235         | 0.000E+00 | 0.0000 | 4.803E-08      | 0.2256 |
| U-238         | 0.000E+00 | 0.0000 | 1.498E-07      | 0.7039 |
| Total         | 0.000E+00 | 0.0000 | 2.129E-07      | 1.0000 |

\*\* Sum of water independent ground, inhalation, plant, meat, milk, soil  
and water dependent water, fish, plant, meat, milk pathways

0

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of  
Radon and its Decay Products at t= 1.000E+00 years

| Radon Pathway | Rn-222     | Po-218    | Pb-214    | Bi-214    | Rn-220    | Po-216    | Pb-212    | Bi-212    |
|---------------|------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
|               | Water-ind. | 0.000E+00 |
| Water-dep.    | 0.000E+00  | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 |
| Total         | 0.000E+00  | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 |

Water-ind. == Water-independent Water-dep. == Water-dependent

0

Total Excess Cancer Risk CNRS(i,p,t)\*\*\* for Initially Existent Radionuclides (i) and Pathways (p)  
and Fraction of Total Risk at t= 1.000E+00 years

| Radio-Nuclide | Ground    |        | Inhalation |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|---------------|-----------|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|               | risk      | fract. | risk       | fract. | risk      | fract. | risk      | fract. | risk      | fract. | risk      | fract. | risk      | fract. |
| U-234         | 3.026E-10 | 0.0014 | 1.954E-09  | 0.0092 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.272E-08 | 0.0598 |
| U-235         | 4.694E-08 | 0.2205 | 1.286E-10  | 0.0006 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 9.751E-10 | 0.0046 |
| U-238         | 1.313E-07 | 0.6170 | 1.602E-09  | 0.0075 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.691E-08 | 0.0794 |
| Total         | 1.786E-07 | 0.8389 | 3.685E-09  | 0.0173 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.060E-08 | 0.1438 |

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 $T_{1/2}$  Limit = 180 days

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Total Excess Cancer Risk CNRS(i,p,t)\*\*\* for Initially Existent Radionuclides (i) and Pathways (p)  
 and Fraction of Total Risk at t= 1.000E+00 years

## Water Dependent Pathways

| Radio-Nuclide | Water     |        | Fish      |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | All pathways |        |
|---------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|--------------|--------|
|               | risk      | fract. | risk         | fract. |
| U-234         | 0.000E+00 | 0.0000 | 1.498E-08    | 0.0704 |
| U-235         | 0.000E+00 | 0.0000 | 4.804E-08    | 0.2257 |
| U-238         | 0.000E+00 | 0.0000 | 1.498E-07    | 0.7039 |
| Total         | 0.000E+00 | 0.0000 | 2.129E-07    | 1.0000 |

\*\*\*CNRSI(i,p,t) includes contribution from decay daughter radionuclides

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Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
As pCi/yr at t = 3.000E+00 years

| Radio-Nuclide | Water Independent Pathways (Inhalation w/o radon) |           |           |           |           | Water Dependent Pathways |           |           |           |           | Total Ingestion* |
|---------------|---|-----------|-----------|-----------|-----------|--------------------------|-----------|-----------|-----------|-----------|------------------|
|               | Inhalation  | Plant     | Meat      | Milk      | Soil      | Water                    | Fish      | Plant     | Meat      | Milk      |                  |
| Ac-227        | 1.501E-09   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 7.050E-07 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 7.050E-07        |
| Pa-231        | 3.247E-08   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 1.525E-05 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 1.525E-05        |
| Pb-210        | 3.683E-12   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 1.730E-09 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 1.730E-09        |
| Ra-226        | 1.213E-10   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 5.696E-08 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 5.696E-08        |
| Th-230        | 1.867E-07   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 8.770E-05 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 8.770E-05        |
| U-234         | 6.906E-03   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 3.244E+00 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 3.244E+00        |
| U-235         | 5.116E-04   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 2.403E-01 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 2.403E-01        |
| U-238         | 6.906E-03   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 3.244E+00 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 3.244E+00        |

\* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil  
and water-dependent water, fish, plant, meat, milk pathways

0 Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of  
Radon and its Decay Products as pCi/yr at t = 3.000E+00 years

| Radon Pathway | Rn-222    | Po-218    | Pb-214    | Bi-214    | Rn-220    | Po-216    | Pb-212    | Bi-212    |
|---------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| Water-ind.    | 0.000E+00 |
| Water-dep.    | 0.000E+00 |
| Total         | 0.000E+00 |

Water-ind. == Water-independent      Water-dep. == Water-dependent

0 Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
and Fraction of Total Risk at t = 3.000E+00 years

| Radio-Nuclide | Water Independent Pathways (Inhalation excludes radon) |        |            |        |           |        |           |        |           |        |           |        |
|---------------|--|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|               | Ground   |        | Inhalation |        | Plant     |        | Meat      |        | Milk      |        |           |        |
|               | risk   | fract. | risk       | fract. | risk      | fract. | risk      | fract. | risk      | fract. | risk      | fract. |
| Ac-227        | 9.966E-12  | 0.0000 | 2.091E-13  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0C00 | 0.000E+00 | 0.0000 | 5.468E-13 | 0.0000 |
| Pa-231        | 3.900E-12  | 0.0000 | 1.887E-13  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0C00 | 0.000E+00 | 0.0000 | 7.284E-13 | 0.0000 |
| Pb-210        | 5.195E-16  | 0.0000 | 2.502E-16  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0C00 | 0.000E+00 | 0.0000 | 2.253E-14 | 0.0000 |
| Ra-226        | 5.569E-12  | 0.0000 | 1.127E-15  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0C00 | 0.000E+00 | 0.0000 | 3.344E-14 | 0.0000 |
| Th-230        | 1.347E-13  | 0.0000 | 6.834E-13  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0C00 | 0.000E+00 | 0.0000 | 2.275E-12 | 0.0000 |
| U-234         | 2.976E-10  | 0.0014 | 1.951E-09  | 0.0092 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0C00 | 0.000E+00 | 0.0000 | 1.270E-08 | 0.0597 |
| U-235         | 4.686E-08  | 0.2205 | 1.280E-10  | 0.0006 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0C00 | 0.000E+00 | 0.0000 | 9.727E-10 | 0.0046 |
| U-238         | 1.311E-07  | 0.6170 | 1.600E-09  | 0.0075 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0C00 | 0.000E+00 | 0.0000 | 1.688E-08 | 0.0794 |
| Total         | 1.783E-07  | 0.8389 | 3.680E-09  | 0.0173 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0C00 | 0.000E+00 | 0.0000 | 3.056E-08 | 0.1438 |

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T<sub>1/2</sub> Limit = 180 days

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Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
and Fraction of Total Risk at t= 3.000E+00 years

Water Dependent Pathways

| Radio-Nuclide | Water       |        | Fish        |        | Plant       |        | Meat        |        | Milk        |        | All Pathways** |        |
|---------------|-------------|--------|-------------|--------|-------------|--------|-------------|--------|-------------|--------|----------------|--------|
|               | risk        | fract. | risk           | fract. |
| Ac-227        | 0.0000E+000 | 0.0000 | 1.072E-11      | 0.0001 |
| Pa-231        | 0.0000E+000 | 0.0000 | 4.817E-12      | 0.0000 |
| Pb-210        | 0.0000E+000 | 0.0000 | 2.330E-14      | 0.0000 |
| Ra-226        | 0.0000E+000 | 0.0000 | 5.604E-12      | 0.0000 |
| Th-230        | 0.0000E+000 | 0.0000 | 3.093E-12      | 0.0000 |
| U-234         | 0.0000E+000 | 0.0000 | 1.495E-08      | 0.0703 |
| U-235         | 0.0000E+000 | 0.0000 | 4.796E-08      | 0.2256 |
| U-238         | 0.0000E+000 | 0.0000 | 1.496E-07      | 0.7039 |
| Total         | 0.0000E+000 | 0.0000 | 2.126E-07      | 1.0000 |

\*\* Sum of water independent ground, inhalation, plant, meat, milk, soil  
and water dependent water, fish, plant, meat, milk pathways

0

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of  
Radon and its Decay Products at t= 3.000E+00 years  
Radionuclides

| Radon Pathway | Rn-222      | Po-218      | Pb-214      | Bi-214      | Rn-220      | Po-216      | Pb-212      | Bi-212      |
|---------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| Water-ind.    | 0.0000E+000 |
| Water-dep.    | 0.0000E+000 |
| Total         | 0.0000E+000 |

Water-ind. == Water-independent      Water-dep. == Water-dependent

0

Total Excess Cancer Risk CNRS(i,p,t)\*\*\* for Initially Existent Radionuclides (i) and Pathways (p)  
and Fraction of Total Risk at t= 3.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

| Radio-Nuclide | Ground    |        | Inhalation |        | Radon       |        | Plant       |        | Meat        |        | Milk        |        | Soil      |        |
|---------------|-----------|--------|------------|--------|-------------|--------|-------------|--------|-------------|--------|-------------|--------|-----------|--------|
|               | risk      | fract. | risk       | fract. | risk        | fract. | risk        | fract. | risk        | fract. | risk        | fract. | risk      | fract. |
| U-234         | 3.032E-10 | 0.0014 | 1.951E-09  | 0.0092 | 0.0000E+000 | 0.0000 | 0.0000E+000 | 0.0000 | 0.0000E+000 | 0.0000 | 0.0000E+000 | 0.0000 | 1.270E-08 | 0.0598 |
| U-235         | 4.688E-08 | 0.2205 | 1.284E-10  | 0.0006 | 0.0000E+000 | 0.0000 | 0.0000E+000 | 0.0000 | 0.0000E+000 | 0.0000 | 0.0000E+000 | 0.0000 | 9.739E-10 | 0.0046 |
| U-238         | 1.311E-07 | 0.6170 | 1.600E-09  | 0.0075 | 0.0000E+000 | 0.0000 | 0.0000E+000 | 0.0000 | 0.0000E+000 | 0.0000 | 0.0000E+000 | 0.0000 | 1.688E-08 | 0.0794 |
| Total         | 1.783E-07 | 0.8389 | 3.680E-09  | 0.0173 | 0.0000E+000 | 0.0000 | 0.0000E+000 | 0.0000 | 0.0000E+000 | 0.0000 | 0.0000E+000 | 0.0000 | 3.056E-08 | 0.1438 |

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T<sub>1/2</sub> Limit = 180 days

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Total Excess Cancer Risk CNRS(i,p,t)\*\*\* for Initially Existent Radionuclides (i) and Pathways (p)  
and Fraction of Total Risk at t= 3.000E+00 years

Water Dependent Pathways

| Radio-Nuclide | Water     |        | Fish      |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | All pathways |        |
|---------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|--------------|--------|
|               | risk      | fract. | risk         | fract. |
| U-234         | 0.000E+00 | 0.0000 | 1.496E-08    | 0.0704 |
| U-235         | 0.000E+00 | 0.0000 | 4.798E-08    | 0.2257 |
| U-238         | 0.000E+00 | 0.0000 | 1.496E-07    | 0.7039 |
| Total         | 0.000E+00 | 0.0000 | 2.126E-07    | 1.0000 |

\*\*\*CNRSI(i,p,t) includes contribution from decay daughter radionuclides

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Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
As pCi/yr at t= 1.000E+01 years

| Radio-Nuclide | Water Independent Pathways (Inhalation w/o radon) |           |           |           |           | Water Dependent Pathways |           |           |           |           | Total Ingestion* |
|---------------|---|-----------|-----------|-----------|-----------|--------------------------|-----------|-----------|-----------|-----------|------------------|
|               | Inhalation  | Plant     | Meat      | Milk      | Soil      | Water                    | Fish      | Plant     | Meat      | Milk      |                  |
| Ac-227        | 1.541E-08   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 7.237E-06 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 7.237E-06        |
| Pa-231        | 1.077E-07   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 5.058E-05 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 5.058E-05        |
| Pb-210        | 1.289E-10   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 6.057E-08 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 6.057E-08        |
| Ra-226        | 1.342E-09   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 6.304E-07 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 6.304E-07        |
| Th-230        | 6.208E-07   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 2.916E-04 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 2.916E-04        |
| U-234         | 6.872E-03   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 3.228E+00 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 3.228E+00        |
| U-235         | 5.090E-04   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 2.391E-01 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 2.391E-01        |
| U-238         | 6.872E-03   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 3.228E+00 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 3.228E+00        |

\* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil  
and water-dependent water, fish, plant, meat, milk pathways

0

Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of  
Radon and its Decay Products as pCi/yr at t= 1.000E+01 years

0

| Radon Pathway | Rn-222    | Po-218    | Pb-214    | Bi-214    | Rn-220    | Po-216    | Pb-212    | Bi-212    |
|---------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| Water-ind.    | 0.000E+00 |
| Water-dep.    | 0.000E+00 |
| Total         | 0.000E+00 |

Water-ind. == Water-independent      Water-dep. == Water-dependent

0

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
and Fraction of Total Risk at t= 1.000E+01 years

0

| Radio-Nuclide | Water Independent Pathways (Inhalation excludes radon) |        |            |        |           |        |           |        |           |        |           |        |
|---------------|--|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|               | Ground   |        | Inhalation |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|               | risk   | fract. | risk       | fract. | risk      | fract. | risk      | fract. | risk      | fract. | risk      | fract. |
| Ac-227        | 1.796E-11  | 0.0001 | 3.769E-13  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 9.854E-13 | 0.0000 |
| Pa-231        | 5.636E-12  | 0.0000 | 2.727E-13  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.053E-12 | 0.0000 |
| Pb-210        | 1.208E-15  | 0.0000 | 5.818E-16  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 5.237E-14 | 0.0000 |
| Ra-226        | 1.060E-11  | 0.0001 | 2.146E-15  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.367E-14 | 0.0000 |
| Th-230        | 1.952E-13  | 0.0000 | 9.899E-13  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.296E-12 | 0.0000 |
| U-234         | 2.961E-10  | 0.0014 | 1.941E-09  | 0.0092 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.264E-08 | 0.0597 |
| U-235         | 4.663E-08  | 0.2204 | 1.274E-10  | 0.0006 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 9.678E-10 | 0.0046 |
| U-238         | 1.305E-07  | 0.6169 | 1.592E-09  | 0.0075 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.680E-08 | 0.0794 |
| Total         | 1.775E-07  | 0.8389 | 3.662E-09  | 0.0173 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.041E-08 | 0.1438 |

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T<sub>1/2</sub> Limit = 180 days

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Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
and Fraction of Total Risk at t= 1.000E+01 years

Water Dependent Pathways

| Radio-Nuclide | Water     |        | Fish      |        | Plant     |        | Meat      |        | Milk      |        | All Pathways** |        |
|---------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|----------------|--------|
|               | risk      | fract. | risk           | fract. |
| Ac-227        | 0.000E+00 | 0.0000 | 1.932E-11      | 0.0001 |
| Pa-231        | 0.000E+00 | 0.0000 | 6.962E-12      | 0.0000 |
| Pb-210        | 0.000E+00 | 0.0000 | 5.416E-14      | 0.0000 |
| Ra-226        | 0.000E+00 | 0.0000 | 1.067E-11      | 0.0001 |
| Th-230        | 0.000E+00 | 0.0000 | 4.481E-12      | 0.0000 |
| U-234         | 0.000E+00 | 0.0000 | 1.487E-08      | 0.0703 |
| U-235         | 0.000E+00 | 0.0000 | 4.772E-08      | 0.2256 |
| U-238         | 0.000E+00 | 0.0000 | 1.489E-07      | 0.7039 |
| Total         | 0.000E+00 | 0.0000 | 2.115E-07      | 1.0000 |

\*\* Sum of water independent ground, inhalation, plant, meat, milk, soil  
and water dependent water, fish, plant, meat, milk pathways

0

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of  
Radon and its Decay Products at t= 1.000E+01 years

0

| Radionuclides |           |           |           |           |           |           |           |           |
|---------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| Radon Pathway | Rn-222    | Po-218    | Pb-214    | Bi-214    | Rn-220    | Po-216    | Pb-212    | Bi-212    |
| Water-ind.    | 0.000E+00 |
| Water-dep.    | 0.000E+00 |
| Total         | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+0C | 0.000E+00 | 0.000E+00 | 0.000E+00 |

Water-ind. == Water-independent      Water-dep. == Water-dependent

0

Total Excess Cancer Risk CNRS(i,p,t)\*\*\* for Initially Existing Radionuclides (i) and Pathways (p)  
and Fraction of Total Risk at t= 1.000E+01 years

0

Water Independent Pathways (Inhalation excludes radon)

0

| Radio-Nuclide | Ground    |        | Inhalation |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|---------------|-----------|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|               | risk      | fract. | risk       | fract. | risk      | fract. | risk      | fract. | risk      | fract. | risk      | fract. | risk      | fract. |
| U-234         | 3.069E-10 | 0.0015 | 1.942E-09  | 0.0092 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.264E-08 | 0.0598 |
| U-235         | 4.665E-08 | 0.2206 | 1.281E-10  | 0.0006 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 9.698E-10 | 0.0046 |
| U-238         | 1.305E-07 | 0.6169 | 1.592E-09  | 0.0075 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.680E-08 | 0.0794 |
| Total         | 1.775E-07 | 0.8389 | 3.662E-09  | 0.0173 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.041E-08 | 0.1438 |

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T<sub>1/2</sub> Limit = 180 days

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Total Excess Cancer Risk CNRS(i,p,t)\*\*\* for Initially Existent Radionuclides (i) and Pathways (p)  
 and Fraction of Total Risk at t= 1.000E+01 years

## Water Dependent Pathways

| Radio-Nuclide | Water     |        | Fish      |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | All pathways |        |
|---------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|--------------|--------|
|               | risk      | fract. | risk         | fract. |
| U-234         | 0.000E+00 | 0.0000 | 1.489E-08    | 0.0704 |
| U-235         | 0.000E+00 | 0.0000 | 4.775E-08    | 0.2257 |
| U-238         | 0.000E+00 | 0.0000 | 1.489E-07    | 0.7039 |
| Total         | 0.000E+00 | 0.0000 | 2.115E-07    | 1.0000 |

\*\*\*CNRSI(i,p,t) includes contribution from decay daughter radionuclides

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Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
As pCi/yr at t = 3.000E+01 years

| Radio-Nuclide | Water Independent Pathways (Inhalation w/o radon) |           |           |           |           | Water Dependent Pathways |           |           |           |           | Total Ingestion* |
|---------------|---|-----------|-----------|-----------|-----------|--------------------------|-----------|-----------|-----------|-----------|------------------|
|               | Inhalation  | Plant     | Meat      | Milk      | Soil      | Water                    | Fish      | Plant     | Meat      | Milk      |                  |
| Ac-227        | 1.123E-07   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 5.275E-05 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 5.275E-05        |
| Pa-231        | 3.184E-07   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 1.496E-04 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 1.496E-04        |
| Pb-210        | 2.990E-09   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 1.405E-06 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 1.405E-06        |
| Ra-226        | 1.194E-08   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 5.611E-06 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 5.611E-06        |
| Th-230        | 1.849E-06   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 8.685E-04 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 8.685E-04        |
| U-234         | 6.774E-03   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 3.182E+00 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 3.182E+00        |
| U-235         | 5.018E-04   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 2.357E-01 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 2.357E-01        |
| U-238         | 6.774E-03   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 3.182E+00 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 3.182E+00        |

\* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil  
and water-dependent water, fish, plant, meat, milk pathways

0 Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of  
Radon and its Decay Products as pCi/yr at t = 3.000E+01 years

| Radon Pathway | Rn-222    | Po-218    | Pb-214    | Bi-214    | Rn-220    | Po-216    | Pb-212    | Bi-212    |
|---------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| Water-ind.    | 0.000E+00 |
| Water-dep.    | 0.000E+00 |
| Total         | 0.000E+00 |

Water-ind. == Water-independent Water-dep. == Water-dependent

0 Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
and Fraction of Total Risk at t = 3.000E+01 years

| Radio-Nuclide | Water Independent Pathways (Inhalation excludes radon) |        |            |        |           |        |           |        |           |        |           |        |
|---------------|--|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|               | Ground   |        | Inhalation |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|               | risk   | fract. | risk       | fract. | risk      | fract. | risk      | fract. | risk      | fract. | risk      | fract. |
| Ac-227        | 5.010E-11  | 0.0002 | 1.051E-12  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.749E-12 | 0.0000 |
| Pa-231        | 1.050E-11  | 0.0001 | 5.080E-13  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.962E-12 | 0.0000 |
| Pb-210        | 5.960E-15  | 0.0000 | 2.871E-15  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.585E-13 | 0.0000 |
| Ra-226        | 3.494E-11  | 0.0002 | 7.073E-15  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.098E-13 | 0.0000 |
| Th-230        | 3.661E-13  | 0.0000 | 1.857E-12  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.183E-12 | 0.0000 |
| U-234         | 2.919E-10  | 0.0014 | 1.913E-09  | 0.0092 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.246E-08 | 0.0597 |
| U-235         | 4.597E-08  | 0.2204 | 1.256E-10  | 0.0006 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 9.541E-10 | 0.0046 |
| U-238         | 1.286E-07  | 0.6167 | 1.570E-09  | 0.0075 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.656E-08 | 0.0794 |
| Total         | 1.750E-07  | 0.8389 | 3.612E-09  | 0.0173 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.998E-08 | 0.1437 |

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T<sub>1/2</sub> Limit = 180 days

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Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
and Fraction of Total Risk at t= 3.000E+01 years

Water Dependent Pathways

| Radio-Nuclide | Water     |        | Fish      |        | Plant     |        | Meat      |        | Milk      |        | All Pathways** |        |
|---------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|----------------|--------|
|               | risk      | fract. | risk           | fract. |
| Ac-227        | 0.000E+00 | 0.0000 | 5.390E-11      | 0.0003 |
| Pa-231        | 0.000E+00 | 0.0000 | 1.297E-11      | 0.0001 |
| Pb-210        | 0.000E+00 | 0.0000 | 2.673E-13      | 0.0000 |
| Ra-226        | 0.000E+00 | 0.0000 | 3.515E-11      | 0.0002 |
| Th-230        | 0.000E+00 | 0.0000 | 8.406E-12      | 0.0000 |
| U-234         | 0.000E+00 | 0.0000 | 1.466E-08      | 0.0703 |
| U-235         | 0.000E+00 | 0.0000 | 4.705E-08      | 0.2255 |
| U-238         | 0.000E+00 | 0.0000 | 1.468E-07      | 0.7036 |
| Total         | 0.000E+00 | 0.0000 | 2.086E-07      | 1.0000 |

\*\* Sum of water independent ground, inhalation, plant, meat, milk, soil  
and water dependent water, fish, plant, meat, milk pathways

0

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of  
Radon and its Decay Products at t= 3.000E+01 years  
Radionuclides

| Radon Pathway | Rn-222    | Po-218    | Pb-214    | Bi-214    | Rn-220    | Po-216    | Pb-212    | Bi-212    |
|---------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| Water-ind.    | 0.000E+00 |
| Water-dep.    | 0.000E+00 |
| Total         | 0.000E+00 |

Water-ind. == Water-independent      Water-dep. == Water-dependent

0

Total Excess Cancer Risk CNRS(i,p,t)\*\*\* for Initially Existent Radionuclides (i) and Pathways (p)  
and Fraction of Total Risk at t= 3.000E+01 years

| Radio-Nuclide | Ground    |        | Inhalation |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|---------------|-----------|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|               | risk      | fract. | risk       | fract. | risk      | fract. | risk      | fract. | risk      | fract. | risk      | fract. | risk      | fract. |
| U-234         | 3.271E-10 | 0.0016 | 1.915E-09  | 0.0092 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.246E-08 | 0.0597 |
| U-235         | 4.603E-08 | 0.2207 | 1.272E-10  | 0.0006 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 9.588E-10 | 0.0046 |
| U-238         | 1.286E-07 | 0.6167 | 1.570E-09  | 0.0075 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.656E-08 | 0.0794 |
| Total         | 1.750E-07 | 0.8389 | 3.612E-09  | 0.0173 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.998E-08 | 0.1437 |

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T<sub>1/2</sub> Limit = 180 days

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Total Excess Cancer Risk CNRS(i,p,t)\*\*\* for Initially Existent Radionuclides (i) and Pathways (p)  
 and Fraction of Total Risk at t= 3.000E+01 years

## Water Dependent Pathways

| Radio-Nuclide | Water     |        | Fish      |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | All pathways |        |
|---------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|--------------|--------|
|               | risk      | fract. | risk         | fract. |
| U-234         | 0.000E+00 | 0.0000 | 1.470E-08    | 0.0705 |
| U-235         | 0.000E+00 | 0.0000 | 4.711E-08    | 0.2259 |
| U-238         | 0.000E+00 | 0.0000 | 1.468E-07    | 0.7036 |
| Total         | 0.000E+00 | 0.0000 | 2.086E-07    | 1.0000 |

\*\*\*CNRSI(i,p,t) includes contribution from decay daughter radionuclides

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Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
As pCi/yr at t= 1.000E+02 years

| Radio-Nuclide | Water Independent Pathways (Inhalation w/o radon) |           |           |           |           | Water Dependent Pathways |           |           |           |           | Total Ingestion* |
|---------------|---|-----------|-----------|-----------|-----------|--------------------------|-----------|-----------|-----------|-----------|------------------|
|               | Inhalation  | Plant     | Meat      | Milk      | Soil      | Water                    | Fish      | Plant     | Meat      | Milk      |                  |
| Ac-227        | 6.908E-07   | 0.000E+00 | 0.000E+00 | 0.000E-00 | 3.245E-04 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 3.245E-04        |
| Pa-231        | 1.009E-06   | 0.000E+00 | 0.000E+00 | 0.000E-00 | 4.739E-04 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 4.739E-04        |
| Pb-210        | 7.099E-08   | 0.000E+00 | 0.000E+00 | 0.000E-00 | 3.335E-05 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 3.335E-05        |
| Ra-226        | 1.277E-07   | 0.000E+00 | 0.000E+00 | 0.000E-00 | 5.997E-05 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 5.997E-05        |
| Th-230        | 6.010E-06   | 0.000E+00 | 0.000E+00 | 0.000E-00 | 2.823E-03 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 2.823E-03        |
| U-234         | 6.444E-03   | 0.000E+00 | 0.000E+00 | 0.000E-00 | 3.027E+00 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 3.027E+00        |
| U-235         | 4.773E-04   | 0.000E+00 | 0.000E+00 | 0.000E-00 | 2.242E-01 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 2.242E-01        |
| U-238         | 6.444E-03   | 0.000E+00 | 0.000E+00 | 0.000E-00 | 3.027E+00 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 3.027E+00        |

\* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil  
and water-dependent water, fish, plant, meat, milk pathways

0 Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of  
Radon and its Decay Products as pCi/yr at t= 1.000E+02 years

| Radionuclides |           |           |           |           |           |           |           |           |
|---------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| Radon Pathway | Rn-222    | Po-218    | Pb-214    | Bi-214    | Rn-220    | Po-216    | Pb-212    | Bi-212    |
| Water-ind.    | 0.000E+00 |
| Water-dep.    | 0.000E+00 |
| Total         | 0.000E+00 |

Water-ind. == Water-independent      Water-dep. == Water-dependent

0 Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
and Fraction of Total Risk at t= 1.000E+02 years

| Radio-Nuclide | Water Independent Pathways (Inhalation excludes radon) |        |            |        |           |        |           |        |           |        |                  |
|---------------|--|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|------------------|
|               | Ground   |        | Inhalation |        | Plant     |        | Meat      |        | Milk      |        |                  |
|               | risk   | fract. | risk       | fract. | risk      | fract. | risk      | fract. | risk      | fract. |                  |
| Ac-227        | 1.993E-10  | 0.0010 | 4.182E-12  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.093E-11 0.0001 |
| Pa-231        | 2.644E-11  | 0.0001 | 1.279E-12  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.938E-12 0.0000 |
| Pb-210        | 6.850E-14  | 0.0000 | 3.300E-14  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.971E-12 0.0000 |
| Ra-226        | 2.300E-10  | 0.0012 | 4.657E-14  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.381E-12 0.0000 |
| Th-230        | 9.454E-13  | 0.0000 | 4.795E-12  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.596E-11 0.0001 |
| U-234         | 2.776E-10  | 0.0014 | 1.820E-09  | 0.0092 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.185E-08 0.0596 |
| U-235         | 4.372E-08  | 0.2199 | 1.195E-10  | 0.0006 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 9.075E-10 0.0046 |
| U-238         | 1.224E-07  | 0.6155 | 1.493E-09  | 0.0075 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.575E-08 0.0792 |
| Total         | 1.668E-07  | 0.8391 | 3.443E-09  | 0.0173 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.854E-08 0.1436 |

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Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
 and Fraction of Total Risk at t= 1.000E+02 years

## Water Dependent Pathways

| Radio-Nuclide | Water     |        | Fish      |        | Plant     |        | Meat      |        | Milk      |        | All Pathways** |        |
|---------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|----------------|--------|
|               | risk      | fract. | risk           | fract. |
| Ac-227        | 0.000E+00 | 0.0000 | 2.144E-10      | 0.0011 |
| Pa-231        | 0.000E+00 | 0.0000 | 3.265E-11      | 0.0002 |
| Pb-210        | 0.000E+00 | 0.0000 | 3.072E-12      | 0.0000 |
| Ra-226        | 0.000E+00 | 0.0000 | 2.315E-10      | 0.0012 |
| Th-230        | 0.000E+00 | 0.0000 | 2.170E-11      | 0.0001 |
| U-234         | 0.000E+00 | 0.0000 | 1.395E-08      | 0.0702 |
| U-235         | 0.000E+00 | 0.0000 | 4.475E-08      | 0.2251 |
| U-238         | 0.000E+00 | 0.0000 | 1.396E-07      | 0.7022 |
| Total         | 0.000E+00 | 0.0000 | 1.988E-07      | 1.0000 |

\*\* Sum of water independent ground, inhalation, plant, meat, milk, soil  
 and water dependent water, fish, plant, meat, milk pathways

0  
 Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of  
 Radon and its Decay Products at t= 1.000E+02 years

| Radon Pathway | Rn-222    | Po-218    | Pb-214    | Bi-214    | Rn-220    | Po-216    | Pb-212    | Bi-212    |
|---------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| Water-ind.    | 0.000E+00 |
| Water-dep.    | 0.000E+00 |
| Total         | 0.000E+00 |

Water-ind. == Water-independent      Water-dep. == Water-dependent

0  
 Total Excess Cancer Risk CNRS(i,p,t)\*\*\* for Initially Existent Radionuclides (i) and Pathways (p)  
 and Fraction of Total Risk at t= 1.000E+02 years

| Radio-Nuclide | Water Independent Pathways (Inhalation excludes radon) |        |           |        | Ground    |        |           |        | Inhalation |        |           |        | Radon     |        |           |        | Plant     |        |           |        | Meat      |        |           |        | Milk      |        |      |        | Soil |  |  |  |
|---------------|--|--------|-----------|--------|-----------|--------|-----------|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|------|--------|------|--|--|--|
|               | risk   | fract. | risk      | fract. | risk      | fract. | risk      | fract. | risk       | fract. | risk      | fract. | risk      | fract. | risk      | fract. | risk      | fract. | risk      | fract. | risk      | fract. | risk      | fract. | risk      | fract. | risk | fract. |      |  |  |  |
| U-234         | 5.086E-10  | 0.0026 | 1.824E-09 | 0.0092 | 0.000E+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 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.187E-08 | 0.0597 |      |        |      |  |  |  |
| U-235         | 4.395E-08  | 0.2211 | 1.249E-10 | 0.0006 | 0.000E+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 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 9.234E-10 | 0.0046 |      |        |      |  |  |  |
| U-238         | 1.224E-07  | 0.6155 | 1.494E-09 | 0.0075 | 0.000E+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 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.575E-08 | 0.0792 |      |        |      |  |  |  |
| Total         | 1.668E-07  | 0.8391 | 3.443E-09 | 0.0173 | 0.000E+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 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.854E-08 | 0.1436 |      |        |      |  |  |  |

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Total Excess Cancer Risk CNRS(i,p,t)\*\*\* for Initially Existent Radionuclides (i) and Pathways (p)  
 and Fraction of Total Risk at t= 1.000E+02 years

## Water Dependent Pathways

| Radio-Nuclide | Water     |        | Fish      |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | All pathways |        |
|---------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|--------------|--------|
|               | risk      | fract. | risk         | fract. |
| U-234         | 0.000E+00 | 0.0000 | 1.420E-08    | 0.0714 |
| U-235         | 0.000E+00 | 0.0000 | 4.500E-08    | 0.2263 |
| U-238         | 0.000E+00 | 0.0000 | 1.396E-07    | 0.7022 |
| Total         | 0.000E+00 | 0.0000 | 1.988E-07    | 1.0000 |

\*\*\*CNRSI(i,p,t) includes contribution from decay daughter radionuclides

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Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
As pCi/yr at t = 3.000E+02 years

| Radio-Nuclide | Water Independent Pathways (Inhalation w/o radon) |           |           |           |           | Water Dependent Pathways |           |           |           |           | Total Ingestion* |
|---------------|---|-----------|-----------|-----------|-----------|--------------------------|-----------|-----------|-----------|-----------|------------------|
|               | Inhalation  | Plant     | Meat      | Milk      | Soil      | Water                    | Fish      | Plant     | Meat      | Milk      |                  |
| Ac-227        | 2.278E-06   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 1.070E-03 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 1.070E-03        |
| Pa-231        | 2.618E-06   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 1.230E-03 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 1.230E-03        |
| Pb-210        | 8.365E-07   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 3.929E-04 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 3.929E-04        |
| Ra-226        | 1.030E-06   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 4.837E-04 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 4.837E-04        |
| Th-230        | 1.680E-05   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 7.890E-03 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 7.890E-03        |
| U-234         | 5.585E-03   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 2.624E+00 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 2.624E+00        |
| U-235         | 4.137E-04   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 1.943E-01 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 1.943E-01        |
| U-238         | 5.585E-03   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 2.624E+00 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 2.624E+00        |

\* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil  
and water-dependent water, fish, plant, meat, milk pathways

0

Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of  
Radon and its Decay Products as pCi/yr at t = 3.000E+02 years

0

| Radon Pathway | Rn-222    | Po-218    | Pb-214    | Bi-214    | Rn-220    | Po-216    | Pb-212    | Bi-212    |
|---------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| Water-ind.    | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+0C | 0.000E+00 |
| Water-dep.    | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+0C | 0.000E+00 |
| Total         | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+0C | 0.000E+00 |

Water-ind. == Water-independent      Water-dep. == Water-dependent

0

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
and Fraction of Total Risk at t = 3.000E+02 years

0

| Radio-Nuclide | Water Independent Pathways (Inhalation excludes radon) |        |            |        |           |        |           |        |           |        |           |        |
|---------------|--|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|               | Ground   |        | Inhalation |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|               | risk   | fract. | risk       | fract. | risk      | fract. | risk      | fract. | risk      | fract. | risk      | fract. |
| Ac-227        | 5.870E-10  | 0.0034 | 1.232E-11  | 0.0001 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.221E-11 | 0.0002 |
| Pa-231        | 6.353E-11  | 0.0004 | 3.074E-12  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.187E-11 | 0.0001 |
| Pb-210        | 6.556E-13  | 0.0000 | 3.158E-13  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.843E-11 | 0.0002 |
| Ra-226        | 1.586E-09  | 0.0091 | 3.210E-13  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 9.521E-12 | 0.0001 |
| Th-230        | 2.447E-12  | 0.0000 | 1.241E-11  | 0.0001 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.132E-11 | 0.0002 |
| U-234         | 2.406E-10  | 0.0014 | 1.578E-09  | 0.0091 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.027E-08 | 0.0589 |
| U-235         | 3.790E-08  | 0.2175 | 1.036E-10  | 0.0006 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 7.866E-10 | 0.0045 |
| U-238         | 1.061E-07  | 0.6086 | 1.294E-09  | 0.0074 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.365E-08 | 0.0783 |
| Total         | 1.464E-07  | 0.8403 | 3.004E-09  | 0.0172 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.483E-08 | 0.1425 |

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Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
and Fraction of Total Risk at t= 3.000E+02 years

Water Dependent Pathways

| Radio-Nuclide | Water       |        | Fish        |        | Plant       |        | Meat        |        | Milk        |        | All Pathways** |        |
|---------------|-------------|--------|-------------|--------|-------------|--------|-------------|--------|-------------|--------|----------------|--------|
|               | risk        | fract. | risk           | fract. |
| Ac-227        | 0.0000E+000 | 0.0000 | 6.316E-10      | 0.0036 |
| Pa-231        | 0.0000E+000 | 0.0000 | 7.847E-11      | 0.0005 |
| Pb-210        | 0.0000E+000 | 0.0000 | 2.940E-11      | 0.0002 |
| Ra-226        | 0.0000E+000 | 0.0000 | 1.595E-09      | 0.0092 |
| Th-230        | 0.0000E+000 | 0.0000 | 5.618E-11      | 0.0003 |
| U-234         | 0.0000E+000 | 0.0000 | 1.209E-08      | 0.0694 |
| U-235         | 0.0000E+000 | 0.0000 | 3.879E-08      | 0.2226 |
| U-238         | 0.0000E+000 | 0.0000 | 1.210E-07      | 0.6943 |
| Total         | 0.0000E+000 | 0.0000 | 1.743E-07      | 1.0000 |

\*\* Sum of water independent ground, inhalation, plant, meat, milk, soil  
and water dependent water, fish, plant, meat, milk pathways

0

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of  
Radon and its Decay Products at t= 3.000E+02 years  
Radionuclides

| Radon Pathway | Rn-222      | Po-218      | Pb-214      | Bi-214      | Rn-220      | Po-216      | Pb-212      | Bi-212      |
|---------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| Water-ind.    | 0.0000E+000 |
| Water-dep.    | 0.0000E+000 |
| Total         | 0.0000E+000 |

Water-ind. == Water-independent      Water-dep. == Water-dependent

0

Total Excess Cancer Risk CNRS(i,p,t)\*\*\* for Initially Existent Radionuclides (i) and Pathways (p)  
and Fraction of Total Risk at t= 3.000E+02 years

| Radio-Nuclide | Ground     |        | Inhalation |        | Radon       |        | Plant       |        | Meat        |        | Milk        |        | Soil       |        |
|---------------|------------|--------|------------|--------|-------------|--------|-------------|--------|-------------|--------|-------------|--------|------------|--------|
|               | risk       | fract. | risk       | fract. | risk        | fract. | risk        | fract. | risk        | fract. | risk        | fract. | risk       | fract. |
| U-234         | 1.829E-009 | 0.0105 | 1.589E-009 | 0.0091 | 0.0000E+000 | 0.0000 | 0.0000E+000 | 0.0000 | 0.0000E+000 | 0.0000 | 0.0000E+000 | 0.0000 | 1.034E-008 | 0.0593 |
| U-235         | 3.855E-008 | 0.2212 | 1.189E-10  | 0.0007 | 0.0000E+000 | 0.0000 | 0.0000E+000 | 0.0000 | 0.0000E+000 | 0.0000 | 0.0000E+000 | 0.0000 | 8.307E-10  | 0.0048 |
| U-238         | 1.061E-007 | 0.6086 | 1.295E-009 | 0.0074 | 0.0000E+000 | 0.0000 | 0.0000E+000 | 0.0000 | 0.0000E+000 | 0.0000 | 0.0000E+000 | 0.0000 | 1.366E-008 | 0.0784 |
| Total         | 1.464E-007 | 0.8403 | 3.004E-009 | 0.0172 | 0.0000E+000 | 0.0000 | 0.0000E+000 | 0.0000 | 0.0000E+000 | 0.0000 | 0.0000E+000 | 0.0000 | 2.483E-008 | 0.1425 |

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Total Excess Cancer Risk CNRS(i,p,t)\*\*\* for Initially Existent Radionuclides (i) and Pathways (p)  
and Fraction of Total Risk at t= 3.000E+02 years

Water Dependent Pathways

| Radio-Nuclide | Water     |        | Fish      |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | All pathways |        |
|---------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|--------------|--------|
|               | risk      | fract. | risk         | fract. |
| U-234         | 0.000E+00 | 0.0000 | 1.376E-08    | 0.0789 |
| U-235         | 0.000E+00 | 0.0000 | 3.950E-08    | 0.2266 |
| U-238         | 0.000E+00 | 0.0000 | 1.210E-07    | 0.6944 |
| Total         | 0.000E+00 | 0.0000 | 1.743E-07    | 1.0000 |

\*\*\*CNRSI(i,p,t) includes contribution from decay daughter radionuclides

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
As pCi/yr at t= 1.000E+03 years

| Radio-Nuclide | Water Independent Pathways (Inhalation w/o radon) |           |           |           |           | Water Dependent Pathways |           |           |           |           | Total Ingestion* |
|---------------|---|-----------|-----------|-----------|-----------|--------------------------|-----------|-----------|-----------|-----------|------------------|
|               | Inhalation  | Plant     | Meat      | Milk      | Soil      | Water                    | Fish      | Plant     | Meat      | Milk      |                  |
| Ac-227        | 4.930E-06   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 2.316E-03 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 2.316E-03        |
| Pa-231        | 5.252E-06   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 2.467E-03 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 2.467E-03        |
| Pb-210        | 7.440E-06   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 3.495E-03 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 3.495E-03        |
| Ra-226        | 7.896E-06   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 3.709E-03 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 3.709E-03        |
| Th-230        | 4.428E-05   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 2.080E-02 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 2.080E-02        |
| U-234         | 3.387E-03   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 1.591E+00 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 1.591E+00        |
| U-235         | 2.509E-04   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 1.178E-01 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 1.178E-01        |
| U-238         | 3.387E-03   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 1.591E+00 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 1.591E+00        |

\* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil  
and water-dependent water, fish, plant, meat, milk pathways

0 Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of  
Radon and its Decay Products as pCi/yr at t= 1.000E+03 years

| Radon Pathway | Radionuclides |           |           |           |           |           |           |           |
|---------------|---------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
|               | Rn-222        | Po-218    | Pb-214    | Bi-214    | Rn-220    | Po-216    | Pb-212    | Bi-212    |
| Water-ind.    | 0.000E+00     | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 |
| Water-dep.    | 0.000E+00     | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 |
| Total         | 0.000E+00     | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 |

Water-ind. == Water-independent      Water-dep. == Water-dependent

0 Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
and Fraction of Total Risk at t= 1.000E+03 years

| Radio-Nuclide | Water Independent Pathways (Inhalation excludes radon) |        |            |        |           |        |           |        |           |        |           |        |
|---------------|--|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|               | Ground   |        | Inhalation |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|               | risk   | fract. | risk       | fract. | risk      | fract. | risk      | fract. | risk      | fract. | risk      | fract. |
| Ac-227        | 1.230E-09  | 0.0105 | 2.581E-11  | 0.0002 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.749E-11 | 0.0006 |
| Pa-231        | 1.239E-10  | 0.0011 | 5.994E-12  | 0.0001 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.314E-11 | 0.0002 |
| Pb-210        | 5.466E-12  | 0.0000 | 2.633E-12  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.370E-10 | 0.0020 |
| Ra-226        | 1.149E-08  | 0.0976 | 2.325E-12  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.897E-11 | 0.0006 |
| Th-230        | 6.272E-12  | 0.0001 | 3.181E-11  | 0.0003 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.059E-10 | 0.0009 |
| U-234         | 1.459E-10  | 0.0012 | 9.566E-10  | 0.0081 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.228E-09 | 0.0529 |
| U-235         | 2.298E-08  | 0.1953 | 6.279E-11  | 0.0005 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.770E-10 | 0.0041 |
| U-238         | 6.431E-08  | 0.5466 | 7.847E-10  | 0.0067 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 8.278E-09 | 0.0704 |
| Total         | 1.003E-07  | 0.8525 | 1.873E-09  | 0.0159 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.549E-08 | 0.1316 |

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Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
and Fraction of Total Risk at t= 1.000E+03 years

## Water Dependent Pathways

| Radio-Nuclide | Water     |        | Fish      |        | Plant     |        | Meat      |        | Milk      |        | All Pathways** |        |
|---------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|----------------|--------|
|               | risk      | fract. | risk           | fract. |
| Ac-227        | 0.000E+00 | 0.0000 | 1.324E-09      | 0.0112 |
| Pa-231        | 0.000E+00 | 0.0000 | 1.530E-10      | 0.0013 |
| Pb-210        | 0.000E+00 | 0.0000 | 2.451E-10      | 0.0021 |
| Ra-226        | 0.000E+00 | 0.0000 | 1.156E-08      | 0.0982 |
| Th-230        | 0.000E+00 | 0.0000 | 1.440E-10      | 0.0012 |
| U-234         | 0.000E+00 | 0.0000 | 7.331E-09      | 0.0623 |
| U-235         | 0.000E+00 | 0.0000 | 2.352E-08      | 0.1999 |
| U-238         | 0.000E+00 | 0.0000 | 7.338E-08      | 0.6237 |
| Total         | 0.000E+00 | 0.0000 | 1.177E-07      | 1.0000 |

\*\* Sum of water independent ground, inhalation, plant, meat, milk, soil  
and water dependent water, fish, plant, meat, milk pathways

0

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of  
Radon and its Decay Products at t= 1.000E+03 years  
Radionuclides

| Radon Pathway | Rn-222    | Po-218    | Pb-214    | Bi-214    | Rn-220    | Po-216    | Pb-212    | Bi-212    |
|---------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| Water-ind.    | 0.000E+00 |
| Water-dep.    | 0.000E+00 |
| Total         | 0.000E+00 |

Water-ind. == Water-independent      Water-dep. == Water-dependent

0

Total Excess Cancer Risk CNRS(i,p,t)\*\*\* for Initially Existent Radionuclides (i) and Pathways (p)  
and Fraction of Total Risk at t= 1.000E+03 years

0

## Water Independent Pathways (Inhalation excludes radon)

| Radio-Nuclide | Ground    |        | Inhalation |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|---------------|-----------|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|               | risk      | fract. | risk       | fract. | risk      | fract. | risk      | fract. | risk      | fract. | risk      | fract. | risk      | fract. |
| U-234         | 1.163E-08 | 0.0989 | 9.906E-10  | 0.0084 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.622E-09 | 0.0563 |
| U-235         | 2.433E-08 | 0.2068 | 9.460E-11  | 0.0008 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 5.676E-10 | 0.0048 |
| U-238         | 6.432E-08 | 0.5467 | 7.875E-10  | 0.0067 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 8.297E-09 | 0.0705 |
| Total         | 1.003E-07 | 0.8525 | 1.873E-09  | 0.0159 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.549E-08 | 0.1316 |

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T<sub>1/2</sub> Limit = 180 days

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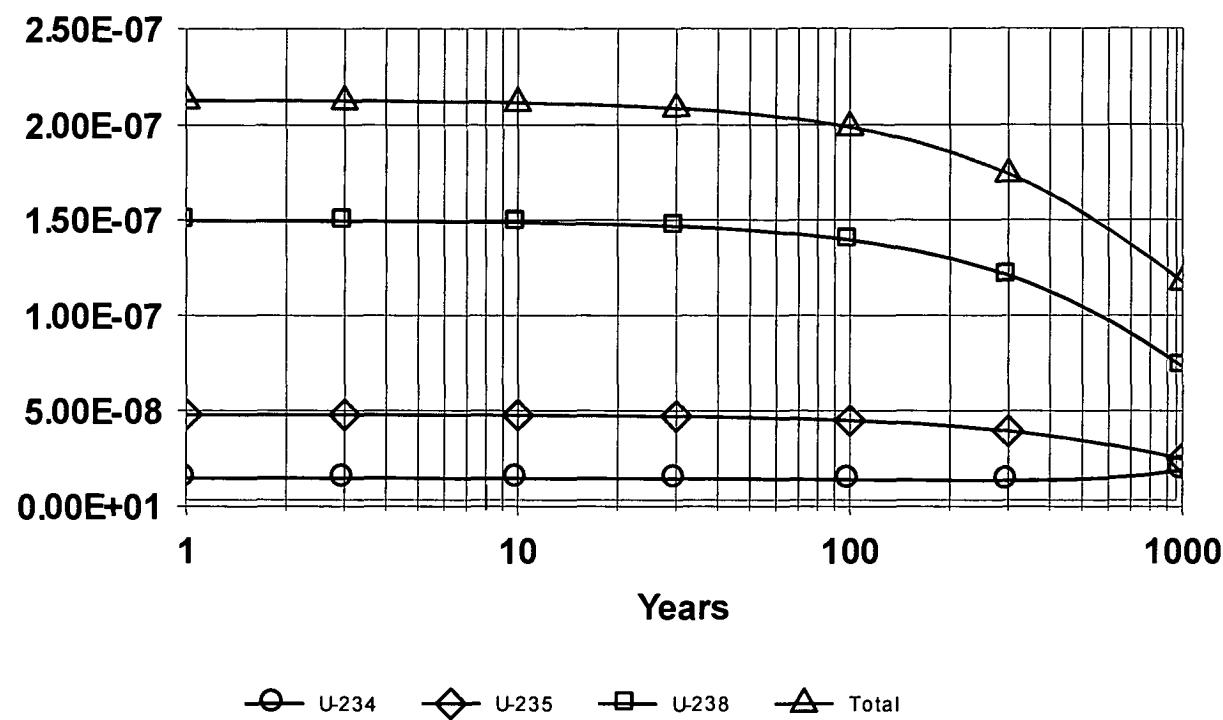
Total Excess Cancer Risk CNRS(i,p,t)\*\*\* for Initially Existent Radionuclides (i) and Pathways (p)  
and Fraction of Total Risk at t= 1.000E+03 years

## Water Dependent Pathways

| Radio-Nuclide | Water     |        | Fish      |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | All pathways |        |
|---------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|--------------|--------|
|               | risk      | fract. | risk         | fract. |
| U-234         | 0.000E+00 | 0.0000 | 1.925E-08    | 0.1636 |
| U-235         | 0.000E+00 | 0.0000 | 2.500E-08    | 0.2125 |
| U-238         | 0.000E+00 | 0.0000 | 7.341E-08    | 0.6240 |
| Total         | 0.000E+00 | 0.0000 | 1.177E-07    | 1.0000 |

\*\*\*CNRSI(i,p,t) includes contribution from decay daughter radionuclides

## EXCESS CANCER RISK: All Nuclides Summed, All Pathways Summed



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Includes All Pathways

DT-34 Utility Worker  
RESRAD Dose Summary

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Dose Conversion Factor (and Related) Parameter Summary  
Dose Library: FGR 12 & FGR 11

| 0<br>Menu | Parameter  | Current<br>Value# | Base<br>Case* | Parameter<br>Name |
|-----------|--|-------------------|---------------|-------------------|
| A-1       | DCF's for external ground radiation, (mrem/yr)/(pCi/g) |                   |               |                   |
| A-1       | Ac-227 (Source: FGR 12)                                | 4.951E-04         | 4.951E-04     | DCF1( 1)          |
| A-1       | At-218 (Source: FGR 12)                                | 5.847E-03         | 5.847E-03     | DCF1( 2)          |
| A-1       | Bi-210 (Source: FGR 12)                                | 3.606E-03         | 3.606E-03     | DCF1( 3)          |
| A-1       | Bi-211 (Source: FGR 12)                                | 2.559E-01         | 2.559E-01     | DCF1( 4)          |
| A-1       | Bi-214 (Source: FGR 12)                                | 9.808E+00         | 9.808E+00     | DCF1( 5)          |
| A-1       | Fr-223 (Source: FGR 12)                                | 1.980E-01         | 1.980E-01     | DCF1( 6)          |
| A-1       | Pa-231 (Source: FGR 12)                                | 1.906E-01         | 1.906E-01     | DCF1( 7)          |
| A-1       | Pa-234 (Source: FGR 12)                                | 1.155E+01         | 1.155E+01     | DCF1( 8)          |
| A-1       | Pa-234m (Source: FGR 12)                               | 8.967E-02         | 8.967E-02     | DCF1( 9)          |
| A-1       | Pb-210 (Source: FGR 12)                                | 2.447E-03         | 2.447E-03     | DCF1( 10)         |
| A-1       | Pb-211 (Source: FGR 12)                                | 3.064E-01         | 3.064E-01     | DCF1( 11)         |
| A-1       | Pb-214 (Source: FGR 12)                                | 1.341E+00         | 1.341E+00     | DCF1( 12)         |
| A-1       | Po-210 (Source: FGR 12)                                | 5.231E-05         | 5.231E-05     | DCF1( 13)         |
| A-1       | Po-211 (Source: FGR 12)                                | 4.764E-02         | 4.764E-02     | DCF1( 14)         |
| A-1       | Po-214 (Source: FGR 12)                                | 5.138E-04         | 5.138E-04     | DCF1( 15)         |
| A-1       | Po-215 (Source: FGR 12)                                | 1.016E-03         | 1.016E-03     | DCF1( 16)         |
| A-1       | Po-218 (Source: FGR 12)                                | 5.642E-05         | 5.642E-05     | DCF1( 17)         |
| A-1       | Ra-223 (Source: FGR 12)                                | 6.034E-01         | 6.034E-01     | DCF1( 18)         |
| A-1       | Ra-226 (Source: FGR 12)                                | 3.176E-02         | 3.176E-02     | DCF1( 19)         |
| A-1       | Rn-219 (Source: FGR 12)                                | 3.083E-01         | 3.083E-01     | DCF1( 20)         |
| A-1       | Rn-222 (Source: FGR 12)                                | 2.354E-03         | 2.354E-03     | DCF1( 21)         |
| A-1       | Th-227 (Source: FGR 12)                                | 5.212E-01         | 5.212E-01     | DCF1( 22)         |
| A-1       | Th-230 (Source: FGR 12)                                | 1.209E-03         | 1.209E-03     | DCF1( 23)         |
| A-1       | Th-231 (Source: FGR 12)                                | 3.643E-02         | 3.643E-02     | DCF1( 24)         |
| A-1       | Th-234 (Source: FGR 12)                                | 2.410E-02         | 2.410E-02     | DCF1( 25)         |
| A-1       | Tl-207 (Source: FGR 12)                                | 1.980E-02         | 1.980E-02     | DCF1( 26)         |
| A-1       | Tl-210 (Source: no data)                               | 0.000E+00         | -2.000E+00    | DCF1( 27)         |
| A-1       | U-234 (Source: FGR 12)                                 | 4.017E-04         | 4.017E-04     | DCF1( 28)         |
| A-1       | U-235 (Source: FGR 12)                                 | 7.211E-01         | 7.211E-01     | DCF1( 29)         |
| A-1       | U-238 (Source: FGR 12)                                 | 1.031E-04         | 1.031E-04     | DCF1( 30)         |
| B-1       | Dose conversion factors for inhalation, mrem/pCi:      |                   |               |                   |
| B-1       | Ac-227+D   | 6.724E+00         | 6.700E+00     | DCF2( 1)          |
| B-1       | Pa-231   | 1.280E+00         | 1.280E+00     | DCF2( 2)          |
| B-1       | Pb-210+D   | 2.320E-02         | 1.360E-02     | DCF2( 3)          |
| B-1       | Ra-226+D   | 8.594E-03         | 8.580E-03     | DCF2( 4)          |
| B-1       | Th-230   | 3.260E-01         | 3.260E-01     | DCF2( 5)          |
| B-1       | U-234  | 1.320E-01         | 1.320E-01     | DCF2( 6)          |
| B-1       | U-235+D  | 1.230E-01         | 1.230E-01     | DCF2( 7)          |
| B-1       | U-238  | 1.180E-01         | 1.180E-01     | DCF2( 8)          |
| B-1       | U-238+D  | 1.180E-01         | 1.180E-01     | DCF2( 9)          |
| D-1       | Dose conversion factors for ingestion, mrem/pCi:       |                   |               |                   |
| D-1       | Ac-227+D   | 1.480E-02         | 1.410E-02     | DCF3( 1)          |
| D-1       | Pa-231   | 1.060E-02         | 1.060E-02     | DCF3( 2)          |
| D-1       | Pb-210+D   | 7.276E-03         | 5.370E-03     | DCF3( 3)          |
| D-1       | Ra-226+D   | 1.321E-03         | 1.320E-03     | DCF3( 4)          |
| D-1       | Th-230   | 5.480E-04         | 5.480E-04     | DCF3( 5)          |
| D-1       | U-234  | 2.830E-04         | 2.830E-04     | DCF3( 6)          |

Dose Conversion Factor (and Related) Parameter Summary (continued)  
Dose Library: FGR 12 & FGR 11

| 0<br>Menu | Parameter  | Current<br>Value# | Base<br>Case* | Parameter<br>Name |
|-----------|--|-------------------|---------------|-------------------|
| D-1       | U-235+D  | 2.673E-04         | 2.660E-04     | DCF3( 7)          |
| D-1       | U-238  | 2.550E-04         | 2.550E-04     | DCF3( 8)          |
| D-1       | U-238+D  | 2.687E-04         | 2.550E-04     | DCF3( 9)          |
| D-34      | Food transfer factors:                                   |                   |               |                   |
| D-34      | Ac-227+D , plant/soil concentration ratio, dimensionless | 2.500E-03         | 2.500E-03     | RTF( 1,1)         |
| D-34      | Ac-227+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d) | 2.000E-05         | 2.000E-05     | RTF( 1,2)         |
| D-34      | Ac-227+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)  | 2.000E-05         | 2.000E-05     | RTF( 1,3)         |
| D-34      |  |                   |               |                   |
| D-34      | Pa-231 , plant/soil concentration ratio, dimensionless   | 1.000E-02         | 1.000E-02     | RTF( 2,1)         |
| D-34      | Pa-231 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)   | 5.000E-03         | 5.000E-03     | RTF( 2,2)         |
| D-34      | Pa-231 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)    | 5.000E-06         | 5.000E-06     | RTF( 2,3)         |
| D-34      |  |                   |               |                   |
| D-34      | Pb-210+D , plant/soil concentration ratio, dimensionless | 1.000E-02         | 1.000E-02     | RTF( 3,1)         |
| D-34      | Pb-210+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d) | 8.000E-04         | 8.000E-04     | RTF( 3,2)         |
| D-34      | Pb-210+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)  | 3.000E-04         | 3.000E-04     | RTF( 3,3)         |
| D-34      |  |                   |               |                   |
| D-34      | Ra-226+D , plant/soil concentration ratio, dimensionless | 4.000E-02         | 4.000E-02     | RTF( 4,1)         |
| D-34      | Ra-226+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d) | 1.000E-03         | 1.000E-03     | RTF( 4,2)         |
| D-34      | Ra-226+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)  | 1.000E-03         | 1.000E-03     | RTF( 4,3)         |
| D-34      |  |                   |               |                   |
| D-34      | Th-230 , plant/soil concentration ratio, dimensionless   | 1.000E-03         | 1.000E-03     | RTF( 5,1)         |
| D-34      | Th-230 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)   | 1.000E-04         | 1.000E-04     | RTF( 5,2)         |
| D-34      | Th-230 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)    | 5.000E-06         | 5.000E-06     | RTF( 5,3)         |
| D-34      |  |                   |               |                   |
| D-34      | U-234 , plant/soil concentration ratio, dimensionless    | 2.500E-03         | 2.500E-03     | RTF( 6,1)         |
| D-34      | U-234 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)    | 3.400E-04         | 3.400E-04     | RTF( 6,2)         |
| D-34      | U-234 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)     | 6.000E-04         | 6.000E-04     | RTF( 6,3)         |
| D-34      |  |                   |               |                   |
| D-34      | U-235+D , plant/soil concentration ratio, dimensionless  | 2.500E-03         | 2.500E-03     | RTF( 7,1)         |
| D-34      | U-235+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)  | 3.400E-04         | 3.400E-04     | RTF( 7,2)         |
| D-34      | U-235+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)   | 6.000E-04         | 6.000E-04     | RTF( 7,3)         |
| D-34      |  |                   |               |                   |
| D-34      | U-238 , plant/soil concentration ratio, dimensionless    | 2.500E-03         | 2.500E-03     | RTF( 8,1)         |
| D-34      | U-238 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)    | 3.400E-04         | 3.400E-04     | RTF( 8,2)         |
| D-34      | U-238 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)     | 6.000E-04         | 6.000E-04     | RTF( 8,3)         |
| D-34      |  |                   |               |                   |
| D-34      | U-238+D , plant/soil concentration ratio, dimensionless  | 2.500E-03         | 2.500E-03     | RTF( 9,1)         |
| D-34      | U-238+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)  | 3.400E-04         | 3.400E-04     | RTF( 9,2)         |
| D-34      | U-238+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)   | 6.000E-04         | 6.000E-04     | RTF( 9,3)         |
| D-5       | Bioaccumulation factors, fresh water, L/kg:              |                   |               |                   |
| D-5       | Ac-227+D , fish  | 1.500E+01         | 1.500E+01     | BIOFAC( 1,1)      |
| D-5       | Ac-227+D , crustacea and mollusks                        | 1.000E+03         | 1.000E+03     | BIOFAC( 1,2)      |
| D-5       |  |                   |               |                   |
| D-5       | Pa-231 , fish  | 1.000E+01         | 1.000E+01     | BIOFAC( 2,1)      |
| D-5       | Pa-231 , crustacea and mollusks                          | 1.100E+02         | 1.100E+02     | BIOFAC( 2,2)      |
| D-5       |  |                   |               |                   |
| D-5       | Pb-210+D , fish  | 3.000E+02         | 3.000E+02     | BIOFAC( 3,1)      |
| D-5       | Pb-210+D , crustacea and mollusks                        | 1.000E+02         | 1.000E+02     | BIOFAC( 3,2)      |

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T<sub>1/2</sub> Limit = 180 days

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## Dose Conversion Factor (and Related) Parameter Summary (continued)

Dose Library: FGR 12 &amp; FGR 11

| 0<br>Menu | Parameter                         | Current<br>Value# | Base<br>Case* | Parameter<br>Name |
|-----------|-----------------------------------|-------------------|---------------|-------------------|
| D-5       | Ra-226+D , fish                   | 5.000E+01         | 5.000E+01     | BIOFAC( 4,1)      |
| D-5       | Ra-226+D , crustacea and mollusks | 2.500E+02         | 2.500E+02     | BIOFAC( 4,2)      |
| D-5       |                                   |                   |               |                   |
| D-5       | Th-230 , fish                     | 1.000E+02         | 1.000E+02     | BIOFAC( 5,1)      |
| D-5       | Th-230 , crustacea and mollusks   | 5.000E+02         | 5.000E+02     | BIOFAC( 5,2)      |
| D-5       |                                   |                   |               |                   |
| D-5       | U-234 , fish                      | 1.000E+01         | 1.000E+01     | BIOFAC( 6,1)      |
| D-5       | U-234 , crustacea and mollusks    | 6.000E+01         | 6.000E+01     | BIOFAC( 6,2)      |
| D-5       |                                   |                   |               |                   |
| D-5       | U-235+D , fish                    | 1.000E+01         | 1.000E+01     | BIOFAC( 7,1)      |
| D-5       | U-235+D , crustacea and mollusks  | 6.000E+01         | 6.000E+01     | BIOFAC( 7,2)      |
| D-5       |                                   |                   |               |                   |
| D-5       | U-238 , fish                      | 1.000E+01         | 1.000E+01     | BIOFAC( 8,1)      |
| D-5       | U-238 , crustacea and mollusks    | 6.000E+01         | 6.000E+01     | BIOFAC( 8,2)      |
| D-5       |                                   |                   |               |                   |
| D-5       | U-238+D , fish                    | 1.000E+01         | 1.000E+01     | BIOFAC( 9,1)      |
| D-5       | U-238+D , crustacea and mollusks  | 6.000E+01         | 6.000E+01     | BIOFAC( 9,2)      |

#For DCF1(xxx) only, factors are for infinite depth &amp; area. See ETFG table in Ground Pathway of Detailed Report.

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

## Site-Specific Parameter Summary

| 0<br>Menu | Parameter                                       | User<br>Input | Default   | Used by RESRAD<br>(If different from user input) | Parameter<br>Name |
|-----------|---|---------------|-----------|--|-------------------|
| R011      | Area of contaminated zone (m**2)                | 9.846E+03     | 1.000E+04 | ---  | AREA              |
| R011      | Thickness of contaminated zone (m)              | 2.000E+00     | 2.000E+00 | ---  | THICK0            |
| R011      | Fraction of contamination that is submerged     | 0.000E+00     | 0.000E+00 | ---  | SUBMFRACT         |
| R011      | Length parallel to aquifer flow (m)             | not used      | 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                |
| 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): U-234   | 2.700E-01     | 0.000E+00 | ---  | S1(6)             |
| R012      | Initial principal radionuclide (pCi/g): U-235   | 2.000E-02     | 0.000E+00 | ---  | S1(7)             |
| R012      | Initial principal radionuclide (pCi/g): U-238   | 2.700E-01     | 0.000E+00 | ---  | S1(8)             |
| R012      | Concentration in groundwater (pCi/L): U-234     | not used      | 0.000E+00 | ---  | W1( 6)            |
| R012      | Concentration in groundwater (pCi/L): U-235     | not used      | 0.000E+00 | ---  | W1( 7)            |
| R012      | Concentration in groundwater (pCi/L): U-238     | not used      | 0.000E+00 | ---  | W1( 8)            |
| 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)          | 1.280E+00     | 1.500E+00 | ---  | DENSCZ            |
| R013      | Contaminated zone erosion rate (m/yr)           | 6.000E-05     | 1.000E-03 | ---  | VCZ               |
| R013      | Contaminated zone total porosity                | 4.200E-01     | 4.000E-01 | ---  | TPCZ              |
| R013      | Contaminated zone field capacity                | 3.600E-01     | 2.000E-01 | ---  | FCCZ              |
| R013      | Contaminated zone hydraulic conductivity (m/yr) | 3.048E+00     | 1.000E+01 | ---  | HCCZ              |
| R013      | Contaminated zone b parameter                   | 1.040E+01     | 5.300E+00 | ---  | BCZ               |
| R013      | Average annual wind speed (m/sec)               | 4.170E+00     | 2.000E+00 | ---  | WIND              |
| R013      | Humidity in air (g/m**3)                        | not used      | 8.000E+00 | ---  | HUMID             |
| R013      | Evapotranspiration coefficient                  | 5.000E-01     | 5.000E-01 | ---  | EVAPTR            |
| R013      | Precipitation (m/yr)                            | 9.200E-01     | 1.000E+00 | ---  | PRECIP            |
| R013      | Irrigation (m/yr)                               | 0.000E+00     | 2.000E-01 | ---  | RI                |
| R013      | Irrigation mode                                 | overhead      | overhead  | ---  | IDITCH            |
| R013      | Runoff coefficient                              | 8.000E-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              |
| R014      | Saturated zone field capacity                   | not used      | 2.000E-01 | ---  | FCSZ              |
| R014      | Saturated zone hydraulic conductivity (m/yr)    | not used      | 1.000E+02 | ---  | HCSZ              |
| R014      | Saturated zone hydraulic gradient               | not used      | 2.000E-02 | ---  | HGWT              |
| R014      | Saturated zone b parameter                      | not used      | 5.300E+00 | ---  | BSZ               |
| R014      | Water table drop rate (m/yr)                    | not used      | 1.000E-03 | ---  | VWT               |

## Site-Specific Parameter Summary (continued)

| 0<br>Menu | Parameter                                      | User<br>Input | Default   | Used by RESRAD<br>(If different from user input) | Parameter<br>Name |
|-----------|--|---------------|-----------|--|-------------------|
| R014      | Well pump intake depth (m below water table)   | not used      | 1.000E+01 | ---  | DWIBWT            |
| R014      | Model: Nondispersion (ND) or Mass-Balance (MB) | not used      | ND        | ---  | MODEL             |
| R014      | Well pumping rate (m**3/yr)                    | not used      | 2.500E+02 | ---  | UW                |
| R015      | Number of unsaturated zone strata              | not used      | 1         | ---  | NS                |
| R015      | Unsat. zone 1, thickness (m)                   | not used      | 4.000E+00 | ---  | H(1)              |
| R015      | Unsat. zone 1, soil density (g/cm**3)          | not used      | 1.500E+00 | ---  | DENSUZ(1)         |
| R015      | Unsat. zone 1, total porosity                  | not used      | 4.000E-01 | ---  | TPUZ(1)           |
| R015      | Unsat. zone 1, effective porosity              | not used      | 2.000E-01 | ---  | EPUZ(1)           |
| R015      | Unsat. zone 1, field capacity                  | not used      | 2.000E-01 | ---  | FCUZ(1)           |
| R015      | Unsat. zone 1, soil-specific b parameter       | not used      | 5.300E+00 | ---  | BUZ(1)            |
| R015      | Unsat. zone 1, hydraulic conductivity (m/yr)   | not used      | 1.000E+01 | ---  | HCUZ(1)           |
| R016      | Distribution coefficients for U-234            |               |           |  |                   |
| R016      | Contaminated zone (cm**3/g)                    | 5.000E+01     | 5.000E+01 | ---  | DCNUCC( 6)        |
| R016      | Unsaturated zone 1 (cm**3/g)                   | not used      | 5.000E+01 | ---  | DCNUCU( 6,1)      |
| R016      | Saturated zone (cm**3/g)                       | not used      | 5.000E+01 | ---  | DCNUCS( 6)        |
| R016      | Leach rate (/yr)                               | 0.000E+00     | 0.000E+00 | 7.147E-04  | ALEACH( 6)        |
| R016      | Solubility constant                            | 0.000E+00     | 0.000E+00 | not used   | SOLUBK( 6)        |
| R016      | Distribution coefficients for U-235            |               |           |  |                   |
| R016      | Contaminated zone (cm**3/g)                    | 5.000E+01     | 5.000E+01 | ---  | DCNUCC( 7)        |
| R016      | Unsaturated zone 1 (cm**3/g)                   | not used      | 5.000E+01 | ---  | DCNUCU( 7,1)      |
| R016      | Saturated zone (cm**3/g)                       | not used      | 5.000E+01 | ---  | DCNUCS( 7)        |
| R016      | Leach rate (/yr)                               | 0.000E+00     | 0.000E+00 | 7.147E-04  | ALEACH( 7)        |
| R016      | Solubility constant                            | 0.000E+00     | 0.000E+00 | not used   | SOLUBK( 7)        |
| R016      | Distribution coefficients for U-238            |               |           |  |                   |
| R016      | Contaminated zone (cm**3/g)                    | 5.000E+01     | 5.000E+01 | ---  | DCNUCC( 8)        |
| R016      | Unsaturated zone 1 (cm**3/g)                   | not used      | 5.000E+01 | ---  | DCNUCU( 8,1)      |
| R016      | Saturated zone (cm**3/g)                       | not used      | 5.000E+01 | ---  | DCNUCS( 8)        |
| R016      | Leach rate (/yr)                               | 0.000E+00     | 0.000E+00 | 7.147E-04  | ALEACH( 8)        |
| R016      | Solubility constant                            | 0.000E+00     | 0.000E+00 | not used   | SOLUBK( 8)        |
| R016      | Distribution coefficients for daughter Ac-227  |               |           |  |                   |
| R016      | Contaminated zone (cm**3/g)                    | 2.000E+01     | 2.000E+01 | ---  | DCNUCC( 1)        |
| R016      | Unsaturated zone 1 (cm**3/g)                   | not used      | 2.000E+01 | ---  | DCNUCU( 1,1)      |
| R016      | Saturated zone (cm**3/g)                       | not used      | 2.000E+01 | ---  | DCNUCS( 1)        |
| R016      | Leach rate (/yr)                               | 0.000E+00     | 0.000E+00 | 1.772E-03  | ALEACH( 1)        |
| R016      | Solubility constant                            | 0.000E+00     | 0.000E+00 | not used   | SOLUBK( 1)        |
| R016      | Distribution coefficients for daughter Pa-231  |               |           |  |                   |
| R016      | Contaminated zone (cm**3/g)                    | 5.000E+01     | 5.000E+01 | ---  | DCNUCC( 2)        |
| R016      | Unsaturated zone 1 (cm**3/g)                   | not used      | 5.000E+01 | ---  | DCNUCU( 2,1)      |
| R016      | Saturated zone (cm**3/g)                       | not used      | 5.000E+01 | ---  | DCNUCS( 2)        |
| R016      | Leach rate (/yr)                               | 0.000E+00     | 0.000E+00 | 7.147E-04  | ALEACH( 2)        |
| R016      | Solubility constant                            | 0.000E+00     | 0.000E+00 | not used   | SOLUBK( 2)        |

## Site-Specific Parameter Summary (continued)

| 0<br>Menu | Parameter                                      | User<br>Input | Default   | Used by RESRAD<br>(If different from user input) | Parameter<br>Name |
|-----------|--|---------------|-----------|--|-------------------|
| R016      | Distribution coefficients for daughter Pb-210  |               |           |  |                   |
| R016      | Contaminated zone (cm**3/g)                    | 1.000E+02     | 1.000E+02 | ---  | DCNUCC( 3)        |
| R016      | Unsaturated zone 1 (cm**3/g)                   | not used      | 1.000E+02 | ---  | DCNUCU( 3,1)      |
| R016      | Saturated zone (cm**3/g)                       | not used      | 1.000E+02 | ---  | DCNUCS( 3)        |
| R016      | Leach rate (/yr)                               | 0.000E+00     | 0.000E+00 | 3.584E-04  | ALEACH( 3)        |
| R016      | Solubility constant                            | 0.000E+00     | 0.000E+00 | not used   | SOLUBK( 3)        |
| R016      | Distribution coefficients for daughter Ra-226  |               |           |  |                   |
| R016      | Contaminated zone (cm**3/g)                    | 7.000E+01     | 7.000E+01 | ---  | DCNUCC( 4)        |
| R016      | Unsaturated zone 1 (cm**3/g)                   | not used      | 7.000E+01 | ---  | DCNUCU( 4,1)      |
| R016      | Saturated zone (cm**3/g)                       | not used      | 7.000E+01 | ---  | DCNUCS( 4)        |
| R016      | Leach rate (/yr)                               | 0.000E+00     | 0.000E+00 | 5.113E-04  | ALEACH( 4)        |
| R016      | Solubility constant                            | 0.000E+00     | 0.000E+00 | not used   | SOLUBK( 4)        |
| R016      | Distribution coefficients for daughter Th-230  |               |           |  |                   |
| R016      | Contaminated zone (cm**3/g)                    | 6.000E+04     | 6.000E+04 | ---  | DCNUCC( 5)        |
| R016      | Unsaturated zone 1 (cm**3/g)                   | not used      | 6.000E+04 | ---  | DCNUCU( 5,1)      |
| R016      | Saturated zone (cm**3/g)                       | not used      | 6.000E+04 | ---  | DCNUCS( 5)        |
| R016      | Leach rate (/yr)                               | 0.000E+00     | 0.000E+00 | 5.990E-07  | ALEACH( 5)        |
| R016      | Solubility constant                            | 0.000E+00     | 0.000E+00 | not used   | SOLUBK( 5)        |
| R017      | Inhalation rate (m**3/yr)                      | 1.055E+04     | 8.400E+03 | ---  | INHALR            |
| R017      | Mass loading for inhalation (g/m**3)           | 2.000E-04     | 1.000E-04 | ---  | MLINH             |
| R017      | Exposure duration                              | 1.000E+00     | 3.000E+01 | ---  | ED                |
| R017      | Shielding factor, inhalation                   | 5.000E-01     | 4.000E-01 | ---  | SHF3              |
| R017      | Shielding factor, external gamma               | 7.000E-01     | 7.000E-01 | ---  | SHF1              |
| R017      | Fraction of time spent indoors                 | 0.000E+00     | 5.000E-01 | ---  | FIND              |
| R017      | Fraction of time spent outdoors (on site)      | 9.100E-03     | 2.500E-01 | ---  | FOTD              |
| R017      | Shape factor flag, external gamma              | 1.000E+00     | 1.000E+00 | >0 shows circular AREA.                          | FS                |
| R017      | Radii of shape factor array (used if FS = -1): |               |           |  |                   |
| R017      | Outer annular radius (m), ring 1:              | not used      | 5.000E+01 | ---  | RAD_SHAPE( 1)     |
| R017      | Outer annular radius (m), ring 2:              | not used      | 7.071E+01 | ---  | RAD_SHAPE( 2)     |
| R017      | Outer annular radius (m), ring 3:              | not used      | 0.000E+00 | ---  | RAD_SHAPE( 3)     |
| R017      | Outer annular radius (m), ring 4:              | not used      | 0.000E+00 | ---  | RAD_SHAPE( 4)     |
| R017      | Outer annular radius (m), ring 5:              | not used      | 0.000E+00 | ---  | RAD_SHAPE( 5)     |
| R017      | Outer annular radius (m), ring 6:              | not used      | 0.000E+00 | ---  | RAD_SHAPE( 6)     |
| R017      | Outer annular radius (m), ring 7:              | not used      | 0.000E+00 | ---  | RAD_SHAPE( 7)     |
| R017      | Outer annular radius (m), ring 8:              | not used      | 0.000E+00 | ---  | RAD_SHAPE( 8)     |
| R017      | Outer annular radius (m), ring 9:              | not used      | 0.000E+00 | ---  | RAD_SHAPE( 9)     |
| R017      | Outer annular radius (m), ring 10:             | not used      | 0.000E+00 | ---  | RAD_SHAPE(10)     |
| R017      | Outer annular radius (m), ring 11:             | not used      | 0.000E+00 | ---  | RAD_SHAPE(11)     |
| R017      | Outer annular radius (m), ring 12:             | not used      | 0.000E+00 | ---  | RAD_SHAPE(12)     |

## Site-Specific Parameter Summary (continued)

| 0<br>Menu | Parameter  | User<br>Input | Default   | Used by RESRAD<br>(If different from user input) | Parameter<br>Name |
|-----------|--|---------------|-----------|--|-------------------|
| R017      | Fractions of annular areas within AREA:          |               |           |  |                   |
| R017      | Ring 1   | not used      | 1.000E+00 | ---  | FRACA( 1)         |
| R017      | Ring 2   | not used      | 2.732E-01 | ---  | FRACA( 2)         |
| R017      | Ring 3   | not used      | 0.000E+00 | ---  | FRACA( 3)         |
| R017      | Ring 4   | not used      | 0.000E+00 | ---  | FRACA( 4)         |
| R017      | Ring 5   | not used      | 0.000E+00 | ---  | FRACA( 5)         |
| R017      | Ring 6   | not used      | 0.000E+00 | ---  | FRACA( 6)         |
| R017      | Ring 7   | not used      | 0.000E+00 | ---  | FRACA( 7)         |
| R017      | Ring 8   | not used      | 0.000E+00 | ---  | FRACA( 8)         |
| R017      | Ring 9   | not used      | 0.000E+00 | ---  | FRACA( 9)         |
| R017      | Ring 10  | not used      | 0.000E+00 | ---  | FRACA(10)         |
| R017      | Ring 11  | not used      | 0.000E+00 | ---  | FRACA(11)         |
| R017      | Ring 12  | not used      | 0.000E+00 | ---  | FRACA(12)         |
| R018      | Fruits, vegetables and grain consumption (kg/yr) | not used      | 1.600E+02 | ---  | DIET(1)           |
| R018      | Leafy vegetable consumption (kg/yr)              | not used      | 1.400E+01 | ---  | DIET(2)           |
| R018      | Milk consumption (L/yr)                          | not used      | 9.200E+01 | ---  | DIET(3)           |
| R018      | Meat and poultry consumption (kg/yr)             | not used      | 6.300E+01 | ---  | DIET(4)           |
| R018      | Fish consumption (kg/yr)                         | not used      | 5.400E+00 | ---  | DIET(5)           |
| R018      | Other seafood consumption (kg/yr)                | not used      | 9.000E-01 | ---  | DIET(6)           |
| R018      | Soil ingestion rate (g/yr)                       | 1.752E+02     | 3.650E+01 | ---  | SOIL              |
| R018      | Drinking water intake (L/yr)                     | not used      | 5.100E+02 | ---  | DWI               |
| R018      | Contamination fraction of drinking water         | not used      | 1.000E+00 | ---  | FDW               |
| R018      | Contamination fraction of household water        | not used      | 1.000E+00 | ---  | FHHW              |
| R018      | Contamination fraction of livestock water        | not used      | 1.000E+00 | ---  | FLW               |
| R018      | Contamination fraction of irrigation water       | not used      | 1.000E+00 | ---  | FIRW              |
| R018      | Contamination fraction of aquatic food           | not used      | 5.000E-01 | ---  | FR9               |
| R018      | Contamination fraction of plant food             | not used      | -1        | ---  | FPLANT            |
| R018      | Contamination fraction of meat                   | not used      | -1        | ---  | FMEAT             |
| R018      | Contamination fraction of milk                   | not used      | -1        | ---  | FMILK             |
| R019      | Livestock fodder intake for meat (kg/day)        | not used      | 6.800E+01 | ---  | LFI5              |
| R019      | Livestock fodder intake for milk (kg/day)        | not used      | 5.500E+01 | ---  | LFI6              |
| R019      | Livestock water intake for meat (L/day)          | not used      | 5.000E+01 | ---  | LWI5              |
| R019      | Livestock water intake for milk (L/day)          | not used      | 1.600E+02 | ---  | LWI6              |
| R019      | Livestock soil intake (kg/day)                   | not used      | 5.000E-01 | ---  | LSI               |
| 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)             |

## Site-Specific Parameter Summary (continued)

| 0<br>Menu | Parameter  | User<br>Input | Default    | Used by RESRAD<br>(If different from user input) | Parameter<br>Name |
|-----------|--|---------------|------------|--|-------------------|
| 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)            | not used      | 2.000E-05  | ---  | C12WTR            |
| C14       | C-12 concentration in contaminated soil (g/g)    | not used      | 3.000E-02  | ---  | C12CZ             |
| C14       | Fraction of vegetation carbon from soil          | not used      | 2.000E-02  | ---  | CSOIL             |
| C14       | Fraction of vegetation carbon from air           | not used      | 9.800E-01  | ---  | CAIR              |
| C14       | C-14 evasion layer thickness in soil (m)         | not used      | 3.000E-01  | ---  | DMC               |
| C14       | C-14 evasion flux rate from soil (1/sec)         | not used      | 7.000E-07  | ---  | EVSN              |
| C14       | C-12 evasion flux rate from soil (1/sec)         | not used      | 1.000E-10  | ---  | REVSN             |
| C14       | Fraction of grain in beef cattle feed            | not used      | 8.000E-01  | ---  | AVFG4             |
| C14       | Fraction of grain in milk cow feed               | not used      | 2.000E-01  | ---  | AVFG5             |
| 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                                       | 1.000E+00     | 1.000E+00  | ---  | STOR_T(7)         |
| STOR      | Surface water                                    | 1.000E+00     | 1.000E+00  | ---  | STOR_T(8)         |
| STOR      | Livestock fodder                                 | 4.500E+01     | 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  | ---  | DENSL             |
| R021      | Total porosity of the cover material             | not used      | 4.000E-01  | ---  | TPCV              |
| R021      | Total porosity of the building foundation        | not used      | 1.000E-01  | ---  | TPFL              |
| R021      | Volumetric water content of the cover material   | not used      | 5.000E-02  | ---  | PH2OCV            |
| R021      | Volumetric water content of the foundation       | not used      | 3.000E-02  | ---  | PH2OFL            |
| R021      | Diffusion coefficient for radon gas (m/sec):     |               |            |  |                   |
| R021      | in cover material                                | not used      | 2.000E-06  | ---  | DIFCV             |
| R021      | in foundation material                           | not used      | 3.000E-07  | ---  | DIFFL             |
| R021      | in contaminated zone soil                        | not used      | 2.000E-06  | ---  | DIFCZ             |
| R021      | Radon vertical dimension of mixing (m)           | not used      | 2.000E+00  | ---  | HMX               |
| R021      | Average building air exchange rate (1/hr)        | not used      | 5.000E-01  | ---  | REXG              |
| R021      | Height of the building (room) (m)                | not used      | 2.500E+00  | ---  | HRM               |
| R021      | Building interior area factor                    | not used      | 0.000E+00  | ---  | FAI               |
| R021      | Building depth below ground surface (m)          | not used      | -1.000E+00 | ---  | DMFL              |
| R021      | Emanating power of Rn-222 gas                    | not used      | 2.500E-01  | ---  | EMANA(1)          |
| R021      | Emanating power of Rn-220 gas                    | not used      | 1.500E-01  | ---  | EMANA(2)          |
| TITL      | Number of graphical time points                  | 32            | ---        | ---  | NPTS              |

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## Site-Specific Parameter Summary (continued)

| 0<br>Menu | Parameter                                     | User<br>Input | Default | Used by RESRAD<br>(If different from user input) | Parameter<br>Name |
|-----------|---|---------------|---------|--|-------------------|
| TITL      | Maximum number of integration points for dose | 17            | ---     | ---  | LYMAX             |
| TITL      | 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         |

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Contaminated Zone Dimensions                          Initial Soil Concentrations, pCi/g

|              |         |               |       |           |
|--------------|---------|---------------|-------|-----------|
| Area:        | 9846.00 | square meters | U-234 | 2.700E-01 |
| Thickness:   | 2.00    | meters        | U-235 | 2.000E-02 |
| Cover Depth: | 0.00    | meters        | U-238 | 2.700E-01 |

0  
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):  | 8.427E-04 | 8.421E-04 | 8.409E-04 | 8.368E-04 | 8.254E-04 | 7.876E-04 | 6.920E-04 | 4.625E-04 |
| M(t):      | 3.371E-05 | 3.368E-05 | 3.364E-05 | 3.347E-05 | 3.302E-05 | 3.151E-05 | 2.768E-05 | 1.850E-05 |

0Maximum TDose(t): 8.427E-04 mrem/yr at t = 0.000E+00 years

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T½ Limit = 180 days

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## 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. |
| U-234         | 9.511E-07 | 0.0011 | 5.767E-05  | 0.0684 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.218E-04 | 0.1445 |
| U-235         | 1.312E-04 | 0.1557 | 3.981E-06  | 0.0047 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 8.525E-06 | 0.0101 |
| U-238         | 3.514E-04 | 0.4170 | 5.157E-05  | 0.0612 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.156E-04 | 0.1372 |
| Total         | 4.835E-04 | 0.5738 | 1.132E-04  | 0.1344 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.459E-04 | 0.2918 |

## 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. |
| U-234         | 0.000E+00 | 0.0000 | 1.804E-04     | 0.2141 |
| U-235         | 0.000E+00 | 0.0000 | 1.437E-04     | 0.1705 |
| U-238         | 0.000E+00 | 0.0000 | 5.186E-04     | 0.6154 |
| Total         | 0.000E+00 | 0.0000 | 8.427E-04     | 1.0000 |

\*Sum of all water independent and dependent pathways.

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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. |
| U-234         | 9.505E-07 | 0.0011 | 5.763E-05  | 0.0684 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.217E-04 | 0.1445 |
| U-235         | 1.311E-04 | 0.1557 | 3.979E-06  | 0.0047 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 8.527E-06 | 0.0101 |
| U-238         | 3.511E-04 | 0.4170 | 5.153E-05  | 0.0612 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.155E-04 | 0.1372 |
| Total         | 4.832E-04 | 0.5738 | 1.131E-04  | 0.1344 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.458E-04 | 0.2919 |

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. |
| U-234         | 0.000E+00 | 0.0000 | 1.803E-04     | 0.2141 |
| U-235         | 0.000E+00 | 0.0000 | 1.436E-04     | 0.1706 |
| U-238         | 0.000E+00 | 0.0000 | 5.182E-04     | 0.6154 |
| Total         | 0.000E+00 | 0.0000 | 8.421E-04     | 1.0000 |

\*Sum of all water independent and dependent pathways.

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## 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. |
| U-234         | 9.497E-07 | 0.0011 | 5.755E-05  | 0.0684 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.215E-04 | 0.1445 |
| U-235         | 1.309E-04 | 0.1557 | 3.976E-06  | 0.0047 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 8.530E-06 | 0.0101 |
| U-238         | 3.506E-04 | 0.4169 | 5.146E-05  | 0.0612 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.154E-04 | 0.1372 |
| Total         | 4.825E-04 | 0.5738 | 1.130E-04  | 0.1344 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.454E-04 | 0.2919 |

## 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. |
| U-234         | 0.000E+00 | 0.0000 | 1.800E-04     | 0.2141 |
| U-235         | 0.000E+00 | 0.0000 | 1.434E-04     | 0.1706 |
| U-238         | 0.000E+00 | 0.0000 | 5.175E-04     | 0.6153 |
| Total         | 0.000E+00 | 0.0000 | 8.409E-04     | 1.0000 |

\*Sum of all water independent and dependent pathways.

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T½ Limit = 180 days

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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

| Radio-Nuclide | Water Independent Pathways (Inhalation excludes radon) |        |            |        |           |        |           |        |           |        | Soil      |        |
|---------------|--|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|               | Ground   |        | Inhalation |        | Radon     |        | Plant     |        | Meat      |        |           |        |
|               | mrem/yr  | fract. | mrem/yr    | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. |
| U-234         | 9.501E-07  | 0.0011 | 5.727E-05  | 0.0684 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.209E-04 | 0.1445 |
| U-235         | 1.303E-04  | 0.1557 | 3.968E-06  | 0.0047 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 8.551E-06 | 0.0102 |
| U-238         | 3.489E-04  | 0.4169 | 5.120E-05  | 0.0612 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.148E-04 | 0.1372 |
| Total         | 4.801E-04  | 0.5737 | 1.124E-04  | 0.1344 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.443E-04 | 0.2919 |

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

| Radio-Nuclide | Water Dependent Pathways |        |           |        |           |        |           |        |           |        | All Pathways* |        |
|---------------|--------------------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|---------------|--------|
|               | Water                    |        | Fish      |        | Radon     |        | Plant     |        | Meat      |        |               |        |
|               | mrem/yr                  | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr   | fract. | mrem/yr       | fract. |
| U-234         | 0.000E+00                | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.791E-04     | 0.2141 |
| U-235         | 0.000E+00                | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.428E-04     | 0.1707 |
| U-238         | 0.000E+00                | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 5.149E-04     | 0.6153 |
| 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 | 8.368E-04     | 1.0000 |

\*Sum of all water independent and dependent pathways.

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 $T_{\frac{1}{2}}$  Limit = 180 days

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## 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. |
| U-234         | 9.777E-07 | 0.0012 | 5.648E-05  | 0.0684 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.193E-04 | 0.1445 |
| U-235         | 1.285E-04 | 0.1557 | 3.971E-06  | 0.0048 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 8.661E-05 | 0.0105 |
| U-238         | 3.439E-04 | 0.4166 | 5.048E-05  | 0.0612 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.132E-04 | 0.1371 |
| Total         | 4.734E-04 | 0.5735 | 1.109E-04  | 0.1344 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.411E-04 | 0.2921 |

## 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. |
| U-234         | 0.000E+00 | 0.0000 | 1.767E-04     | 0.2141 |
| U-235         | 0.000E+00 | 0.0000 | 1.412E-04     | 0.1710 |
| U-238         | 0.000E+00 | 0.0000 | 5.076E-04     | 0.6149 |
| Total         | 0.000E+00 | 0.0000 | 8.254E-04     | 1.0000 |

\*Sum of all water independent and dependent pathways.

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T<sub>1/2</sub> Limit = 180 days

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## 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)

| 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. |
| U-234         | 1.369E-06 | 0.0017 | 5.380E-05  | 0.0683 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.136E-04 | 0.1442 |
| U-235         | 1.227E-04 | 0.1558 | 4.083E-06  | 0.0052 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 9.242E-06 | 0.0117 |
| U-238         | 3.271E-04 | 0.4153 | 4.803E-05  | 0.0610 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.077E-04 | 0.1367 |
| Total         | 4.512E-04 | 0.5729 | 1.059E-04  | 0.1345 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.305E-04 | 0.2927 |

## 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

| Radio-Nuclide | Water     |        | Fish      |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | All Pathways* |        |
|---------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|---------------|--------|
|               | mrem/yr   | fract. | mrem/yr       | fract. |
| U-234         | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | C.0000 | 0.000E+00 | 0.0000 | 1.688E-04     | 0.2143 |
| U-235         | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | C.0000 | 0.000E+00 | 0.0000 | 1.360E-04     | 0.1727 |
| U-238         | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | C.0000 | 0.000E+00 | 0.0000 | 4.828E-04     | 0.6130 |
| Total         | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | C.0000 | 0.000E+00 | 0.0000 | 7.876E-04     | 1.0000 |

\*Sum of all water independent and dependent pathways.

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T<sub>½</sub> Limit = 180 days

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## 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. |
| U-234         | 4.631E-06 | 0.0067 | 4.685E-05  | 0.0677 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 9.923E-05 | 0.1434 |
| U-235         | 1.076E-04 | 0.1555 | 4.393E-06  | 0.0063 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.070E-05 | 0.0155 |
| U-238         | 2.836E-04 | 0.4098 | 4.166E-05  | 0.0602 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 9.340E-05 | 0.1350 |
| Total         | 3.958E-04 | 0.5719 | 9.289E-05  | 0.1342 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.033E-04 | 0.2938 |

## 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. |
| U-234         | 0.000E+00 | 0.0000 | 1.507E-04     | 0.2178 |
| U-235         | 0.000E+00 | 0.0000 | 1.227E-04     | 0.1773 |
| U-238         | 0.000E+00 | 0.0000 | 4.186E-04     | 0.6049 |
| Total         | 0.000E+00 | 0.0000 | 6.920E-04     | 1.0000 |

\*Sum of all water independent and dependent pathways.

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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)

| 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. |
| U-234         | 2.997E-05 | 0.0648 | 2.906E-05  | 0.0628 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.495E-05 | 0.1404 |
| U-235         | 6.788E-05 | 0.1468 | 4.466E-06  | 0.0097 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.217E-05 | 0.0263 |
| U-238         | 1.720E-04 | 0.3718 | 2.531E-05  | 0.0547 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 5.676E-05 | 0.1227 |
| Total         | 2.698E-04 | 0.5833 | 5.885E-05  | 0.1272 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.339E-04 | 0.2894 |

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

| Radio-Nuclide | Water     |        | Fish      |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | All Pathways* |        |
|---------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|---------------|--------|
|               | mrem/yr   | fract. | mrem/yr       | fract. |
| U-234         | 0.000E+00 | 0.0000 | 1.240E-04     | 0.2681 |
| U-235         | 0.000E+00 | 0.0000 | 8.452E-05     | 0.1827 |
| U-238         | 0.000E+00 | 0.0000 | 2.540E-04     | 0.5492 |
| Total         | 0.000E+00 | 0.0000 | 4.625E-04     | 1.0000 |

\*Sum of all water independent and dependent pathways.

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Dose/Source Ratios Summed Over All Pathways

| 0        | Parent<br>(i)   | Product<br>(j) | Thread<br>Fraction | Parent and Progeny Principal Radionuclide Contributions Indicated |           |           |           |           |           |           |           |
|----------|-----------------|----------------|--------------------|---|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
|          |                 |                |                    | DSR(j,t) At Time in Years   | 0.000E+00 | 1.000E+00 | 3.000E+00 | 1.000E+01 | 3.000E+01 | 1.000E+02 | 3.000E+02 |
| U-234    | U-234           | U-234          | 1.000E+00          | 6.681E-04   | 6.677E-04 | 6.667E-04 | 6.634E-04 | 6.539E-04 | 6.219E-04 | 5.387E-04 | 3.260E-04 |
| U-234    | Th-230          | Th-230         | 1.000E+00          | 6.353E-09   | 1.905E-08 | 4.443E-08 | 1.329E-07 | 3.834E-07 | 1.232E-06 | 3.430E-06 | 9.025E-06 |
| U-234    | Ra-226+D        | Ra-226+D       | 1.000E+00          | 6.356E-11   | 4.447E-10 | 2.348E-09 | 2.092E-08 | 1.745E-07 | 1.822E-06 | 1.460E-05 | 1.116E-04 |
| U-234    | Pb-210+D        | Pb-210+D       | 1.000E+00          | 5.866E-14   | 8.738E-13 | 1.004E-11 | 2.517E-10 | 5.290E-09 | 1.214E-07 | 1.418E-06 | 1.257E-05 |
| U-234    | $\Sigma$ DSR(j) |                |                    | 6.681E-04   | 6.677E-04 | 6.667E-04 | 6.634E-04 | 6.539E-04 | 6.219E-04 | 5.387E-04 | 3.260E-04 |
| OU-235+D | U-235+D         | U-235+D        | 1.000E+00          | 7.186E-03   | 7.181E-03 | 7.170E-03 | 7.134E-03 | 7.033E-03 | 6.690E-03 | 5.799E-03 | 3.516E-03 |
| U-235+D  | Pa-231          | Pa-231         | 1.000E+00          | 2.179E-07   | 6.534E-07 | 1.522E-06 | 4.544E-06 | 1.301E-05 | 4.075E-05 | 1.054E-04 | 2.112E-04 |
| U-235+D  | Ac-227+D        | Ac-227+D       | 1.000E+00          | 5.766E-09   | 3.996E-08 | 2.066E-07 | 1.708E-06 | 1.167E-05 | 7.026E-05 | 2.305E-04 | 4.984E-04 |
| U-235+D  | $\Sigma$ DSR(j) |                |                    | 7.186E-03   | 7.181E-03 | 7.172E-03 | 7.141E-03 | 7.058E-03 | 6.801E-03 | 6.135E-03 | 4.226E-03 |
| OU-238   | U-238           | U-238          | 5.400E-05          | 3.231E-08   | 3.228E-08 | 3.224E-08 | 3.208E-08 | 3.162E-08 | 3.008E-08 | 2.607E-08 | 1.581E-08 |
| OU-238+D | U-238+D         | U-238+D        | 9.999E-01          | 1.921E-03   | 1.919E-03 | 1.916E-03 | 1.907E-03 | 1.880E-03 | 1.788E-03 | 1.550E-03 | 9.398E-04 |
| U-238+D  | U-234           | U-234          | 9.999E-01          | 9.469E-10   | 2.839E-09 | 6.615E-09 | 1.975E-08 | 5.654E-08 | 1.772E-07 | 4.591E-07 | 9.260E-07 |
| U-238+D  | Th-230          | Th-230         | 9.999E-01          | 6.003E-15   | 4.200E-14 | 2.218E-13 | 1.978E-12 | 1.652E-11 | 1.734E-10 | 1.410E-09 | 1.131E-08 |
| U-238+D  | Ra-226+D        | Ra-226+D       | 9.999E-01          | 4.504E-17   | 6.752E-16 | 7.869E-15 | 2.078E-13 | 5.023E-12 | 1.723E-10 | 4.093E-09 | 1.007E-07 |
| U-238+D  | Pb-210+D        | Pb-210+D       | 9.999E-01          | 3.330E-20   | 1.026E-18 | 2.552E-17 | 1.906E-15 | 1.192E-13 | 9.636E-12 | 3.640E-10 | 1.101E-08 |
| U-238+D  | $\Sigma$ DSR(j) |                |                    | 1.921E-03   | 1.919E-03 | 1.916E-03 | 1.907E-03 | 1.880E-03 | 1.788E-03 | 1.550E-03 | 9.409E-04 |

The DSR includes contributions from associated (half-life ≤ 180 days) daughters.

0

Single Radionuclide Soil Guidelines G(i,t) in pCi/g  
 Basic Radiation Dose Limit = 2.500E+01 mrem/yr

| ONuclide<br>(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 |
|-----------------|--------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| U-234           | 3.742E+04    | 3.744E+04 | 3.750E+04 | 3.768E+04 | 3.820E+04 | 4.000E+04 | 4.479E+04 | 5.444E+04 |
| U-235           | 3.479E+03    | 3.481E+03 | 3.486E+03 | 3.501E+03 | 3.542E+03 | 3.676E+03 | 4.075E+03 | 5.916E+03 |
| U-238           | 1.302E+04    | 1.303E+04 | 1.304E+04 | 1.311E+04 | 1.330E+04 | 1.398E+04 | 1.612E+04 | 2.657E+04 |

0

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 = 0.000E+00 years

| ONuclide<br>(i) | Initial<br>(pCi/g) | tmin<br>(years) | DSR(i,tmin) | G(i,tmin) | DSR(i,tmax) | G(i,tmax) |
|-----------------|--------------------|-----------------|-------------|-----------|-------------|-----------|
| U-234           | 2.700E-01          | 0.000E+00       | 6.681E-04   | 3.742E+04 | 6.681E-04   | 3.742E+04 |
| U-235           | 2.000E-02          | 0.000E+00       | 7.186E-03   | 3.479E+03 | 7.186E-03   | 3.479E+03 |
| U-238           | 2.700E-01          | 0.000E+00       | 1.921E-03   | 1.302E+04 | 1.921E-03   | 1.302E+04 |

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| ONuclide<br>(j) | Parent<br>(i)    | THF(i)    | Individual Nuclide Dose Summed Over All Pathways |           |           |           |           |           |           |           |
|-----------------|------------------|-----------|--|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
|                 |                  |           | Parent Nuclide and Branch Fraction Indicated     |           |           |           |           |           |           |           |
|                 |                  |           | 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-234           | U-234            | 1.000E+00 | 1.804E-04  | 1.803E-04 | 1.800E-04 | 1.791E-04 | 1.766E-04 | 1.679E-04 | 1.455E-04 | 8.803E-05 |
| U-234           | U-238            | 9.999E-01 | 2.557E-10  | 7.665E-10 | 1.786E-09 | 5.331E-09 | 1.527E-08 | 4.784E-08 | 1.240E-07 | 2.500E-07 |
| U-234           | $\Sigma$ DOSE(j) |           | 1.804E-04  | 1.803E-04 | 1.800E-04 | 1.791E-04 | 1.766E-04 | 1.680E-04 | 1.456E-04 | 8.828E-05 |
| OTh-230         | U-234            | 1.000E+00 | 1.715E-09  | 5.145E-09 | 1.200E-08 | 3.590E-08 | 1.035E-07 | 3.326E-07 | 9.262E-07 | 2.437E-06 |
| Th-230          | U-238            | 9.999E-01 | 1.621E-15  | 1.134E-14 | 5.989E-14 | 5.340E-13 | 4.459E-12 | 4.682E-11 | 3.806E-10 | 3.054E-09 |
| Th-230          | $\Sigma$ DOSE(j) |           | 1.715E-09  | 5.145E-09 | 1.200E-08 | 3.590E-08 | 1.035E-07 | 3.326E-07 | 9.266E-07 | 2.440E-06 |
| ORa-226         | U-234            | 1.000E+00 | 1.716E-11  | 1.201E-10 | 6.339E-10 | 5.649E-09 | 4.711E-08 | 4.920E-07 | 3.941E-06 | 3.013E-05 |
| Ra-226          | U-238            | 9.999E-01 | 1.216E-17  | 1.823E-16 | 2.125E-15 | 5.611E-14 | 1.356E-12 | 4.653E-11 | 1.105E-09 | 2.718E-08 |
| Ra-226          | $\Sigma$ DOSE(j) |           | 1.716E-11  | 1.201E-10 | 6.339E-10 | 5.649E-09 | 4.711E-08 | 4.920E-07 | 3.942E-06 | 3.016E-05 |
| OPb-210         | U-234            | 1.000E+00 | 1.584E-14  | 2.359E-13 | 2.710E-12 | 6.795E-11 | 1.428E-09 | 3.278E-08 | 3.828E-07 | 3.393E-06 |
| Pb-210          | U-238            | 9.999E-01 | 8.990E-21  | 2.771E-19 | 6.892E-18 | 5.146E-16 | 3.219E-14 | 2.602E-12 | 9.829E-11 | 2.973E-09 |
| Pb-210          | $\Sigma$ DOSE(j) |           | 1.584E-14  | 2.359E-13 | 2.710E-12 | 6.795E-11 | 1.428E-09 | 3.278E-08 | 3.829E-07 | 3.396E-06 |
| OU-235          | U-235            | 1.000E+00 | 1.437E-04  | 1.436E-04 | 1.434E-04 | 1.427E-04 | 1.407E-04 | 1.338E-04 | 1.160E-04 | 7.032E-05 |
| OPa-231         | U-235            | 1.000E+00 | 4.359E-09  | 1.307E-08 | 3.045E-08 | 9.089E-08 | 2.602E-07 | 8.149E-07 | 2.108E-06 | 4.224E-06 |
| OAc-227         | U-235            | 1.000E+00 | 1.153E-10  | 7.993E-10 | 4.131E-09 | 3.417E-08 | 2.335E-07 | 1.405E-06 | 4.611E-06 | 9.967E-06 |
| OU-238          | U-238            | 5.400E-05 | 8.723E-09  | 8.717E-09 | 8.704E-09 | 8.661E-09 | 8.538E-09 | 8.121E-09 | 7.039E-09 | 4.268E-09 |
| U-238           | U-238            | 9.999E-01 | 5.186E-04  | 5.182E-04 | 5.174E-04 | 5.149E-04 | 5.076E-04 | 4.828E-04 | 4.185E-04 | 2.537E-04 |
| U-238           | $\Sigma$ DOSE(j) |           | 5.186E-04  | 5.182E-04 | 5.175E-04 | 5.149E-04 | 5.076E-04 | 4.828E-04 | 4.185E-04 | 2.538E-04 |

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

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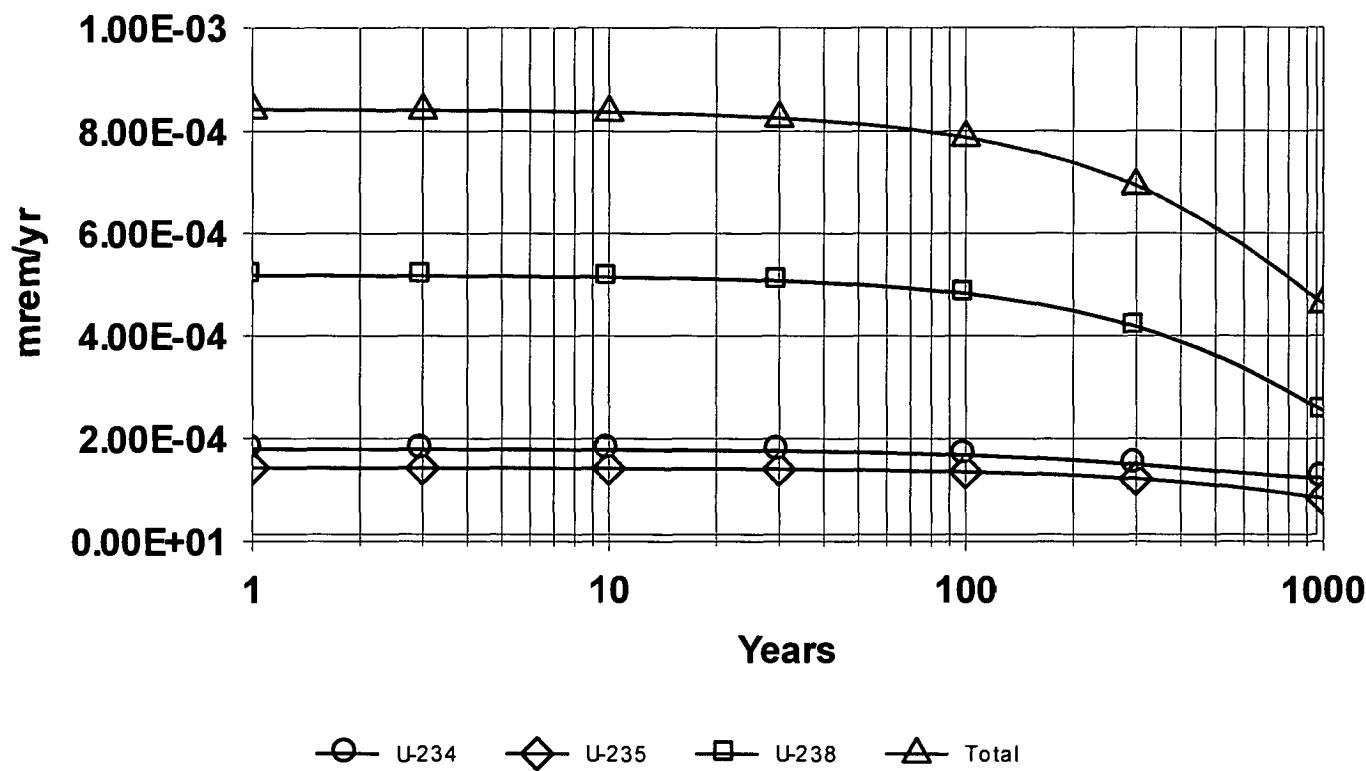
Individual Nuclide Soil Concentration  
Parent Nuclide and Branch Fraction Indicated

| ONuclide | Parent          | THF(i)       | S(j,t), pCi/g |           |           |           |           |           |           |           |
|----------|-----------------|--------------|---------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| (j)      | (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 |           |
| U-234    | U-234           | 1.000E+00    | 2.700E-01     | 2.698E-01 | 2.694E-01 | 2.681E-01 | 2.643E-01 | 2.513E-01 | 2.177E-01 | 1.317E-01 |
| U-234    | U-238           | 9.999E-01    | 0.000E+00     | 7.648E-07 | 2.291E-06 | 7.599E-06 | 2.247E-05 | 7.125E-05 | 1.852E-04 | 3.740E-04 |
| U-234    | $\Sigma S(j)$ : |              | 2.700E-01     | 2.698E-01 | 2.694E-01 | 2.681E-01 | 2.643E-01 | 2.514E-01 | 2.179E-01 | 1.321E-01 |
| 0Th-230  | U-234           | 1.000E+00    | 0.000E+00     | 2.430E-06 | 7.284E-06 | 2.422E-05 | 7.213E-05 | 2.344E-04 | 6.550E-04 | 1.725E-03 |
| Th-230   | U-238           | 9.999E-01    | 0.000E+00     | 3.443E-12 | 3.096E-11 | 3.429E-10 | 3.056E-09 | 3.284E-08 | 2.688E-07 | 2.161E-06 |
| Th-230   | $\Sigma S(j)$ : |              | 0.000E+00     | 2.430E-06 | 7.284E-06 | 2.422E-05 | 7.213E-05 | 2.345E-04 | 6.553E-04 | 1.727E-03 |
| 0Ra-226  | U-234           | 1.000E+00    | 0.000E+00     | 5.262E-10 | 4.730E-09 | 5.235E-08 | 4.660E-07 | 4.980E-06 | 4.016E-05 | 3.078E-04 |
| Ra-226   | U-238           | 9.999E-01    | 0.000E+00     | 4.972E-16 | 1.341E-14 | 4.945E-13 | 1.319E-11 | 4.687E-10 | 1.124E-08 | 2.775E-07 |
| Ra-226   | $\Sigma S(j)$ : |              | 0.000E+00     | 5.262E-10 | 4.730E-09 | 5.236E-08 | 4.660E-07 | 4.981E-06 | 4.017E-05 | 3.080E-04 |
| 0Pb-210  | U-234           | 1.000E+00    | 0.000E+00     | 5.410E-12 | 1.437E-10 | 5.030E-09 | 1.167E-07 | 2.769E-06 | 3.263E-05 | 2.900E-04 |
| Pb-210   | U-238           | 9.999E-01    | 0.000E+00     | 3.840E-18 | 3.069E-16 | 3.617E-14 | 2.584E-12 | 2.187E-10 | 8.364E-09 | 2.539E-07 |
| Pb-210   | $\Sigma S(j)$ : |              | 0.000E+00     | 5.410E-12 | 1.437E-10 | 5.030E-09 | 1.167E-07 | 2.770E-06 | 3.263E-05 | 2.902E-04 |
| 0U-235   | U-235           | 1.000E+00    | 2.000E-02     | 1.999E-02 | 1.996E-02 | 1.986E-02 | 1.958E-02 | 1.862E-02 | 1.614E-02 | 9.787E-03 |
| 0Pa-231  | U-235           | 1.000E+00    | 0.000E+00     | 4.229E-07 | 1.267E-06 | 4.201E-06 | 1.242E-05 | 3.936E-05 | 1.021E-04 | 2.049E-04 |
| 0Ac-227  | U-235           | 1.000E+00    | 0.000E+00     | 6.658E-09 | 5.855E-08 | 6.011E-07 | 4.381E-06 | 2.695E-05 | 8.885E-05 | 1.923E-04 |
| 0U-238   | U-238           | 5.400E-05    | 1.458E-05     | 1.457E-05 | 1.455E-05 | 1.448E-05 | 1.427E-05 | 1.357E-05 | 1.177E-05 | 7.135E-06 |
| U-238    | U-238           | 9.999E-01    | 2.700E-01     | 2.698E-01 | 2.694E-01 | 2.681E-01 | 2.643E-01 | 2.514E-01 | 2.179E-01 | 1.321E-01 |
| U-238    | $\Sigma S(j)$ : |              | 2.700E-01     | 2.698E-01 | 2.694E-01 | 2.681E-01 | 2.643E-01 | 2.514E-01 | 2.179E-01 | 1.321E-01 |

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

0RESCALC.EXE execution time = 2.86 seconds

### DOSE: All Nuclides Summed, All Pathways Summed



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Includes All Pathways

DT-34 Utility Worker  
RESRAD Risk Summary

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Cancer Risk Slope Factors Summary Table  
Risk Library: HEAST 2001 Morbidity

| 0<br>Menu | Parameter  | Current Value | Base Case* | Parameter Name |
|-----------|--|---------------|------------|----------------|
| Sf-1      | Ground external radiation slope factors, 1/yr per (pCi/g): |               |            |                |
| Sf-1      | Ac-227+D   | 1.47E-06      | 3.48E-10   | SLPF( 1,1)     |
| Sf-1      | Pa-231   | 1.39E-07      | 1.39E-07   | SLPF( 2,1)     |
| Sf-1      | Pb-210+D   | 4.21E-09      | 1.41E-09   | SLPF( 3,1)     |
| Sf-1      | Ra-226+D   | 8.49E-06      | 2.29E-08   | SLPF( 4,1)     |
| Sf-1      | Th-230   | 8.19E-10      | 8.19E-10   | SLPF( 5,1)     |
| Sf-1      | U-234  | 2.52E-10      | 2.52E-10   | SLPF( 6,1)     |
| Sf-1      | U-235+D  | 5.43E-07      | 5.18E-07   | SLPF( 7,1)     |
| Sf-1      | U-238  | 4.99E-11      | 4.99E-11   | SLPF( 8,1)     |
| Sf-1      | U-238+D  | 1.14E-07      | 4.99E-11   | SLPF( 9,1)     |
| Sf-2      | Inhalation, slope factors, 1/(pCi):                        |               |            |                |
| Sf-2      | Ac-227+D   | 2.09E-07      | 1.49E-07   | SLPF( 1,2)     |
| Sf-2      | Pa-231   | 4.55E-08      | 4.55E-08   | SLPF( 2,2)     |
| Sf-2      | Pb-210+D   | 1.39E-08      | 2.77E-09   | SLPF( 3,2)     |
| Sf-2      | Ra-226+D   | 1.16E-08      | 1.15E-08   | SLPF( 4,2)     |
| Sf-2      | Th-230   | 2.85E-08      | 2.85E-08   | SLPF( 5,2)     |
| Sf-2      | U-234  | 1.14E-08      | 1.14E-08   | SLPF( 6,2)     |
| Sf-2      | U-235+D  | 1.01E-08      | 1.01E-08   | SLPF( 7,2)     |
| Sf-2      | U-238  | 9.32E-09      | 9.32E-09   | SLPF( 8,2)     |
| Sf-2      | U-238+D  | 9.35E-09      | 9.32E-09   | SLPF( 9,2)     |
| Sf-3      | Food ingestion, slope factors, 1/(pCi):                    |               |            |                |
| Sf-3      | Ac-227+D   | 6.53E-10      | 2.45E-10   | SLPF( 1,3)     |
| Sf-3      | Pa-231   | 2.26E-10      | 2.26E-10   | SLPF( 2,3)     |
| Sf-3      | Pb-210+D   | 3.44E-09      | 1.18E-09   | SLPF( 3,3)     |
| Sf-3      | Ra-226+D   | 5.15E-10      | 5.14E-10   | SLPF( 4,3)     |
| Sf-3      | Th-230   | 1.19E-10      | 1.19E-10   | SLPF( 5,3)     |
| Sf-3      | U-234  | 9.55E-11      | 9.55E-11   | SLPF( 6,3)     |
| Sf-3      | U-235+D  | 9.76E-11      | 9.44E-11   | SLPF( 7,3)     |
| Sf-3      | U-238  | 8.66E-11      | 8.66E-11   | SLPF( 8,3)     |
| Sf-3      | U-238+D  | 1.21E-10      | 8.66E-11   | SLPF( 9,3)     |
| Sf-3      | Water ingestion, slope factors, 1/(pCi):                   |               |            |                |
| Sf-3      | Ac-227+D   | 4.86E-10      | 2.01E-10   | SLPF( 1,4)     |
| Sf-3      | Pa-231   | 1.73E-10      | 1.73E-10   | SLPF( 2,4)     |
| Sf-3      | Pb-210+D   | 1.27E-09      | 8.81E-10   | SLPF( 3,4)     |
| Sf-3      | Ra-226+D   | 3.86E-10      | 3.85E-10   | SLPF( 4,4)     |
| Sf-3      | Th-230   | 9.10E-11      | 9.10E-11   | SLPF( 5,4)     |
| Sf-3      | U-234  | 7.07E-11      | 7.07E-11   | SLPF( 6,4)     |
| Sf-3      | U-235+D  | 7.18E-11      | 6.96E-11   | SLPF( 7,4)     |
| Sf-3      | U-238  | 6.40E-11      | 6.40E-11   | SLPF( 8,4)     |
| Sf-3      | U-238+D  | 8.71E-11      | 6.40E-11   | SLPF( 9,4)     |
| Sf-3      | Soil ingestion, slope factors, 1/(pCi):                    |               |            |                |
| Sf-3      | Ac-227+D   | 1.16E-09      | 3.81E-10   | SLPF( 1,5)     |
| Sf-3      | Pa-231   | 3.74E-10      | 3.74E-10   | SLPF( 2,5)     |
| Sf-3      | Pb-210+D   | 2.66E-09      | 1.84E-09   | SLPF( 3,5)     |
| Sf-3      | Ra-226+D   | 7.30E-10      | 7.29E-10   | SLPF( 4,5)     |
| Sf-3      | Th-230   | 2.02E-10      | 2.02E-10   | SLPF( 5,5)     |

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Cancer Risk Slope Factors Summary Table (continued)  
Risk Library: HEAST 2001 Morbidity

| 0<br>Menu | Parameter                                | Current<br>Value | Base<br>Case* | Parameter<br>Name |
|-----------|--|------------------|---------------|-------------------|
| Sf-3      | U-234                                    | 1.58E-10         | 1.58E-10      | SLPF( 6,5)        |
| Sf-3      | U-235+D                                  | 1.63E-10         | 1.57E-10      | SLPF( 7,5)        |
| Sf-3      | U-238                                    | 1.43E-10         | 1.43E-10      | SLPF( 8,5)        |
| Sf-3      | U-238+D                                  | 2.10E-10         | 1.43E-10      | SLPF( 9,5)        |
| Sf-Rn     | Radon Inhalation slope factors, 1/(pCi): |                  |               |                   |
| Sf-Rn     | Rn-222                                   | 1.80E-12         | 1.80E-12      | SLPFRN(1,1)       |
| Sf-Rn     | Po-218                                   | 3.70E-12         | 3.70E-12      | SLPFRN(1,2)       |
| Sf-Rn     | Pb-214                                   | 6.20E-12         | 6.20E-12      | SLPFRN(1,3)       |
| Sf-Rn     | Bi-214                                   | 1.50E-11         | 1.50E-11      | SLPFRN(1,4)       |
| Sf-Rn     | Radon K factors, (mrem/WLM):             |                  |               |                   |
| Sf-Rn     | Rn-222 Indoor                            | 7.60E+02         | 7.60E+02      | KFACTR(1,1)       |
| Sf-Rn     | Rn-222 Outdoor                           | 5.70E+02         | 5.70E+02      | KFACTR(1,2)       |

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

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| ONuclide<br>(i) | Risk Slope and Environmental Transport Factors for the Ground Pathway |              |           |           |           |           |           |           |           |
|-----------------|---|--------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
|                 | Slope(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 |
| Ac-227          | 3.480E-10   | 8.703E-03    | 8.703E-03 | 8.703E-03 | 8.703E-03 | 8.703E-03 | 8.703E-03 | 8.703E-03 | 8.703E-03 |
| At-218          | 3.570E-09   | 8.826E-03    | 8.826E-03 | 8.826E-03 | 8.826E-03 | 8.826E-03 | 8.826E-03 | 8.826E-03 | 8.826E-03 |
| Bi-210          | 2.760E-09   | 8.596E-03    | 8.596E-03 | 8.596E-03 | 8.596E-03 | 8.596E-03 | 8.596E-03 | 8.596E-03 | 8.596E-03 |
| Bi-211          | 1.880E-07   | 8.599E-03    | 8.599E-03 | 8.599E-03 | 8.599E-03 | 8.599E-03 | 8.599E-03 | 8.599E-03 | 8.599E-03 |
| Bi-214          | 7.480E-06   | 8.551E-03    | 8.551E-03 | 8.551E-03 | 8.551E-03 | 8.551E-03 | 8.551E-03 | 8.551E-03 | 8.551E-03 |
| Fr-223          | 1.400E-07   | 8.643E-03    | 8.643E-03 | 8.643E-03 | 8.643E-03 | 8.643E-03 | 8.643E-03 | 8.643E-03 | 8.643E-03 |
| Pa-231          | 1.390E-07   | 8.6C2E-03    | 8.602E-03 |
| Pa-234          | 8.710E-06   | 8.551E-03    | 8.551E-03 | 8.551E-03 | 8.551E-03 | 8.551E-03 | 8.551E-03 | 8.551E-03 | 8.551E-03 |
| Pa-234m         | 6.870E-08   | 8.544E-03    | 8.544E-03 | 8.544E-03 | 8.544E-03 | 8.544E-03 | 8.544E-03 | 8.544E-03 | 8.544E-03 |
| Pb-210          | 1.410E-09   | 8.927E-03    | 8.927E-03 | 8.927E-03 | 8.927E-03 | 8.927E-03 | 8.927E-03 | 8.927E-03 | 8.927E-03 |
| Pb-211          | 2.290E-07   | 8.550E-03    | 8.550E-03 | 8.550E-03 | 8.550E-03 | 8.550E-03 | 8.550E-03 | 8.550E-03 | 8.550E-03 |
| Pb-214          | 9.820E-07   | 8.602E-03    | 8.602E-03 | 8.602E-03 | 8.602E-03 | 8.602E-03 | 8.602E-03 | 8.602E-03 | 8.602E-03 |
| Po-210          | 3.950E-11   | 8.542E-03    | 8.542E-03 | 8.542E-03 | 8.542E-03 | 8.542E-03 | 8.542E-03 | 8.542E-03 | 8.542E-03 |
| Po-211          | 3.580E-08   | 8.514E-03    | 8.514E-03 | 8.514E-03 | 8.514E-03 | 8.514E-03 | 8.514E-03 | 8.514E-03 | 8.514E-03 |
| Po-214          | 3.860E-10   | 8.514E-03    | 8.514E-03 | 8.514E-03 | 8.514E-03 | 8.514E-03 | 8.514E-03 | 8.514E-03 | 8.514E-03 |
| Po-215          | 7.480E-10   | 8.560E-03    | 8.560E-03 | 8.560E-03 | 8.560E-03 | 8.560E-03 | 8.560E-03 | 8.560E-03 | 8.560E-03 |
| Po-218          | 4.260E-11   | 8.542E-03    | 8.542E-03 | 8.542E-03 | 8.542E-03 | 8.542E-03 | 8.542E-03 | 8.542E-03 | 8.542E-03 |
| Ra-223          | 4.340E-07   | 8.639E-03    | 8.639E-03 | 8.639E-03 | 8.639E-03 | 8.639E-03 | 8.639E-03 | 8.639E-03 | 8.639E-03 |
| Ra-226          | 2.290E-08   | 8.664E-03    | 8.664E-03 | 8.664E-03 | 8.664E-03 | 8.664E-03 | 8.664E-03 | 8.664E-03 | 8.664E-03 |
| Rn-219          | 2.250E-07   | 8.607E-03    | 8.607E-03 | 8.607E-03 | 8.607E-03 | 8.607E-03 | 8.607E-03 | 8.607E-03 | 8.607E-03 |
| Rn-222          | 1.740E-09   | 8.523E-03    | 8.523E-03 | 8.523E-03 | 8.523E-03 | 8.523E-03 | 8.523E-03 | 8.523E-03 | 8.523E-03 |
| Th-227          | 3.780E-07   | 8.650E-03    | 8.650E-03 | 8.650E-03 | 8.650E-03 | 8.650E-03 | 8.650E-03 | 8.650E-03 | 8.650E-03 |
| Th-230          | 8.190E-10   | 8.722E-03    | 8.722E-03 | 8.722E-03 | 8.722E-03 | 8.722E-03 | 8.722E-03 | 8.722E-03 | 8.722E-03 |
| Th-231          | 2.450E-08   | 8.732E-03    | 8.732E-03 | 8.732E-03 | 8.732E-03 | 8.732E-03 | 8.732E-03 | 8.732E-03 | 8.732E-03 |
| Th-234          | 1.630E-08   | 8.742E-03    | 8.742E-03 | 8.742E-03 | 8.742E-03 | 8.742E-03 | 8.742E-03 | 8.742E-03 | 8.742E-03 |
| Tl-207          | 1.520E-08   | 8.553E-03    | 8.553E-03 | 8.553E-03 | 8.553E-03 | 8.553E-03 | 8.553E-03 | 8.553E-03 | 8.553E-03 |
| Tl-210          | 0.0000E+00  | 9.100E-03    | 9.100E-03 | 9.100E-03 | 9.100E-03 | 9.100E-03 | 9.100E-03 | 9.100E-03 | 9.100E-03 |
| U-234           | 2.520E-10   | 8.772E-03    | 8.772E-03 | 8.772E-03 | 8.772E-03 | 8.772E-03 | 8.772E-03 | 8.772E-03 | 8.772E-03 |
| U-235           | 5.180E-07   | 8.660E-03    | 8.660E-03 | 8.660E-03 | 8.660E-03 | 8.660E-03 | 8.660E-03 | 8.660E-03 | 8.660E-03 |
| U-238           | 4.990E-11   | 9.018E-03    | 9.018E-03 | 9.018E-03 | 9.018E-03 | 9.018E-03 | 9.018E-03 | 9.018E-03 | 9.018E-03 |

\* - Units are 1/yr per (pCi/g) at infinite depth and area. Multiplication by ETFG(i,t) converts to site conditions.

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Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
 As pCi/yr at t = 0.000E+00 years

| Radio-Nuclide | Water Independent Pathways (Inhalation w/o radon) |           |           |           |           | Water Dependent Pathways |           |           |           |           | Total Ingestion* |
|---------------|---|-----------|-----------|-----------|-----------|--------------------------|-----------|-----------|-----------|-----------|------------------|
|               | Inhalation  | Plant     | Meat      | Milk      | Soil      | Water                    | Fish      | Plant     | Meat      | Milk      |                  |
| Ac-227        | 0.000E+00   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00        |
| Pa-231        | 0.000E+00   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00        |
| Pb-210        | 0.000E+00   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00        |
| Ra-226        | 0.000E+00   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00        |
| Th-230        | 0.000E+00   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00        |
| U-234         | 4.370E-04   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 4.305E-01 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 4.305E-01        |
| U-235         | 3.237E-05   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 3.189E-02 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 3.189E-02        |
| U-238         | 4.370E-04   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 4.305E-01 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 4.305E-01        |

\* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, scil  
 and water-dependent water, fish, plant, meat, milk pathways

0

Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of  
 Radon and its Decay Products as pCi/yr at t = 0.000E+00 years

0

| Radon Pathway | Rn-222    | Po-218    | Pb-214    | Bi-214    | Rn-220    | Po-216    | Pb-212    | Bi-212    |
|---------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| Water-ind.    | 0.000E+00 |
| Water-dep.    | 0.000E+00 |
| Total         | 0.000E+00 |

Water-ind. == Water-independent Water-dep. == Water-dependent

0

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
 and Fraction of Total Risk at t = 0.000E+00 years

0

| Radio-Nuclide | Water Independent Pathways (Inhalation excludes radon) |        |            |        |           |        |           |        |           |        |           |        |
|---------------|--|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|               | Ground   |        | Inhalation |        | Plant     |        | Meat      |        | Milk      |        |           |        |
|               | risk   | fract. | risk       | fract. | risk      | fract. | risk      | fract. | risk      | fract. | risk      | fract. |
| Ac-227        | 2.814E-17  | 0.0000 | 7.517E-19  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.121E-18 | 0.0000 |
| Pa-231        | 2.529E-16  | 0.0000 | 1.558E-17  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.261E-16 | 0.0000 |
| Pb-210        | 4.965E-23  | 0.0000 | 3.045E-23  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 5.748E-21 | 0.0000 |
| Ra-226        | 1.274E-17  | 0.0000 | 3.284E-21  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.042E-19 | 0.0000 |
| Th-230        | 8.679E-18  | 0.0000 | 5.605E-17  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.913E-16 | 0.0000 |
| U-234         | 5.966E-13  | 0.0011 | 4.980E-12  | 0.0094 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.799E-11 | 0.1282 |
| U-235         | 9.396E-11  | 0.1771 | 3.269E-13  | 0.0006 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 5.207E-12 | 0.0098 |
| U-238         | 2.630E-10  | 0.4957 | 4.085E-12  | 0.0077 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 9.037E-11 | 0.1704 |
| Total         | 3.575E-10  | 0.6740 | 9.392E-12  | 0.0177 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.636E-10 | 0.3083 |

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Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
and Fraction of Total Risk at t= 0.000E+00 years

## Water Dependent Pathways

| Radio-Nuclide | Water     |        | Fish      |        | Plant     |        | Meat      |        | Milk      |        | All Pathways** |        |
|---------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|----------------|--------|
|               | risk      | fract. | risk           | fract. |
| Ac-227        | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.000C | 0.000E+00 | 0.0000 | 3.301E-17      | 0.0000 |
| Pa-231        | 0.000E+00 | 0.0000 | 3.945E-16      | 0.0000 |
| Pb-210        | 0.000E+00 | 0.0000 | 5.828E-21      | 0.0000 |
| Ra-226        | 0.000E+00 | 0.0000 | 1.295E-17      | 0.0000 |
| Th-230        | 0.000E+00 | 0.0000 | 4.560E-16      | 0.0000 |
| U-234         | 0.000E+00 | 0.0000 | 7.357E-11      | 0.1387 |
| U-235         | 0.000E+00 | 0.0000 | 9.950E-11      | 0.1876 |
| U-238         | 0.000E+00 | 0.0000 | 3.574E-10      | 0.6738 |
| Total         | 0.000E+00 | 0.0000 | 5.305E-10      | 1.0000 |

\*\* Sum of water independent ground, inhalation, plant, meat, milk, soil  
and water dependent water, fish, plant, meat, milk pathways

0

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of  
Radon and its Decay Products at t= 0.000E+00 years  
Radionuclides

| Radon Pathway | En-222    | Po-218    | Pb-214    | Bi-214    | Rn-220    | Po-216    | Pb-212    | Bi-212    |
|---------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| Water-ind.    | 0.000E+00 |
| Water-dep.    | 0.000E+00 |
| Total         | 0.000E+00 |

Water-ind. == Water-independent      Water-dep. == Water-dependent

0

Total Excess Cancer Risk CNRS(i,p,t)\*\*\* for Initially Existent Radionuclides (i) and Pathways (p)  
and Fraction of Total Risk at t= 0.000E+00 years

## Water Independent Pathways (Inhalation excludes radon)

| Radio-Nuclide | Ground    |        | Inhalation |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|---------------|-----------|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|               | risk      | fract. | risk       | fract. | risk      | fract. | risk      | fract. | risk      | fract. | risk      | fract. | risk      | fract. |
| U-234         | 5.967E-13 | 0.0011 | 4.980E-12  | 0.0094 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.799E-11 | 0.1282 |
| U-235         | 9.396E-11 | 0.1771 | 3.269E-13  | 0.0006 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 5.207E-12 | 0.0098 |
| U-238         | 2.630E-10 | 0.4957 | 4.085E-12  | 0.0077 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 9.037E-11 | 0.1704 |
| Total         | 3.575E-10 | 0.6740 | 9.392E-12  | 0.0177 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.636E-10 | 0.3083 |

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Total Excess Cancer Risk CNRS(i,p,t)\*\*\* for Initially Existent Radionuclides (i) and Pathways (p)  
and Fraction of Total Risk at t= 0.000E+00 years

Water Dependent Pathways

| Radio-Nuclide | Water     |        | Fish      |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | All pathways |        |
|---------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|--------------|--------|
|               | risk      | fract. | risk         | fract. |
| U-234         | 0.000E+00 | 0.0000 | 7.357E-11    | 0.1387 |
| U-235         | 0.000E+00 | 0.0000 | 9.950E-11    | 0.1876 |
| U-238         | 0.000E+00 | 0.0000 | 3.574E-10    | 0.6738 |
| Total         | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | C.0000 | 0.000E+00 | 0.0000 | 5.305E-10    | 1.0000 |

\*\*\*CNRSI(i,p,t) includes contribution from decay daughter radionuclides

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T<sub>1/2</sub> Limit = 180 days

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Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
As pCi/yr at t= 1.000E+00 years

| Radio-Nuclide | Water Independent Pathways (Inhalation w/o radon) |           |           |           |           | Water Dependent Pathways |           |           |           |           | Total Ingestion* |
|---------------|---|-----------|-----------|-----------|-----------|--------------------------|-----------|-----------|-----------|-----------|------------------|
|               | Inhalation  | Plant     | Meat      | Milk      | Soil      | Water                    | Fish      | Plant     | Meat      | Milk      |                  |
| Ac-227        | 1.078E-11   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 1.061E-08 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 1.061E-08        |
| Pa-231        | 6.845E-10   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 6.742E-07 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 6.742E-07        |
| Pb-210        | 8.757E-15   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 8.625E-12 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 8.625E-12        |
| Ra-226        | 8.517E-13   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 8.389E-10 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 8.389E-10        |
| Th-230        | 3.933E-09   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 3.874E-06 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 3.874E-06        |
| U-234         | 4.367E-04   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 4.302E-01 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 4.302E-01        |
| U-235         | 3.235E-05   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 3.186E-02 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 3.186E-02        |
| U-238         | 4.367E-04   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 4.302E-01 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 4.302E-01        |

\* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil  
and water-dependent water, fish, plant, meat, milk pathways

0 Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of  
Radon and its Decay Products as pCi/yr at t= 1.000E+00 years

| Radon Pathway | Rn-222    | Po-218    | Pb-214    | Bi-214    | Rn-220    | Po-216    | Pb-212    | Bi-212    |
|---------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| Water-ind.    | 0.000E+00 |
| Water-dep.    | 0.000E+00 |
| Total         | 0.000E+00 |

Water-ind. == Water-independent      Water-dep. == Water-dependent

0 Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
and Fraction of Total Risk at t= 1.000E+00 years

| Radio-Nuclide | Water Independent Pathways (Inhalation excludes radon) |        |            |        |           |        |           |        |           |        |
|---------------|--|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|
|               | Ground   |        | Inhalation |        | Plant     |        | Meat      |        | Milk      |        |
|               | risk   | fract. | risk       | fract. | risk      | fract. | risk      | fract. | risk      | fract. |
| Ac-227        | 1.950E-16  | 0.0000 | 5.210E-18  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Pa-231        | 7.581E-16  | 0.0000 | 4.670E-17  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Pb-210        | 7.395E-22  | 0.0000 | 4.536E-22  | 0.0000 | 0.000E-00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Ra-226        | 8.914E-17  | 0.0000 | 2.298E-20  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Th-230        | 2.603E-17  | 0.0000 | 1.681E-16  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| U-234         | 5.962E-13  | 0.0011 | 4.977E-12  | 0.0094 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| U-235         | 9.390E-11  | 0.1771 | 3.267E-13  | 0.0006 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| U-238         | 2.628E-10  | 0.4957 | 4.082E-12  | 0.0077 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 |
| Total         | 3.573E-10  | 0.6740 | 9.386E-12  | 0.0177 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.3083 |

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Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
and Fraction of Total Risk at t= 1.000E+00 years

Water Dependent Pathways

| Radio-Nuclide | Water     |        | Fish      |        | Plant     |        | Meat      |        | Milk      |        | All Pathways** |        |
|---------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|----------------|--------|
|               | risk      | fract. | risk           | fract. |
| Ac-227        | 0.000E+00 | 0.0000 | 2.288E-16      | 0.0000 |
| Pa-231        | 0.000E+00 | 0.0000 | 1.183E-15      | 0.0000 |
| Pb-210        | 0.000E+00 | 0.0000 | 8.682E-20      | 0.0000 |
| Ra-226        | 0.000E+00 | 0.0000 | 9.059E-17      | 0.0000 |
| Th-230        | 0.000E+00 | 0.0000 | 1.368E-15      | 0.0000 |
| U-234         | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | C.0000 | 7.351E-11      | 0.1387 |
| U-235         | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | C.0000 | 9.943E-11      | 0.1876 |
| U-238         | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | C.0000 | 3.572E-10      | 0.6738 |
| Total         | 0.000E+00 | 0.0000 | 5.301E-10      | 1.0000 |

\*\* Sum of water independent ground, inhalation, plant, meat, milk, soil  
and water dependent water, fish, plant, meat, milk pathways

0  
Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of  
Radon and its Decay Products at t= 1.000E+00 years  
Radionuclides

| Radon Pathway | Rn-222    | Po-218    | Pb-214    | Bi-214    | Rn-220    | Po-216    | Pb-212    | Bi-212    |
|---------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| Water-ind.    | 0.000E+00 |
| Water-dep.    | 0.000E+00 |
| Total         | 0.000E+00 |

Water-ind. == Water-independent Water-dep. == Water-dependent

0  
Total Excess Cancer Risk CNRS(i,p,t)\*\*\* for Initially Existent Radionuclides (i) and Pathways (p)  
and Fraction of Total Risk at t= 1.000E+00 years

| Radio-Nuclide | Ground    |        | Inhalation |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|---------------|-----------|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|               | risk      | fract. | risk       | fract. | risk      | fract. | risk      | fract. | risk      | fract. | risk      | fract. | risk      | fract. |
| U-234         | 5.963E-13 | 0.0011 | 4.977E-12  | 0.0094 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.794E-11 | 0.1282 |
| U-235         | 9.390E-11 | 0.1771 | 3.267E-13  | 0.0006 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 5.204E-12 | 0.0098 |
| U-238         | 2.628E-10 | 0.4957 | 4.082E-12  | 0.0077 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 9.031E-11 | 0.1704 |
| Total         | 3.573E-10 | 0.6740 | 9.386E-12  | 0.0177 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.635E-10 | 0.3083 |

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Total Excess Cancer Risk CNRS(i,p,t)\*\*\* for Initially Existent Radionuclides (i) and Pathways (p)  
 and Fraction of Total Risk at t = 1.000E+00 years

## Water Dependent Pathways

| Radio-Nuclide | Water     |        | Fish      |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | All pathways |        |
|---------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|--------------|--------|
|               | risk      | fract. | risk         | fract. |
| U-234         | 0.000E+00 | 0.0000 | 7.352E-11    | 0.1387 |
| U-235         | 0.000E+00 | 0.0000 | 9.943E-11    | 0.1876 |
| U-238         | 0.000E+00 | 0.0000 | 3.572E-10    | 0.6738 |
| Total         | 0.000E+00 | 0.0000 | 5.301E-10    | 1.0000 |

\*\*\*CNRSI(i,p,t) includes contribution from decay daughter radionuclides

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Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
As pCi/yr at t= 3.000E+00 years

| Radio-Nuclide | Water Independent Pathways (Inhalation w/o radon) |           |           |           |           | Water Dependent Pathways |           |           |           |           | Total Ingestion* |
|---------------|---|-----------|-----------|-----------|-----------|--------------------------|-----------|-----------|-----------|-----------|------------------|
|               | Inhalation  | Plant     | Meat      | Milk      | Soil      | Water                    | Fish      | Plant     | Meat      | Milk      |                  |
| Ac-227        | 9.477E-11   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 9.335E-08 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 9.335E-08        |
| Pa-231        | 2.050E-09   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 2.020E-06 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 2.020E-06        |
| Pb-210        | 2.326E-13   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 2.291E-10 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 2.291E-10        |
| Ra-226        | 7.657E-12   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 7.542E-09 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 7.542E-09        |
| Th-230        | 1.179E-08   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 1.161E-05 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 1.161E-05        |
| U-234         | 4.361E-04   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 4.295E-01 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 4.295E-01        |
| U-235         | 3.230E-05   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 3.182E-02 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 3.182E-02        |
| U-238         | 4.361E-04   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 4.295E-01 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 4.295E-01        |

\* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil  
and water-dependent water, fish, plant, meat, milk pathways

0

Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of  
Radon and its Decay Products as pCi/yr at t= 3.000E+00 years

0

| Radon Pathway | Rn-222    | Po-218    | Pb-214    | Bi-214    | Rn-220    | Po-216    | Pb-212    | Bi-212    |
|---------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| Water-ind.    | 0.000E+00 |
| Water-dep.    | 0.000E+00 |
| Total         | 0.000E+00 |

Water-ind. == Water-independent      Water-dep. == Water-dependent

0

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
and Fraction of Total Risk at t= 3.000E+00 years

0

| Radio-Nuclide | Water Independent Pathways (Inhalation excludes radon) |        |            |        |           |        |           |        |           |        |           |        |
|---------------|--|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|               | Ground   |        | Inhalation |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|               | risk   | fract. | risk       | fract. | risk      | fract. | risk      | fract. | risk      | fract. | risk      | fract. |
| Ac-227        | 1.008E-15  | 0.0000 | 2.693E-17  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.476E-16 | 0.0000 |
| Pa-231        | 1.766E-15  | 0.0000 | 1.088E-16  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 8.809E-16 | 0.0000 |
| Pb-210        | 8.494E-21  | 0.0000 | 5.209E-21  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 9.834E-19 | 0.0000 |
| Ra-226        | 4.706E-16  | 0.0000 | 1.213E-19  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 7.545E-18 | 0.0000 |
| Th-230        | 6.069E-17  | 0.0000 | 3.919E-16  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.736E-15 | 0.0000 |
| U-234         | 5.954E-13  | 0.0011 | 4.970E-12  | 0.0094 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.784E-11 | 0.1282 |
| U-235         | 9.376E-11  | 0.1771 | 3.262E-13  | 0.0006 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 5.196E-12 | 0.0098 |
| U-238         | 2.624E-10  | 0.4957 | 4.076E-12  | 0.0077 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 9.018E-11 | 0.1704 |
| Total         | 3.568E-10  | 0.6740 | 9.373E-12  | 0.0177 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.632E-10 | 0.3083 |

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T<sub>1/2</sub> Limit = 180 days

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Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
and Fraction of Total Risk at t= 3.000E+00 years

Water Dependent Pathways

| Radio-Nuclide | Water     |        | Fish      |        | Plant     |        | Meat      |        | Milk      |        | All Pathways** |        |
|---------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|----------------|--------|
|               | risk      | fract. | risk           | fract. |
| Ac-227        | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.00CE+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.182E-15      | 0.0000 |
| Pa-231        | 0.000E+00 | 0.0000 | 2.756E-15      | 0.0000 |
| Pb-210        | 0.000E+00 | 0.0000 | 9.971E-19      | 0.0000 |
| Ra-226        | 0.000E+00 | 0.0000 | 4.783E-16      | 0.0000 |
| Th-230        | 0.000E+00 | 0.0000 | 3.189E-15      | 0.0000 |
| U-234         | 0.000E+00 | 0.0000 | 7.341E-11      | 0.1387 |
| U-235         | 0.000E+00 | 0.0000 | 9.928E-11      | 0.1876 |
| U-238         | 0.000E+00 | 0.0000 | 3.567E-10      | 0.6738 |
| Total         | 0.000E+00 | 0.0000 | 5.294E-10      | 1.0000 |

\*\* Sum of water independent ground, inhalation, plant, meat, milk, soil  
and water dependent water, fish, plant, meat, milk pathways

0

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of  
Radon and its Decay Products at t= 3.000E+00 years  
Radionuclides

| Radon Pathway | Rn-222    | Po-218    | Pb-214    | Bi-214    | Rn-220    | Po-216    | Pb-212    | Bi-212    |
|---------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| Water-ind.    | 0.000E+00 |
| Water-dep.    | 0.000E+00 |
| Total         | 0.000E+00 |

Water-ind. == Water-independent      Water-dep. == Water-dependent

0

Total Excess Cancer Risk CNRS(i,p,t)\*\*\* for Initially Existent Radionuclides (i) and Pathways (p)  
and Fraction of Total Risk at t= 3.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

| Radio-Nuclide | Ground    |        | Inhalation |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|---------------|-----------|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|               | risk      | fract. | risk       | fract. | risk      | fract. | risk      | fract. | risk      | fract. | risk      | fract. | risk      | fract. |
| U-234         | 5.959E-13 | 0.0011 | 4.970E-12  | 0.0094 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.785E-11 | 0.1282 |
| U-235         | 9.376E-11 | 0.1771 | 3.263E-13  | 0.0006 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 5.197E-12 | 0.0098 |
| U-238         | 2.624E-10 | 0.4957 | 4.076E-12  | 0.0077 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 9.018E-11 | 0.1704 |
| Total         | 3.568E-10 | 0.6740 | 9.373E-12  | 0.0177 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.632E-10 | 0.3083 |

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Total Excess Cancer Risk CNRS(i,p,t)\*\*\* for Initially Existent Radionuclides (i) and Pathways (p)  
and Fraction of Total Risk at t= 3.000E+00 years

Water Dependent Pathways

| Radio-Nuclide | Water     |        | Fish      |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | All pathways |        |
|---------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|--------------|--------|
|               | risk      | fract. | risk         | fract. |
| U-234         | 0.000E+00 | 0.0000 | 7.341E-11    | 0.1387 |
| U-235         | 0.000E+00 | 0.0000 | 9.929E-11    | 0.1876 |
| U-238         | 0.000E+00 | 0.0000 | 3.567E-10    | 0.6738 |
| Total         | 0.000E+00 | 0.0000 | 5.294E-10    | 1.0000 |

\*\*\*CNRSI(i,p,t) includes contribution from decay daughter radionuclides

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Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
As pCi/yr at t= 1.000E+01 years

| Radio-Nuclide | Water Independent Pathways (Inhalation w/o radon) |           |           |           |           | Water Dependent Pathways |           |           |           |           | Total Ingestion* |
|---------------|---|-----------|-----------|-----------|-----------|--------------------------|-----------|-----------|-----------|-----------|------------------|
|               | Inhalation  | Plant     | Meat      | Milk      | Soil      | Water                    | Fish      | Plant     | Meat      | Milk      |                  |
| Ac-227        | 9.729E-10   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 9.583E-07 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 9.583E-07        |
| Pa-231        | 6.800E-09   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 6.698E-06 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 6.698E-06        |
| Pb-210        | 8.142E-12   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 8.020E-09 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 8.020E-09        |
| Ra-226        | 8.474E-11   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 8.347E-08 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 8.347E-08        |
| Th-230        | 3.920E-08   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 3.861E-05 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 3.861E-05        |
| U-234         | 4.339E-04   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 4.274E-01 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 4.274E-01        |
| U-235         | 3.214E-05   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 3.166E-02 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 3.166E-02        |
| U-238         | 4.339E-04   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 4.274E-01 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 4.274E-01        |

\* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil  
and water-dependent water, fish, plant, meat, milk pathways

0 Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of  
Radon and its Decay Products as pCi/yr at t= 1.000E+01 years

| Radon Pathway | Rn-222    | Po-218    | Pb-214    | Bi-214    | Rn-220    | Po-216    | Pb-212    | Bi-212    |
|---------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| Water-ind.    | 0.000E+00 |
| Water-dep.    | 0.000E+00 |
| Total         | 0.000E+00 |

Water-ind. == Water-independent      Water-dep. == Water-dependent

0 Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
and Fraction of Total Risk at t= 1.000E+01 years

| Radio-Nuclide | Water Independent Pathways (Inhalation excludes radon) |        |            |        |           |        |           |        |           |        |           |        |
|---------------|--|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|               | Ground   |        | Inhalation |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|               | risk   | fract. | risk       | fract. | risk      | fract. | risk      | fract. | risk      | fract. | risk      | fract. |
| Ac-227        | 8.336E-15  | 0.0000 | 2.227E-16  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.221E-15 | 0.0000 |
| Pa-231        | 5.272E-15  | 0.0000 | 3.248E-16  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.629E-15 | 0.0000 |
| Pb-210        | 2.130E-19  | 0.0000 | 1.306E-19  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.466E-17 | 0.0000 |
| Ra-226        | 4.194E-15  | 0.0000 | 1.081E-18  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.724E-17 | 0.0000 |
| Th-230        | 1.816E-16  | 0.0000 | 1.173E-15  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 8.188E-15 | 0.0000 |
| U-234         | 5.924E-13  | 0.0011 | 4.945E-12  | 0.0094 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.751E-11 | 0.1282 |
| U-235         | 9.329E-11  | 0.1771 | 3.246E-13  | 0.0006 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 5.170E-12 | 0.0098 |
| U-238         | 2.611E-10  | 0.4957 | 4.056E-12  | 0.0077 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 8.973E-11 | 0.1703 |
| Total         | 3.550E-10  | 0.6739 | 9.327E-12  | 0.0177 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.624E-10 | 0.3083 |

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Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
and Fraction of Total Risk at t= 1.000E+01 years

Water Dependent Pathways

| Radio-Nuclide | Water     |        | Fish      |        | Plant     |        | Meat      |        | Milk      |        | All Pathways** |        |
|---------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|----------------|--------|
|               | risk      | fract. | risk           | fract. |
| Ac-227        | 0.000E+00 | 0.0000 | 9.779E-15      | 0.0000 |
| Pa-231        | 0.000E+00 | 0.0000 | 8.226E-15      | 0.0000 |
| Pb-210        | 0.000E+00 | 0.0000 | 2.501E-17      | 0.0000 |
| Ra-226        | 0.000E+00 | 0.0000 | 4.262E-15      | 0.0000 |
| Th-230        | 0.000E+00 | 0.0000 | 9.542E-15      | 0.0000 |
| U-234         | 0.000E+00 | 0.0000 | 7.304E-11      | 0.1387 |
| U-235         | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.00CE+00 | 0.0000 | 0.000E+00 | 0.0000 | 9.879E-11      | 0.1875 |
| U-238         | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.00CE+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.549E-10      | 0.6737 |
| Total         | 0.000E+00 | 0.0000 | 5.267E-10      | 1.0000 |

\*\* Sum of water independent ground, inhalation, plant, meat, milk, soil  
and water dependent water, fish, plant, meat, milk pathways

0 Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of  
Radon and its Decay Products at t= 1.000E+01 years

| Radon Pathway | Rn-222    | Po-218    | Pb-214    | Bi-214    | Rn-220    | Po-216    | Pb-212    | Bi-212    |
|---------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| Water-ind.    | 0.000E+00 |
| Water-dep.    | 0.000E+00 |
| Total         | 0.000E+00 |

Water-ind. == Water-independent Water-dep. == Water-dependent

0 Total Excess Cancer Risk CNRS(i,p,t)\*\*\* for Initially Existent Radionuclides (i) and Pathways (p)  
and Fraction of Total Risk at t= 1.000E+01 years

| Radio-Nuclide | Ground    |        | Inhalation |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|---------------|-----------|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|               | risk      | fract. | risk       | fract. | risk      | fract. | risk      | fract. | risk      | fract. | risk      | fract. | risk      | fract. |
| U-234         | 5.967E-13 | 0.0011 | 4.946E-12  | 0.0094 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.751E-11 | 0.1282 |
| U-235         | 9.331E-11 | 0.1771 | 3.251E-13  | 0.0006 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 5.174E-12 | 0.0098 |
| U-238         | 2.611E-10 | 0.4957 | 4.056E-12  | 0.0077 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 8.973E-11 | 0.1704 |
| Total         | 3.550E-10 | 0.6739 | 9.327E-12  | 0.0177 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.624E-10 | 0.3083 |

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T½ Limit = 180 days

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Total Excess Cancer Risk CNRS(i,p,t)\*\*\* for Initially Existent Radionuclides (i) and Pathways (p)  
and Fraction of Total Risk at t= 1.000E+01 years

## Water Dependent Pathways

| Radio-Nuclide | Water     |        | Fish      |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | All pathways |        |
|---------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|--------------|--------|
|               | risk      | fract. | risk         | fract. |
| U-234         | 0.000E+00 | 0.0000 | 7.305E-11    | 0.1387 |
| U-235         | 0.000E+00 | 0.0000 | 9.881E-11    | 0.1876 |
| U-238         | 0.000E+00 | 0.0000 | 3.549E-10    | 0.6737 |
| Total         | 0.000E+00 | 0.0000 | 5.267E-10    | 1.0000 |

\*\*\*CNRSI(i,p,t) includes contribution from decay daughter radionuclides

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Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
 As pCi/yr at t = 3.000E+01 years

| Radio-Nuclide | Water Independent Pathways (Inhalation w/o radon) |           |           |           |           | Water Dependent Pathways |           |           |           |           | Total Ingestion* |
|---------------|---|-----------|-----------|-----------|-----------|--------------------------|-----------|-----------|-----------|-----------|------------------|
|               | Inhalation  | Plant     | Meat      | Milk      | Soil      | Water                    | Fish      | Plant     | Meat      | Milk      |                  |
| Ac-227        | 7.091E-09   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 6.985E-06 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 6.985E-06        |
| Pa-231        | 2.011E-08   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 1.980E-05 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 1.980E-05        |
| Pb-210        | 1.888E-10   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 1.860E-07 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 1.860E-07        |
| Ra-226        | 7.543E-10   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 7.429E-07 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 7.429E-07        |
| Th-230        | 1.168E-07   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 1.150E-04 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 1.150E-04        |
| U-234         | 4.278E-04   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 4.213E-01 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 4.213E-01        |
| U-235         | 3.169E-05   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 3.121E-02 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 3.121E-02        |
| U-238         | 4.278E-04   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 4.213E-01 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 4.213E-01        |

\* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil  
 and water-dependent water, fish, plant, meat, milk pathways

0

Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of  
 Radon and its Decay Products as pCi/yr at t = 3.000E+01 years

| Radon Pathway | Radionuclides |           |           |           |           |           |           |           |
|---------------|---------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
|               | Rn-222        | Po-218    | Pb-214    | Bi-214    | Rn-220    | Po-216    | Pb-212    | Bi-212    |
| Water-ind.    | 0.000E+00     | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 |
| Water-dep.    | 0.000E+00     | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 |
| Total         | 0.000E+00     | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 |

Water-ind. == Water-independent Water-dep. == Water-dependent

0 Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
 and Fraction of Total Risk at t = 3.000E+01 years

| Radio-Nuclide | Water Independent Pathways (Inhalation excludes radon) |        |            |        |           |        |           |        |           |        |           |        |
|---------------|--|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|               | Ground   |        | Inhalation |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|               | risk   | fract. | risk       | fract. | risk      | fract. | risk      | fract. | risk      | fract. | risk      | fract. |
| Ac-227        | 5.696E-14  | 0.0001 | 1.522E-15  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0300 | 0.000E+00 | 0.0000 | 8.343E-15 | 0.0000 |
| Pa-231        | 1.509E-14  | 0.0000 | 9.297E-16  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 7.527E-15 | 0.0000 |
| Pb-210        | 4.478E-18  | 0.0000 | 2.746E-18  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 5.184E-16 | 0.0000 |
| Ra-226        | 3.497E-14  | 0.0001 | 9.015E-18  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+0C | 0.0000 | 5.607E-16 | 0.0000 |
| Th-230        | 5.237E-16  | 0.0000 | 3.382E-15  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+0C | 0.0000 | 2.361E-14 | 0.0000 |
| U-234         | 5.840E-13  | 0.0011 | 4.875E-12  | 0.0094 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+0C | 0.0000 | 6.655E-11 | 0.1281 |
| U-235         | 9.197E-11  | 0.1771 | 3.200E-13  | 0.0006 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+0G | 0.0000 | 5.097E-12 | 0.0098 |
| U-238         | 2.574E-10  | 0.4956 | 3.998E-12  | 0.0077 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+0G | 0.0000 | 8.846E-11 | 0.1703 |
| Total         | 3.501E-10  | 0.6740 | 9.199E-12  | 0.0177 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.C000 | 0.000E+00 | 0.0000 | 1.601E-10 | 0.3083 |

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Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
and Fraction of Total Risk at t= 3.000E+01 years

## Water Dependent Pathways

| Radio-Nuclide | Water     |        | Fish      |        | Plant     |        | Meat      |        | Milk      |        | All Pathways** |        |
|---------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|----------------|--------|
|               | risk      | fract. | risk           | fract. |
| Ac-227        | 0.000E+00 | 0.0000 | 0.030E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.683E-14      | 0.0001 |
| Pa-231        | 0.000E+00 | 0.0000 | 0.030E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.355E-14      | 0.0000 |
| Pb-210        | 0.000E+00 | 0.0000 | 5.256E-16      | 0.0000 |
| Ra-226        | 0.000E+00 | 0.0000 | 3.554E-14      | 0.0001 |
| Th-230        | 0.000E+00 | 0.0000 | 2.752E-14      | 0.0001 |
| U-234         | 0.000E+00 | 0.0000 | 7.201E-11      | 0.1386 |
| U-235         | 0.000E+00 | 0.0000 | 9.739E-11      | 0.1875 |
| U-238         | 0.000E+00 | 0.0000 | 3.498E-10      | 0.6736 |
| Total         | 0.000E+00 | 0.0000 | 5.194E-10      | 1.0000 |

\*\* Sum of water independent ground, inhalation, plant, meat, milk, soil  
and water dependent water, fish, plant, meat, milk pathways

0

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of  
Radon and its Decay Products at t= 3.000E+01 years  
Radionuclides

| Radon Pathway | Rn-222    | Po-218    | Pb-214    | Bi-214    | Rn-220    | Po-216    | Pb-212    | Bi-212    |
|---------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| Water-ind.    | 0.000E+00 |
| Water-dep.    | 0.000E+00 |
| Total         | 0.000E+00 |

Water-ind. == Water-independent      Water-dep. == Water-dependent

0

Total Excess Cancer Risk CNRS(i,p,t)\*\*\* for Initially Existent Radionuclides (i) and Pathways (p)  
and Fraction of Total Risk at t= 3.000E+01 years  
Water Independent Pathways (Inhalation excludes radon)

| Radio-Nuclide | Ground    |        | Inhalation |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|---------------|-----------|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|               | risk      | fract. | risk       | fract. | risk      | fract. | risk      | fract. | risk      | fract. | risk      | fract. | risk      | fract. |
| U-234         | 6.194E-13 | 0.0012 | 4.878E-12  | 0.0094 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.657E-11 | 0.1282 |
| U-235         | 9.204E-11 | 0.1772 | 3.224E-13  | 0.0006 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 5.113E-12 | 0.0098 |
| U-238         | 2.574E-10 | 0.4956 | 3.999E-12  | 0.0077 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 8.846E-11 | 0.1703 |
| Total         | 3.501E-10 | 0.6740 | 9.199E-12  | 0.0177 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.601E-10 | 0.3083 |

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Inrisk : DT-34-Utility

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Total Excess Cancer Risk CNRS(i,p,t)\*\*\* for Initially Existent Radionuclides (i) and Pathways (p)  
and Fraction of Total Risk at t= 3.000E+01 years

Water Dependent Pathways

| Radio-Nuclide | Water     |        | Fish      |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | All pathways |        |
|---------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|--------------|--------|
|               | risk      | fract. | risk         | fract. |
| U-234         | 0.000E+00 | 0.0000 | 7.206E-11    | 0.1387 |
| U-235         | 0.000E+00 | 0.0000 | 9.748E-11    | 0.1877 |
| U-238         | 0.000E+00 | 0.0000 | 3.499E-10    | 0.6736 |
| Total         | 0.000E+00 | 0.0000 | 5.194E-10    | 1.0000 |

\*\*\*CNRSI(i,p,t) includes contribution from decay daughter radionuclides

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Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
As pCi/yr at t= 1.000E+02 years

| Radio-Nuclide | Water Independent Pathways (Inhalation w/o radon) |           |           |           |           | Water Dependent Pathways |           |           |           |           | Total Ingestion* |
|---------------|---|-----------|-----------|-----------|-----------|--------------------------|-----------|-----------|-----------|-----------|------------------|
|               | Inhalation  | Plant     | Meat      | Milk      | Soil      | Water                    | Fish      | Plant     | Meat      | Milk      |                  |
| Ac-227        | 4.362E-08   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 4.296E-05 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 4.296E-05        |
| Pa-231        | 6.370E-08   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 6.275E-05 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 6.275E-05        |
| Pb-210        | 4.483E-09   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 4.416E-06 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 4.416E-06        |
| Ra-226        | 8.062E-09   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 7.941E-06 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 7.941E-06        |
| Th-230        | 3.795E-07   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 3.738E-04 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 3.738E-04        |
| U-234         | 4.069E-04   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 4.008E-01 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 4.008E-01        |
| U-235         | 3.014E-05   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 2.969E-02 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 2.969E-02        |
| U-238         | 4.069E-04   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 4.008E-01 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 4.008E-01        |

\* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil  
and water-dependent water, fish, plant, meat, milk pathways

0 Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of  
Radon and its Decay Products as pCi/yr at t= 1.000E+02 years

| Radon Pathway | Radionuclides |           |           |           |           |           |           |           |
|---------------|---------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
|               | Rn-222        | Po-218    | Pb-214    | Bi-214    | Rn-220    | Po-216    | Pb-212    | Bi-212    |
| Water-ind.    | 0.000E+00     | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 |
| Water-dep.    | 0.000E+00     | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 |
| Total         | 0.000E+00     | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 |

Water-ind. == Water-independent      Water-dep. == Water-dependent

0 Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
and Fraction of Total Risk at t= 1.000E+02 years

| Radio-Nuclide | Water Independent Pathways (Inhalation excludes radon) |        |            |        |           |        |           |        |           |        |           |        |
|---------------|--|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|               | Ground   |        | Inhalation |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|               | risk   | fract. | risk       | fract. | risk      | fract. | risk      | fract. | risk      | fract. | risk      | fract. |
| Ac-227        | 3.429E-13  | 0.0007 | 9.160E-15  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 5.022E-14 | 0.0001 |
| Pa-231        | 4.727E-14  | 0.0001 | 2.912E-15  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.358E-14 | 0.0000 |
| Pb-210        | 1.028E-16  | 0.0000 | 6.302E-17  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.190E-14 | 0.0000 |
| Ra-226        | 3.653E-13  | 0.0007 | 9.415E-17  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 5.856E-15 | 0.0000 |
| Th-230        | 1.683E-15  | 0.0000 | 1.087E-14  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 7.587E-14 | 0.0002 |
| U-234         | 5.555E-13  | 0.0011 | 4.637E-12  | 0.0094 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.330E-11 | 0.1279 |
| U-235         | 8.748E-11  | 0.1768 | 3.043E-13  | 0.0006 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.848E-12 | 0.0098 |
| U-238         | 2.448E-10  | 0.4948 | 3.803E-12  | 0.0077 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 8.414E-11 | 0.1700 |
| Total         | 3.336E-10  | 0.6742 | 8.768E-12  | 0.0177 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.525E-10 | 0.3081 |

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Inrisk : DT-34-Utility

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Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
 and Fraction of Total Risk at t= 1.000E+02 years

## Water Dependent Pathways

| Radio-Nuclide | Water     |        | Fish      |        | Plant     |        | Meat      |        | Milk      |        | All Pathways** |        |
|---------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|----------------|--------|
|               | risk      | fract. | risk           | fract. |
| Ac-227        | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.00CE+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.022E-13      | 0.0008 |
| Pa-231        | 0.000E+00 | 0.0000 | 7.376E-14      | 0.0001 |
| Pb-210        | 0.000E+00 | 0.0000 | 1.206E-14      | 0.0000 |
| Ra-226        | 0.000E+00 | 0.0000 | 3.712E-13      | 0.0008 |
| Th-230        | 0.000E+00 | 0.0000 | 8.842E-14      | 0.0002 |
| U-234         | 0.000E+00 | 0.0000 | 6.849E-11      | 0.1384 |
| U-235         | 0.000E+00 | 0.0000 | 9.263E-11      | 0.1872 |
| U-238         | 0.000E+00 | 0.0000 | 3.328E-10      | 0.6725 |
| Total         | 0.000E+00 | 0.0000 | 4.948E-10      | 1.0000 |

\*\* Sum of water independent ground, inhalation, plant, meat, milk, soil  
 and water dependent water, fish, plant, meat, milk pathways

0 Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of  
 Radon and its Decay Products at t= 1.000E+02 years

| Radon Pathway | Rn-222    | Po-218    | Pb-214    | Bi-214    | Rn-220    | Po-216    | Pb-212    | Bi-212    |
|---------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| Water-ind.    | 0.000E+00 |
| Water-dep.    | 0.000E+00 |
| Total         | 0.000E+00 |

Water-ind. == Water-independent Water-dep. == Water-dependent

0 Total Excess Cancer Risk CNRS(i,p,t)\*\*\* for Initially Existent Radionuclides (i) and Pathways (p)  
 and Fraction of Total Risk at t= 1.000E+02 years

| Radio-Nuclide | Ground    |        | Inhalation |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|---------------|-----------|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|               | risk      | fract. | risk       | fract. | risk      | fract. | risk      | fract. | risk      | fract. | risk      | fract. | risk      | fract. |
| U-234         | 9.223E-13 | 0.0019 | 4.647E-12  | 0.0094 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.338E-11 | 0.1281 |
| U-235         | 8.787E-11 | 0.1776 | 3.164E-13  | 0.0006 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.922E-12 | 0.0099 |
| U-238         | 2.448E-10 | 0.4948 | 3.805E-12  | 0.0077 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 8.416E-11 | 0.1701 |
| Total         | 3.336E-10 | 0.6742 | 8.768E-12  | 0.0177 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.525E-10 | 0.3081 |

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T<sub>1/2</sub> Limit = 180 days

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Total Excess Cancer Risk CNRS(i,p,t)\*\*\* for Initially Existent Radionuclides (i) and Pathways (p)  
 and Fraction of Total Risk at t= 1.000E+C2 years

## Water Dependent Pathways

| Radio-Nuclide | Water     |        | Fish      |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | All pathways |        |
|---------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|--------------|--------|
|               | risk      | fract. | risk         | fract. |
| U-234         | 0.000E+00 | 0.0000 | 6.894E-11    | 0.1393 |
| U-235         | 0.000E+00 | 0.0000 | 9.311E-11    | 0.1882 |
| U-238         | 0.000E+00 | 0.0000 | 3.328E-10    | 0.6725 |
| Total         | 0.000E+00 | 0.0000 | 4.948E-10    | 1.0000 |

\*\*\*CNRSI(i,p,t) includes contribution from decay daughter radionuclides

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Intrisk : DT-34-Utility

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Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
As pCi/yr at t= 3.000E+02 years

| Radio-Nuclide | Water Independent Pathways (Inhalation w/o radon) |           |           |           |           | Water Dependent Pathways |           |           |           |           | Total Ingestion* |
|---------------|---|-----------|-----------|-----------|-----------|--------------------------|-----------|-----------|-----------|-----------|------------------|
|               | Inhalation  | Plant     | Meat      | Milk      | Soil      | Water                    | Fish      | Plant     | Meat      | Milk      |                  |
| Ac-227        | 1.438E-07   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 1.417E-04 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 1.417E-04        |
| Pa-231        | 1.653E-07   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 1.628E-04 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 1.628E-04        |
| Pb-210        | 5.282E-08   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 5.203E-05 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 5.203E-05        |
| Ra-226        | 6.502E-08   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 6.405E-05 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 6.405E-05        |
| Th-230        | 1.061E-06   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 1.045E-03 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 1.045E-03        |
| U-234         | 3.527E-04   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 3.474E-01 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 3.474E-01        |
| U-235         | 2.613E-05   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 2.573E-02 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 2.573E-02        |
| U-238         | 3.527E-04   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 3.474E-01 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 3.474E-01        |

\* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil  
and water-dependent water, fish, plant, meat, milk pathways

0 Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of  
Radon and its Decay Products as pCi/yr at t= 3.000E+02 years  
0 Radon nuclides

| Radon Pathway | Rn-222    | Po-218    | Pb-214    | Bi-214    | Rn-220    | Po-216    | Pb-212    | Bi-212    |
|---------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| Water-ind.    | 0.000E+00 |
| Water-dep.    | 0.000E+00 |
| Total         | 0.000E+00 |

Water-ind. == Water-independent Water-dep. == Water-dependent

0 Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
and Fraction of Total Risk at t= 3.000E+02 years  
0 Water Independent Pathways (Inhalation excludes radon)

| Radio-Nuclide | Ground    |        | Inhalation |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|---------------|-----------|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|               | risk      | fract. | risk       | fract. | risk      | fract. | risk      | fract. | risk      | fract. | risk      | fract. |
| Ac-227        | 1.125E-12 | 0.0026 | 3.005E-14  | 0.0001 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.648E-13 | 0.0004 |
| Pa-231        | 1.223E-13 | 0.0003 | 7.531E-15  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.097E-14 | 0.0001 |
| Pb-210        | 1.200E-15 | 0.0000 | 7.361E-16  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.390E-13 | 0.0003 |
| Ra-226        | 2.926E-12 | 0.0068 | 7.543E-16  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.692E-14 | 0.0001 |
| Th-230        | 4.688E-15 | 0.0000 | 3.028E-14  | 0.0001 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.114E-13 | 0.0005 |
| U-234         | 4.815E-13 | 0.0011 | 4.019E-12  | 0.0093 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 5.487E-11 | 0.1267 |
| U-235         | 7.583E-11 | 0.1751 | 2.638E-13  | 0.0006 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.202E-12 | 0.0097 |
| U-238         | 2.122E-10 | 0.4901 | 3.297E-12  | 0.0076 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 7.293E-11 | 0.1684 |
| Total         | 2.927E-10 | 0.6760 | 7.649E-12  | 0.0177 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.326E-10 | 0.3063 |

1RESRAD, Version 6.5

T<sub>1/2</sub> Limit = 180 days

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Intrinsic : DT-34-Utility

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\DT-34-UTILITY 2011.RAD

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
and Fraction of Total Risk at t= 3.000E+02 years

Water Dependent Pathways

| Radio-Nuclide | Water     |        | Fish      |        | Plant     |        | Meat      |        | Milk      |        | All Pathways** |        |
|---------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|----------------|--------|
|               | risk      | fract. | risk           | fract. |
| Ac-227        | 0.000E+00 | 0.0000 | 1.320E-12      | 0.0030 |
| Pa-231        | 0.000E+00 | 0.0000 | 1.908E-13      | 0.0004 |
| Pb-210        | 0.000E+00 | 0.0000 | 1.409E-13      | 0.0003 |
| Ra-226        | 0.000E+00 | 0.0000 | 2.974E-12      | 0.0069 |
| Th-230        | 0.000E+00 | 0.0000 | 2.463E-13      | 0.0006 |
| U-234         | 0.000E+00 | 0.0000 | 5.937E-11      | 0.1371 |
| U-235         | 0.000E+00 | 0.0000 | 8.030E-11      | 0.1854 |
| U-238         | 0.000E+00 | 0.0000 | 2.884E-10      | 0.6662 |
| Total         | 0.000E+00 | 0.0000 | 4.330E-10      | 1.0000 |

\*\* Sum of water independent ground, inhalation, plant, meat, milk, soil  
and water dependent water, fish, plant, meat, milk pathways

0

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of  
Radon and its Decay Products at t= 3.000E+02 years  
Radionuclides

| Radon Pathway | Rn-222    | Po-218    | Pb-214    | Bi-214    | Rn-220    | Po-216    | Pb-212    | Bi-212    |
|---------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| Water-ind.    | 0.000E+00 |
| Water-dep.    | 0.000E+00 |
| Total         | 0.000E+00 |

Water-ind. == Water-independent      Water-dep. == Water-dependent

0

Total Excess Cancer Risk CNRS(i,p,t)\*\*\* for Initially Existent Radionuclides (i) and Pathways (p)  
and Fraction of Total Risk at t= 3.000E+02 years

| Radio-Nuclide | Ground    |        | Inhalation |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|---------------|-----------|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|               | risk      | fract. | risk       | fract. | risk      | fract. | risk      | fract. | risk      | fract. | risk      | fract. | risk      | fract. |
| U-234         | 3.413E-12 | 0.0079 | 4.048E-12  | 0.0093 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 5.522E-11 | 0.1275 |
| U-235         | 7.708E-11 | 0.1780 | 3.014E-13  | 0.0007 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.428E-12 | 0.0102 |
| U-238         | 2.122E-10 | 0.4901 | 3.300E-12  | 0.0076 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 7.298E-11 | 0.1686 |
| Total         | 2.927E-10 | 0.6760 | 7.649E-12  | 0.0177 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.326E-10 | 0.3063 |

1RESRAD, Version 6.5

T<sub>1/2</sub> Limit = 180 days

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Inrisk : DT-34-Utility

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\DT-34-UTILITY 2011.RAD

Total Excess Cancer Risk CNRS(i,p,t)\*\*\* for Initially Existent Radionuclides (i) and Pathways (p)  
and Fraction of Total Risk at t= 3.000E+02 years

Water Dependent Pathways

| Radio-Nuclide | Water     |        | Fish      |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | All pathways |        |
|---------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|--------------|--------|
|               | risk      | fract. | risk         | fract. |
| U-234         | 0.000E+00 | 0.0000 | 6.268E-11    | 0.1448 |
| U-235         | 0.000E+00 | 0.0000 | 8.181E-11    | 0.1889 |
| U-238         | 0.000E+00 | 0.0000 | 2.885E-10    | 0.6663 |
| Total         | 0.000E+00 | 0.0000 | 4.330E-10    | 1.0000 |

\*\*\*CNRSI(i,p,t) includes contribution from decay daughter radionuclides

1RESRAD, Version 6.5

T<sub>1/2</sub> Limit = 180 days

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Intrinsic : DT-34-Utility

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\DT-34-UTILITY 2011.RAD

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
As pCi/yr at t= 1.000E+03 years

| Radio-Nuclide | Water Independent Pathways (Inhalation w/o radon) |           |           |           |           | Water Dependent Pathways |           |           |           |           | Total Ingestion* |
|---------------|---|-----------|-----------|-----------|-----------|--------------------------|-----------|-----------|-----------|-----------|------------------|
|               | Inhalation  | Plant     | Meat      | Milk      | Soil      | Water                    | Fish      | Plant     | Meat      | Milk      |                  |
| Ac-227        | 3.113E-07   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 3.067E-04 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 3.067E-04        |
| Pa-231        | 3.317E-07   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 3.267E-04 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 3.267E-04        |
| Pb-210        | 4.698E-07   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 4.627E-04 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 4.627E-04        |
| Ra-226        | 4.986E-07   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 4.911E-04 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 4.911E-04        |
| Th-230        | 2.796E-06   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 2.754E-03 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 2.754E-03        |
| U-234         | 2.139E-04   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 2.106E-01 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 2.106E-01        |
| U-235         | 1.584E-05   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 1.560E-02 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 1.560E-02        |
| U-238         | 2.139E-04   | 0.000E+00 | 0.000E+00 | 0.000E+00 | 2.106E-01 | 0.000E+00                | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 2.106E-01        |

\* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil  
and water-dependent water, fish, plant, meat, milk pathways

0 Amount of Intake Quantities QINT9(irn,i,t) and QINT9W(irn,i,t) for Inhalation of  
Radon and its Decay Products as pCi/yr at t= 1.000E+03 years

| Radionuclides |           |           |           |           |           |           |           |           |
|---------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| Radon Pathway | Rn-222    | Po-218    | Pb-214    | Bi-214    | Rn-220    | Po-216    | Pb-212    | Bi-212    |
| Water-ind.    | 0.000E+00 |
| Water-dep.    | 0.000E+00 |
| Total         | 0.000E+00 |

Water-ind. == Water-independent      Water-dep. == Water-dependent

0 Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
and Fraction of Total Risk at t= 1.000E+03 years

| Water Independent Pathways (Inhalation excludes radon) |           |        |            |        |           |        |           |        |           |        |           |        |
|--|-----------|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
| Radio-Nuclide  | Ground    |        | Inhalation |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|  | risk      | fract. | risk       | fract. | risk      | fract. | risk      | fract. | risk      | fract. | risk      | fract. |
| Ac-227   | 2.432E-12 | 0.0085 | 6.497E-14  | 0.0002 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.562E-13 | 0.0012 |
| Pa-231   | 2.450E-13 | 0.0009 | 1.509E-14  | 0.0001 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.222E-13 | 0.0004 |
| Pb-210   | 1.065E-14 | 0.0000 | 6.529E-15  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.232E-12 | 0.0043 |
| Ra-226   | 2.239E-11 | 0.0779 | 5.771E-15  | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.589E-13 | 0.0012 |
| Th-230   | 1.234E-14 | 0.0000 | 7.971E-14  | 0.0003 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 5.565E-13 | 0.0019 |
| U-234  | 2.920E-13 | 0.0010 | 2.437E-12  | 0.0085 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.327E-11 | 0.1157 |
| U-235  | 4.598E-11 | 0.1599 | 1.600E-13  | 0.0006 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.548E-12 | 0.0089 |
| U-238  | 1.287E-10 | 0.4476 | 1.999E-12  | 0.0070 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.422E-11 | 0.1538 |
| Total  | 2.000E-10 | 0.6958 | 4.768E-12  | 0.0166 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 8.267E-11 | 0.2876 |

1RESRAD, Version 6.5

T<sub>1/2</sub> Limit = 180 days

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Intrinsic : DT-34-Utility

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Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)  
and Fraction of Total Risk at t= 1.000E+03 years

## Water Dependent Pathways

| Radio-Nuclide | Water     |        | Fish      |        | Plant     |        | Meat      |        | Milk      |        | All Pathways** |        |
|---------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|----------------|--------|
|               | risk      | fract. | risk           | fract. |
| Ac-227        | 0.000E+00 | 0.0000 | 2.853E-12      | 0.0099 |
| Pa-231        | 0.000E+00 | 0.0000 | 3.823E-13      | 0.0013 |
| Pb-210        | 0.000E+00 | 0.0000 | 1.250E-12      | 0.0043 |
| Ra-226        | 0.000E+00 | 0.0000 | 2.275E-11      | 0.0791 |
| Th-230        | 0.000E+00 | 0.0000 | 6.485E-13      | 0.0023 |
| U-234         | 0.000E+00 | 0.0000 | 3.600E-11      | 0.1252 |
| U-235         | 0.000E+00 | 0.0000 | 4.869E-11      | 0.1694 |
| U-238         | 0.000E+00 | 0.0000 | 1.749E-10      | 0.6084 |
| Total         | 0.000E+00 | 0.0000 | 2.875E-10      | 1.0000 |

\*\* Sum of water independent ground, inhalation, plant, meat, milk, soil  
and water dependent water, fish, plant, meat, milk pathways

0

Excess Cancer Risks CNRS9(irn,i,t) and CNRS9W(irn,i,t) for Inhalation of  
Radon and its Decay Products at t= 1.000E+03 years

0

| Radon Pathway | Rn-222    | Po-218    | Pb-214    | Bi-214    | Rn-220    | Po-216    | Pb-212    | Bi-212    |
|---------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| Water-ind.    | 0.000E+00 |
| Water-dep.    | 0.000E+00 |
| Total         | 0.000E+00 |

Water-ind. == Water-independent      Water-dep. == Water-dependent

0

Total Excess Cancer Risk CNRS(i,p,t)\*\*\* for Initially Existent Radionuclides (i) and Pathways (p)  
and Fraction of Total Risk at t= 1.000E+03 years

0

## Water Independent Pathways (Inhalation excludes radon)

0

| Radio-Nuclide | Ground    |        | Inhalation |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | Soil      |        |
|---------------|-----------|--------|------------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|               | risk      | fract. | risk       | fract. | risk      | fract. | risk      | fract. | risk      | fract. | risk      | fract. | risk      | fract. |
| U-234         | 2.268E-11 | 0.0789 | 2.522E-12  | 0.0088 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.532E-11 | 0.1229 |
| U-235         | 4.866E-11 | 0.1693 | 2.400E-13  | 0.0008 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.026E-12 | 0.0105 |
| U-238         | 1.287E-10 | 0.4477 | 2.006E-12  | 0.0070 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.432E-11 | 0.1542 |
| Total         | 2.000E-10 | 0.6958 | 4.768E-12  | 0.0166 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 8.267E-11 | 0.2876 |

1RESRAD, Version 6.5

T<sub>1/2</sub> Limit = 180 days

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Intrinsic : DT-34-Utility

File : C:\RESRAD\_FAMILY\RESRAD\6.5\USERFILES\DT-34-UTILITY 2011.RAD

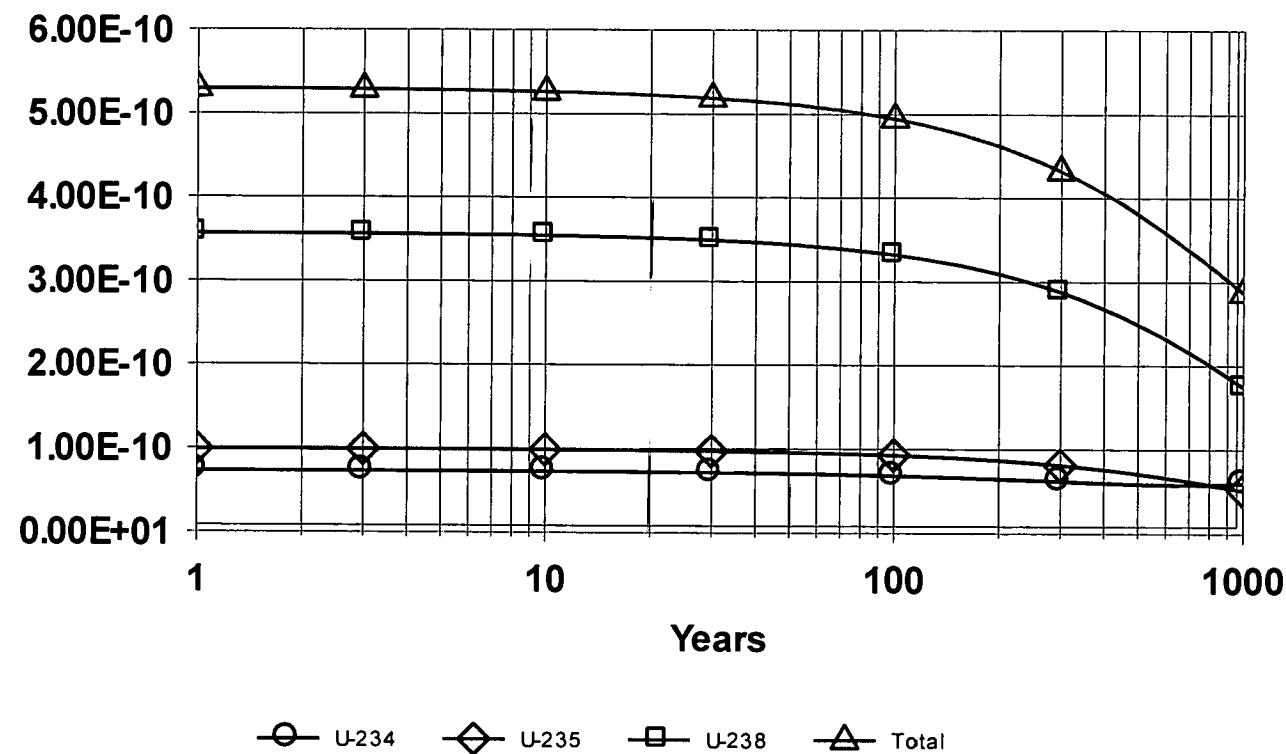
Total Excess Cancer Risk CNRS(i,p,t)\*\*\* for Initially Existent Radionuclides (i) and Pathways (p)  
 and Fraction of Total Risk at t= 1.000E+03 years

## Water Dependent Pathways

| Radio-Nuclide | Water     |        | Fish      |        | Radon     |        | Plant     |        | Meat      |        | Milk      |        | All pathways |        |
|---------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|--------------|--------|
|               | risk      | fract. | risk         | fract. |
| U-234         | 0.000E+00 | 0.0000 | 6.053E-11    | 0.2105 |
| U-235         | 0.000E+00 | 0.0000 | 5.192E-11    | 0.1806 |
| U-238         | 0.000E+00 | 0.0000 | 1.750E-10    | 0.6088 |
| Total         | 0.000E+00 | 0.0000 | 2.875E-10    | 1.0000 |

\*\*\*CNRSI(i,p,t) includes contribution from decay daughter radionuclides

## EXCESS CANCER RISK: All Nuclides Summed, All Pathways Summed



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Includes All Pathways

## **APPENDIX I**

### **BORING LOGS AND FIELD LOGBOOK ENTRIES FOR SAMPLES**

**(On CD-ROM on the Back Cover of this Report)**

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10-13-06  
DC COC No.: SA 10132006 -01H

Task Team Members: D. LYERLA, J. MASSET, M. LYERLA  
J. ELDL

|                           |  |                        |  |
|---------------------------|--|------------------------|--|
| Sample ID:                | HTZ 95807                              | Station ID:            | HTZ 95807                              |
| Collection Date:          | 10-13-06                               | Collection Time:       | 1122                                   |
| Property Name:            | DT-34                                  | Sample Location:       | MID - SOUTHWESTERN<br>SECTION OF DT-34 |
| Northing (units):         | 908876.78                              | Easting (units):       | 1031311.95                             |
|                           | DL 10-13-06                            |                        | 10-13-06                               |
| Elevation (units):        | N/A                                    | Sample Type:           | HOMOGENEOUS GRAB                       |
| Sample Collection Method: | HAND TROWEL                            | Sample Depth:          | 0' - 0.5"                              |
| Soil Type:                | GRAVEL & SANDY BROWN<br>FILE MATERIAL. | Rad Screen Instrument: | 44-9 "J" / 44-10 "H"                   |
| Rad Screen Bkg. (cpm):    | 42 / 7600                              | Rad Screen (cpm):      | 34 / 4137                              |

Comments:

Recorded by: David Lyerla 10/13/06 QA by: Mark A. Johnson Date: 10-16-06

COC No.: SA 10132006 -01H

Task Team Members: D. Lyerla, J. ELDL, M. Lyerla

|                           |   |                        |                               |
|---------------------------|---|------------------------|-------------------------------|
| Sample ID:                | HTZ 95808                                 | Station ID:            | HTZ 95808                     |
| Collection Date:          | 10-13-06                                  | Collection Time:       | 1129                          |
| Property Name:            | DT-34                                     | Sample Location:       | South West corner<br>OF DT-34 |
| Northing (units):         | 908899.41                                 | Easting (units):       | 1031220.48                    |
|                           | DL 10-13-06                               |                        | 10-13-06                      |
| Elevation (units):        | N/A                                       | Sample Type:           | HOMOGENEOUS GRAB              |
| Sample Collection Method: | HAND TROWEL                               | Sample Depth:          | 0.0 - 0.5'                    |
| Soil Type:                | GRAVELY, SANDY LIGHT BROWN<br>SILTY CLAY. | Rad Screen Instrument: | 44-9 "J" / 44-10 "H"          |
| Rad Screen Bkg. (cpm):    | 46 / 8100                                 | Rad Screen (cpm):      | 58 / 5263                     |

Comments:

Recorded by: David Lyerla 10/13/06 QA by: Mark A. Johnson Date: 10-16-06

- COC No.: SA 10132006-01H

Task Team Members: D. Lyerla, J. Ebel, M. Lyerla

|                           |                                     |                        |                                     |
|---------------------------|-------------------------------------|------------------------|-------------------------------------|
| Sample ID:                | HTZ 95 809                          | Station ID:            | HTZ 95809                           |
| Collection Date:          | 10-13-06                            | Collection Time:       | 1139                                |
| Property Name:            | DT-34                               | Sample Location:       | Eastern DT-34 Near<br>ACCESS GATE.  |
| Northing (units):         | 909182.03 Du 10-13-06<br>1031335.39 | Easting (units):       | 1031395.39 Du 10-13-06<br>909182.03 |
| Elevation (units):        | N/A                                 | Sample Type:           | HOMOGENEOUS GRAS                    |
| Sample Collection Method: | HAND TROWEL                         | Sample Depth:          | 0.0 - 0.5'                          |
| Soil Type:                | GRAVELY, LIGHT BROWN<br>SILTY CLAY. | Rad Screen Instrument: | 44-9 "J" / 44-10 "H"                |
| Rad Screen Bkg. (cpm):    | 40 / 4300                           | Rad Screen (cpm):      | 39 / 3955                           |

Comments:

Recorded by: David Lyerla 10/13/06 QA by: Mark F. Johnson Date: 10-16-06

COC No.: SA 10132006-01H

Task Team Members: D. Lyerla, J. Ebel, M. Lyerla

|                           |                                     |                        |                                     |
|---------------------------|-------------------------------------|------------------------|-------------------------------------|
| Sample ID:                | HTZ 95 810                          | Station ID:            | HTZ 95810                           |
| Collection Date:          | 10-13-06                            | Collection Time:       | 1150                                |
| Property Name:            | DT-34                               | Sample Location:       | NE CORNER, EAST OF<br>EXIT GATE.    |
| Northing (units):         | 909073.90 Du 10-13-06<br>1031796.18 | Easting (units):       | 1031796.18 Du 10-13-06<br>909073.90 |
| Elevation (units):        | N/A                                 | Sample Type:           | HOMOGENEOUS GRAS                    |
| Sample Collection Method: | HAND TROWEL                         | Sample Depth:          | 0.0 - 0.5'                          |
| Soil Type:                | GRAVELY, LIGHT BROWN<br>SILTY CLAY. | Rad Screen Instrument: | 44-9 "J" / 44-10 "H"                |
| Rad Screen Bkg. (cpm):    | 41 / 4773                           | Rad Screen (cpm):      | 48 / 5567                           |

Comments:

Recorded by: David Lyerla 10/13/06 QA by: Mark F. Johnson Date: 10-16-06

COC No.: SA 10132006 - 01 H

Task Team Members: D.Lyerla, J.Ebel, M.Lyerla

Sample ID: HTZ 95811

Station ID: HTZ 95811

Collection Date: 10-13-06

Collection Time: 1203

Property Name: DT-34

Sample Location: NW CORNER NEAR  
ACCESS GATE.

Northing (units): 908837.03 Du 10-13-06

Easting (units): 1031670.57 908837.03 Du 10-13-06

Elevation (units): N/A

Sample Type: HOMOGENEOUS CRAB

Sample Collection Method: HAND TROWEL

Sample Depth: 0.0 - 0.5'

Soil Type: GRAVELY, LIGHT BROWN SILTY CLAY Rad Screen Instrument: 44-9 "T" / 44-10 "H"

Rad Screen Bkg. (cpm): 48 / 9500

Rad Screen (cpm): 60 / 7600

Comments:

Recorded by: David Lyerla 10/13/06 QA by: Mark Felt Date: 10-16-06

COC No.: SA 10132006 - 01 H

Task Team Members: D.Lyerla, J.Ebel, M.Lyerla

Sample ID: HTZ 95812

Station ID: HTZ 95812

Collection Date: 10-13-06

Collection Time: 1206

Property Name: DT-34

Sample Location: NW CORNER NEAR  
ACCESS GATE.

Northing (units): 908837.03 Du 10-13-06

Easting (units): 1031670.57 908837.03 Du 10-13-06

Elevation (units): N/A

Sample Type: HOMOGENEOUS CRAB

Sample Collection Method: HAND AUGER

Sample Depth: 0.5 - 1.0'

Soil Type: BROWN SILTY CLAY

Rad Screen Instrument: 44-9 "T" / 44-10 "H"

Rad Screen Bkg. (cpm): 48 / 9500

Rad Screen (cpm): 58 cpm / 7900

Comments: - PIECES OF BRICK WERE DISCOVERED DURING SAMPLE  
COLLECTION.

Recorded by: David Lyerla 10/13/06 QA by: Mark Felt Date: 10-16-06

|                           |  |  |
|---------------------------|--|--|
| Task Team Members:        | TEAM 1   |  |
|                           | COC No.:   | 11012006-014                           |
| Sample ID:                | <del>SLD 97094</del> 97094   | Station ID: <del>SLD 97094</del> 97094 |
| Collection Date:          | 10-31-06   | Collection Time: 1000                  |
| Property Name:            | SLDS   | Sample Location: DT - 34               |
| Northing (units):         | 1031528.49   | Easting (units): 909028.83             |
| Elevation (units):        | N/A  | Sample Type: HOMO. GRAB                |
| Sample Collection Method: | HAND AUGER   | Sample Depth: 0 - 0.5'                 |
| Soil Type:                | BROWN SILTY CLAY   | Rad Screen Instrument: 44-9 'G'        |
| Rad Screen Bkg. (cpm):    | 31 cpm   | Rad Screen (cpm): 50 cpm               |
| Comments:                 | 18" OF COVER MATERIAL (GRAVEL)<br>0.5 - 1.0' = 56 cpm<br>1.0 - 1.5' = 46 cpm |  |
| Recorded by:              | David J. Fuchs 10/31/06  | QA by: Michael C. Fuchs Date: 11/2/06  |
| Task Team Members:        | TEAM 1   |  |
| Sample ID:                | SLD 97095  | Station ID: SLD 97094                  |
| Collection Date:          | 10-31-06   | Collection Time: 1010                  |
| Property Name:            | SLDS   | Sample Location: DT - 34               |
| Northing (units):         | 1031528.49   | Easting (units): 909028.83             |
| Elevation (units):        | N/A  | Sample Type: HOMO. GRAB                |
| Sample Collection Method: | HAND AUGER   | Sample Depth: 1.5 - 2.0'               |
| Soil Type:                | DARK BROWN SILTY CLAY  | Rad Screen Instrument: 44-9 'G'        |
| Rad Screen Bkg. (cpm):    | 31 cpm   | Rad Screen (cpm): 53 cpm               |
| Comments:                 |  |  |
| Recorded by:              | David J. Fuchs 10/31/06  | QA by: Michael C. Fuchs Date: 11/2/06  |

COC No.: 11012006 - 01 H

Task Team Members: TEAM 1

Sample ID: SLD97966 DL 10-30-06 Station ID: SLD97966 DL 10-30-06  
 SLD97096

Collection Date: 10-30-06 Collection Time: 1330

Property Name: SLD5 Sample Location: DT - 34

Northing (units): 1031355.63 Easting (units): 908891.89

Elevation (units): N/A Sample Type: HOMO. GRAB

Sample Collection Method: HAND AUGER Sample Depth: 0 - 0.5'

Soil Type: Lt. brown silty clay Rad Screen Instrument: 94-9 'B'

Rad Screen Bkg. (cpm): 21 cpm Rad Screen (cpm): 45 cpm

Comments: 0.5 - 1.0' = 36 cpm  
 1.0 - 1.5' = 28 cpm  
 + 10-30-06

Recorded by: David Lytle 10/30/06 QA by: Michael C. Tyroler Date: 11/2/06

COC No.: 11012006 - 01 H

Task Team Members: TEAM 1

Sample ID: SLD97967 DL 10-30-06 Station ID: SLD97966 DL 10-30-06  
 SLD97097

Collection Date: 10-30-06 Collection Time: 1345

Property Name: SLD5 Sample Location: DT - 34

Northing (units): 1031355.63 Easting (units): 908891.89

Elevation (units): N/A Sample Type: HOMO. GRAB

Sample Collection Method: HAND AUGER Sample Depth: 1.5 - 2.0'

Soil Type: LINDERY, BLACK, SILTY CLAY w/ BRICK, GRAVEL PIGGIES Rad Screen Instrument: 94-9 'B'

Rad Screen Bkg. (cpm): 21 Rad Screen (cpm): 47

Comments: 2.0 - 2.5' = 59 cpm \* Q.C. LOCATION  
 2.5 - 3.0' = 71 cpm  
 3.0 - 3.5' = 56 cpm

Recorded by: David Lytle 10/30/06 QA by: Michael C. Tyroler Date: 11/2/06

COC No.:

11012006-01HTask Team Members: TEAM 1

Sample ID: SLD 77968 DL 10-30-06 Station ID: SLD 97096 SL 10-30-06

Collection Date: 10-30-06 Collection Time: 1355

Property Name: DT-34 Sample Location: South west corner of Property

Northing (units): 1031355.63 Easting (units): 908891.89

Elevation (units): N/A Sample Type: Homo Grab.

Sample Collection Method: HAND AUGER Sample Depth: 3.5 - 4.0'

Soil Type: Lt. Brown Silty clay. Rad Screen Instrument: 44-9 "B"

Rad Screen Bkg. (cpm): 21 cpm Rad Screen (cpm): 70 cpm

Comments: 9.0 - 9.5' = 51  
9.5 - 5.0' = 70  
5.0 - 5.5' = 59

Recorded by: David Ager Date: 10/30/06 QA by: Michael C. Ziska Date: 11/2/06

COC No.:

11012006-01HTask Team Members: TEAM 1

Sample ID: SLD 77969 DL 10-30-06 Station ID: SLD 97096 SL 10-30-06

Collection Date: 10-30-06 Collection Time: 1412

Property Name: DT-34 Sample Location: South west corner of

Northing (units): 1031355.63 Easting (units): 908891.89

Elevation (units): N/A Sample Type: Homo Grab.

Sample Collection Method: HAND AUGER Sample Depth: 5.5 - 6.0'

Soil Type: Lt. Brown Silty clay. Rad Screen Instrument: 44-9 "B"

Rad Screen Bkg. (cpm): 21 cpm Rad Screen (cpm): 44 cpm

Comments:

Recorded by: David Ager Date: 10/30/06 QA by: Michael C. Ziska Date: 11/2/06

11012006 - 01 H

Task Team Members: TEAM 1

COC No.:

Sample ID: SLD 97100

Station ID: SLD 97100

Collection Date: 10-30-06

Collection Time: 1300

Property Name: SLD5

Sample Location: DT-34

Northing (units): 1031555.90

Easting (units): 908884.39

Elevation (units): N/A

Sample Type: HOMO. GRAB

Sample Collection Method: HAND AUGER

Sample Depth: 0-0.5'

Soil Type: DARK BROWN SILTY CLAY

Rad Screen Instrument: 44-9 'B'

Rad Screen Bkg. (cpm):

38 cpm

Rad Screen (cpm):

50 cpm

Comments: 0.5 - 1.0 = 55 cpm

1.0 - 1.5 = 66 cpm

Recorded by:

*David Thayer* 10/30/06 QA by: *Markel C. Lytle* Date: 11/2/06

COC No.: 11012006 - 01 H

Task Team Members: TEAM 1

Sample ID: SLD 97101

Station ID: SLD 97100

Collection Date: 10-30-06

Collection Time: 1310

Property Name: SLD5

Sample Location: DT-34

Northing (units): 1031555.90

Easting (units): 908884.39

Elevation (units): N/A

Sample Type: HOMO. GRAB

Sample Collection Method: HAND AUGER

Sample Depth: 1.5-2.0'

Soil Type: DARK BROWN SILTY CLAY

Rad Screen Instrument: 44-9 'B'

Rad Screen Bkg. (cpm):

38 cpm

Rad Screen (cpm):

57 cpm

Comments:

Recorded by: *David Thayer* 10/30/06 QA by: *Markel C. Lytle* Date: 11/2/06

COC No.: 11012006 - 01 H

|                           |  |                        |                     |
|---------------------------|--|------------------------|---------------------|
| Task Team Members:        | TEAM 1                                     |                        |                     |
| Sample ID:                | SLD 97110 SLD 97102                        | Station ID:            | SLD 97110 SLD 97102 |
| Collection Date:          | 10-30-06                                   | Collection Time:       | 1125                |
| Property Name:            | SLDS V.P.                                  | Sample Location:       | DT-34               |
| Northing (units):         | 1031521.34                                 | Easting (units):       | 909026.14           |
| Elevation (units):        | 1031670.40                                 | Sample Type:           | HOMO GRAB           |
| Sample Collection Method: | AUGER                                      | Sample Depth:          | 0-0.5'              |
| Soil Type:                | Gray / Lt. Brown SANDY, SILT               | Rad Screen Instrument: | 44-9 'B'            |
| Rad Screen Bkg. (cpm):    | 51 cpm                                     | Rad Screen (cpm):      | 36 cpm              |
| Comments:                 | 0.5 - 1.0' = 41 cpm<br>1.0 - 1.5' = 55 cpm |                        |                     |

Recorded by: David J. Fyffe 10/30/06 QA by: Michael C. Franks Date: 11/2/06

COC No.: 11012006 - 01 H

|                           |                                 |                        |                     |
|---------------------------|---------------------------------|------------------------|---------------------|
| Task Team Members:        | TEAM 1                          |                        |                     |
| Sample ID:                | SLD 97111 SLD 97103             | Station ID:            | SLD 97110 SLD 97102 |
| Collection Date:          | 10-30-06                        | Collection Time:       | 1130                |
| Property Name:            | SLDS V.P.                       | Sample Location:       | DT-34               |
| Northing (units):         | 1031670.40                      | Easting (units):       | 909026.14           |
| Elevation (units):        | N/A                             | Sample Type:           | HOMO. GRAB          |
| Sample Collection Method: | AUGER                           | Sample Depth:          | 1.5 - 2.0'          |
| Soil Type:                | Gray / Light Brown silty, clay. | Rad Screen Instrument: | 44-9 'B'            |
| Rad Screen Bkg. (cpm):    | 51 cpm                          | Rad Screen (cpm):      | 68 cpm              |
| Comments:                 |                                 |                        |                     |

Recorded by: David J. Fyffe 10/30/06 QA by: Michael C. Franks Date: 11/2/06

COC No.: 11012006 - 01 H

Task Team Members: TEAM 1

|                           |  |                        |                               |
|---------------------------|--|------------------------|-------------------------------|
| Sample ID:                | SLD 97104                                  | Station ID:            | SLD 97104                     |
| Collection Date:          | 10-30-06                                   | Collection Time:       | 1245                          |
| Property Name:            | SLODS                                      | Sample Location:       | DT - 34                       |
| Northing (units):         | 1031782.46                                 | Easting (units):       | 909085.67                     |
| Elevation (units):        | N/A  | Sample Type:           | HOMO. GRAB                    |
| Sample Collection Method: | AUGER                                      | Sample Depth:          | 0.0 - 0.5                     |
| Soil Type:                | Dark Brown Silty Clay                      | Rad Screen Instrument: | 44-9 B                        |
| Rad Screen Bkg. (cpm):    | 36 cpm                                     | Rad Screen (cpm):      | <del>10-30-06</del> 36 43 cpm |
| Comments:                 | 0.5 - 1.0' = 51 cpm<br>1.0 - 1.5' = 48 cpm |                        |                               |

Recorded by: David Tyeer 10/30/06 QA by: Michael C. Zwick Date: 11/2/06

COC No.: 11012006 - 01 H

Task Team Members: TEAM 1

|                           |   |                        |            |
|---------------------------|---|------------------------|------------|
| Sample ID:                | SLD 97105                                 | Station ID:            | SLD 97104  |
| Collection Date:          | 10-30-06                                  | Collection Time:       | 1255       |
| Property Name:            | SLODS                                     | Sample Location:       | DT - 34    |
| Northing (units):         | 1031782.46                                | Easting (units):       | 909085.67  |
| Elevation (units):        | N/A                                       | Sample Type:           | HOMO. GRAB |
| Sample Collection Method: | Dark brown <del>10-30-06</del> HAND AUGER | Sample Depth:          | 1.5 - 2.0  |
| Soil Type:                | Dark Brown Silty Clay                     | Rad Screen Instrument: | 44-9 B     |
| Rad Screen Bkg. (cpm):    | 36 cpm                                    | Rad Screen (cpm):      | 51 cpm     |
| Comments:                 |   |                        |            |

Recorded by: David Tyeer 10/30/06 QA by: Michael C. Zwick Date: 11/2/06

COC No.:

11012006 - 01H

Task Team Members: D. Leyerle, J. Ebl, M. Leyerle (TEAM 1)

Sample ID: SLD 97106

Station ID: SLD 97106

Collection Date: 10/30/06

Collection Time: 1053

Property Name: DT-34

Sample Location: North west corner of  
front parking lot

Northing (units): 1031728.38

Easting (units): 908852.69

Elevation (units): N/A

Sample Type: Home grab

Sample Collection Method: AUGER

Sample Depth: 0.0 - 0.5'

Soil Type: Slag & Brick, BLACK  
Soil & fill material

Rad Screen Instrument: 44-9 B

Rad Screen Bkg. (cpm):

43 cpm

Rad Screen (cpm):

39 cpm

Comments: 0.5 - 1.0 rad screen = 70 cpm (archive) DL 10-30-06  
1.0 - 1.5 rad screen = 52 cpm  
1.5 - 2.0 rad screen = DL 58 cpm 67 cpm  
10-30-06

Recorded by:

David Leyerle 10/30/06

QA by: Michael C. Leyerle Date: 11/2/06

COC No.: 11012006 - 01H

Task Team Members: (TEAM 1)

Sample ID: SLD 97107

Station ID: SLD 97106

Collection Date: 10-30-06

Collection Time: 1058

Property Name: DT-34

Sample Location: Northwest corner of front  
parking lot

Northing (units): 1031728.38

Easting (units): 908852.69

Elevation (units): N/A

Sample Type: Home grab

Sample Collection Method: AUGER

Sample Depth: 1.5 - 2.0

Soil Type: GRAY silty clay

Rad Screen Instrument: 44-9 B

Rad Screen Bkg. (cpm):

43

Rad Screen (cpm):

67 cpm

Comments: 2.0 - 2.5 rad screen = 50 cpm

2.5 - 3.0 rad screen = 70 cpm

3.0 - 3.5 rad screen = 70 cpm

Recorded by:

David Leyerle 10/30/06

QA by: Michael C. Leyerle Date: 11/2/06

COC No.: 11012006 - 01 H

Task Team Members: TEAM 1

Sample ID: SLD 97106

Station ID: SLD 97106

Collection Date: 10-30-06

Collection Time: 1106

Property Name: DT-34

Sample Location: North west corner of front parking lot

Northing (units): 1031728.38

Easting (units): 908852.69

Elevation (units): N/A

Sample Type: Hand Grab

Sample Collection Method: AUGER

Sample Depth: 3.5 - 4.0'

Soil Type: Light Gray clay

Rad Screen Instrument: 44-9 "B"

Rad Screen Bkg. (cpm): 43 cpm

Rad Screen (cpm): 72 cpm

Comments: 4.0 - 4.5 rad screen = 47  
4.5 - 5.0 rad screen = 60  
5.0 - 5.5 rad screen = 68

Recorded by: David Tyler 10/30/06 QA by: Michael C. Tipton Date: 11/2/06

COC No.: 11012006 - 01 H

Task Team Members: TEAM 1

Sample ID: SLD 97106 SLD 97109

Station ID: SLD 97106

Collection Date: 10-30-06

Collection Time: 1115

Property Name: DT-34

Sample Location: Northwest corner of front parking lot.

Northing (units): 1031731.21

Easting (units): 908854.74

Elevation (units): N/A

Sample Type: Hand Grab.

Sample Collection Method: AUGER

Sample Depth: 5.5 - 6.0'

Soil Type: Light Gray clay

Rad Screen Instrument: 44-9 "B"

Rad Screen Bkg. (cpm): 43 cpm

Rad Screen (cpm): 57 cpm

Comments:

Recorded by: David Tyler 10/30/06 QA by: Michael C. Tipton Date: 11/2/06

COC No.:

11012006-014

Task Team Members: TEAM 1

|                           |  |                        |           |
|---------------------------|--|------------------------|-----------|
| Sample ID:                | SLD 97140                                | Station ID:            | SLD 97140 |
| Collection Date:          | 10 - 30 - 06                             | Collection Time:       | 1430      |
| Property Name:            | SLDS                                     | Sample Location:       | DT - 34   |
| Northing (units):         | 1031235.80                               | Easting (units):       | 909054.60 |
| Elevation (units):        | N/A                                      | Sample Type:           | Hand Grab |
| Sample Collection Method: | HAND AUGER                               | Sample Depth:          | 0 - 0.5'  |
| Soil Type:                | Lt. Brown Silty clay.                    | Rad Screen Instrument: | 44-9 "B"  |
| Rad Screen Bkg. (cpm):    | 39 cpm                                   | Rad Screen (cpm):      | 53 cpm    |
| Comments:                 | 0.5-1.0' = 58 cpm<br>1.0 - 1.5' = 46 cpm |                        |           |

Recorded by: David Tysor 10/30/06 QA by: Michael C. Tyrola Date: 11/2/06

COC No.: 11012006-014

Task Team Members: TEAM 1

|                           |                       |                        |                  |
|---------------------------|-----------------------|------------------------|------------------|
| Sample ID:                | SLD 97141             | Station ID:            | SLD 97140        |
| Collection Date:          | 10 - 30 - 06          | Collection Time:       | 1430 DL 10-31-06 |
| Property Name:            | DT - 34               | Sample Location:       | SLDS             |
| Northing (units):         | 1031235.80            | Easting (units):       | 909054.60        |
| Elevation (units):        | N/A                   | Sample Type:           | Hand Grab        |
| Sample Collection Method: | HAND AUGER            | Sample Depth:          | 1.5 - 2.0'       |
| Soil Type:                | Lt. Brown Silty clay. | Rad Screen Instrument: | 44-9 "B"         |
| Rad Screen Bkg. (cpm):    | 34 cpm                | Rad Screen (cpm):      | 54 cpm           |
| Comments:                 | * Q.C. LOCATION       |                        |                  |

Recorded by: David Tysor 10/30/06 QA by: Michael C. Tyrola Date: 11/2/06

COC No.: 11012006-01H

Task Team Members: A. MARTINEZ, M. LYERLA, D. LYERLA.  
E. SCHRUMPF (TEAM 1)

Sample ID: SLD 97142 Station ID: SLD 97192

Collection Date: 10-31-06 Collection Time: 0935

Property Name: SLDS Sample Location: DT-34

Northing (units): 1031527.38 Easting (units): 909111.86

Elevation (units): N/A Sample Type: HOMO. GRAB

Sample Collection Method: AUGER Sample Depth: 0 - 0.5'

Soil Type: Rusy, light brown silty clay Rad Screen Instrument: 44-9 'G'

Rad Screen Bkg. (cpm): 75 cpm Rad Screen (cpm): 55 cpm

Comments: 0.5-1.0' = 53 cpm + Q.C. LOCATION  
1.0-1.5' = 52 cpm grayish clay

Recorded by: David French 10/31/06 QA by: Michael C. Zule Date: 11/2/06

COC No.: 11012006-01H

Task Team Members: TEAM 1

Sample ID: SLD 97143 Station ID: SLD 97192

Collection Date: 10-31-06 Collection Time: 0945

Property Name: SLDS Sample Location: DT-34

Northing (units): 1031527.38 Easting (units): 909111.86

Elevation (units): N/A Sample Type: HOMO. GRAB

Sample Collection Method: AUGER Sample Depth: 1.5 - 2.0'

Soil Type: Gravely, dark brown silty clay Rad Screen Instrument: 44-9 'G'

Rad Screen Bkg. (cpm): 75 cpm Rad Screen (cpm): 66 cpm

Comments:

Recorded by: David French 10/31/06 QA by: Michael C. Zule Date: 11/2/06

COC No.: 11012006-01H

Task Team Members: TEAM 1

|                           |  |                        |                   |
|---------------------------|--|------------------------|-------------------|
| Sample ID:                | <u>SLD97144</u>                                | Station ID:            | <u>SLD97144</u>   |
| Collection Date:          | <u>10-31-06</u>                                | Collection Time:       | <u>1030</u>       |
| Property Name:            | <u>SLDS</u>                                    | Sample Location:       | <u>DT-34</u>      |
| Northing (units):         | <u>1031331.57</u>                              | Easting (units):       | <u>909192.07</u>  |
| Elevation (units):        | <u>N/A</u>                                     | Sample Type:           | <u>HOMO. GRAB</u> |
| Sample Collection Method: | <u>HAND AUGER</u>                              | Sample Depth:          | <u>0-0.5'</u>     |
| Soil Type:                | <u>BLACK, CINDERY SILTY CLAY</u>               | Rad Screen Instrument: | <u>44-9 'G'</u>   |
| Rad Screen Bkg. (cpm):    | <u>49 cpm</u>                                  | Rad Screen (cpm):      | <u>67 cpm</u>     |
| Comments:                 | <u>0.5-1.0' = 76 cpm<br/>1.0-1.5' = 61 cpm</u> |                        |                   |

Recorded by: Daniel Lycet 10/31/06 QA by: Michael C. Lyden Date: 11/2/06

COC No.: 11012006-01H

Task Team Members: TEAM 1

|                           |                                  |                        |                   |
|---------------------------|----------------------------------|------------------------|-------------------|
| Sample ID:                | <u>SLD97145</u>                  | Station ID:            | <u>SLD97144</u>   |
| Collection Date:          | <u>10-31-06</u>                  | Collection Time:       | <u>1040</u>       |
| Property Name:            | <u>SLDS</u>                      | Sample Location:       | <u>DT-34</u>      |
| Northing (units):         | <u>1031331.57</u>                | Easting (units):       | <u>909192.07</u>  |
| Elevation (units):        | <u>N/A</u>                       | Sample Type:           | <u>HOMO. GRAB</u> |
| Sample Collection Method: | <u>HAND AUGER</u>                | Sample Depth:          | <u>1.5-2.0'</u>   |
| Soil Type:                | <u>BLACK, CINDERY SILTY CLAY</u> | Rad Screen Instrument: | <u>44-9 'G'</u>   |
| Rad Screen Bkg. (cpm):    | <u>49 cpm</u>                    | Rad Screen (cpm):      | <u>58 cpm</u>     |
| Comments:                 |                                  |                        |                   |

Recorded by: Daniel Lycet 10/31/06 QA by: Michael C. Lyden Date: 11/2/06

COC No.: SA-11152006-01H

Task Team Members: Antonio Martinez, Todd Keeton, Eric Schrumpf,  
Stephen Bangs - "Team A"

Sample ID: SLD97210 Station ID: SLD97104

Collection Date: 11/15/06 Collection Time: 1330

Property Name: DT-34 SLDS Sample Location: DT-34

Northing (units): 1031782.46 Easting (units): 909085.67

Elevation (units): N/A Sample Type: Grab

Sample Collection Method: Hand Auger Sample Depth: 3.5-4.0'

Soil Type: Black Silty Soil Rad Screen Instrument: 44-9 "C"

Rad Screen Bkg. (cpm): 53 cpm Rad Screen (cpm): 63 cpm

Comments:  $2.0 \cdot 2.5 = 53 \text{ cpm}$   
 $2.5 \cdot 3.0 = 66 \text{ cpm}$   
 $3.0 \cdot 3.5 = 56 \text{ cpm}$

Recorded by: E. Bangs QA by: Mark Peters Date: 11-20-06

COC No.: SA-11152006-01H

Task Team Members: Team A SA-11152006-01H

Sample ID: SLD97211 Station ID: SLD97104

Collection Date: 11/15/06 Collection Time: 1340

Property Name: SLDS Sample Location: DT-34

Northing (units): 1031782.46 Easting (units): 909085.67

Elevation (units): N/A Sample Type: Grab

Sample Collection Method: Hand Auger Sample Depth: 5.5-6.0'

Soil Type: Black/Brown Soil Rad Screen Instrument: 44-9 "C"

Rad Screen Bkg. (cpm): 53 cpm Rad Screen (cpm): 61 cpm

Comments:  $3.5 \cdot 4.0 = 63$   
 $4.0 \cdot 4.5 = 61$   
 $4.5 \cdot 5.0 = 62$   
 $5.0 \cdot 5.5 = 54$

Recorded by: E. Bangs QA by: Mark Peters Date: 11-20-06

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