Final
Saddle Road
Uranium Soils Investigation and
Baseline Human Health Risk Assessment

Ke'amuku Parcel, South Kohala District
Hawai'i Island, State of Hawai'i
TMK (3rd) 6-7-001:003

Prepared for:

Hawai'i Department of Transportation – Highways Division
and
U.S. Department of Transportation – Federal Highway Administration
Central Federal Lands Highway Division

Prepared by:

AMEC Earth and Environmental
3375 Koapaka Street, Suite F-251
Honolulu, Hawai'i 96819

October 2009

Table of Contents

List of Figures

List of Tables

List of Appendices

GLOSSARY OF ACRONYMS, TECHNICAL TERMS AND MEASUREMENTS

µg/m^3 - Micrograms of compound per cubic meter of air.

^{234}Th - Thorium-234

^{234}U - Uranium-234

^{235}U - Uranium-235

^{238}U - Uranium-238

ADD - Average Daily Dose. A compound- and facility-specific value generated by an equation designed to estimate a receptor's potential daily intake from exposure to compound with potential noncarcinogenic effects.

ANL - Argonne National Laboratory

ATSDR - Agency for Toxic Substances and Disease Registry

BHHRA - Baseline Human Health Risk Assessment

C - Carbon

CERCLA - Comprehensive Environmental Response, Compensation, and Liability Act

COPC - Compounds of Potential Concern - Those site-related compounds examined in detail in the quantitative risk assessment.

cm - centimeter

CSF - Cancer Slope Factor - A numerical estimate of the carcinogenic potency of a compound. CSFs are developed by the United States Environmental Protection Agency's Human Health Assessment Group for both oral and inhalation routes of exposure.

CSM - Conceptual Site Model

d - day

Dose - Concentration of a compound to which a receptor may be exposed. Dose is usually expressed in units of milligrams of compound per kilogram of body weight per day.

Dose-Response Evaluation - The process of quantitatively evaluating toxicity information and characterizing the relationship between the dose of the compound and the likelihood and magnitude of adverse health effects in the exposed population. From the quantitative dose-response relationship, toxicity values are identified and used in the risk characterization step to estimate the potential for adverse effects occurring in the receptors evaluated in the risk assessment.

DU - Depleted Uranium

EPC - Exposure Point Concentration

EU - Enriched Uranium

F - Temperature in Degrees Fahrenheit

HEAST - Health Effects Assessment Summary Tables

HI - Hazard Index - The sum of the compound-specific hazard quotients for a particular exposure pathway.

HQ - Hazard Quotient - The ratio of the calculated Chronic Average Daily Dose to the Reference Dose for a particular compound. A Hazard Quotient of less than one indicates that the Reference Dose for that compound has not been exceeded. Therefore, it can be assumed with a high degree of certainty that no adverse noncarcinogenic health effects are expected to occur as a result of exposure to that particular compound via that particular route. Because the reference dose is derived using multiple safety factors, a Hazard Quotient greater than one does not indicate that health effects are expected but rather that further analysis is warranted.

IRIS - Integrated Risk Information System - A computerized database of toxicological information maintained by the United States Environmental Protection Agency.

K - Potassium

LADD - Lifetime Average Daily Dose - A compound- and facility-specific value generated by an equation designed to estimate a receptor's potential daily intake from exposure to potentially carcinogenic compounds.

LOAEL - Lowest Observed Adverse Effect Level - The lowest experimental dose above the NOAEL at which a statistically significant difference in response between the control and exposed group is discernable.

mg/kg - Milligrams of compound per kilogram of medium.

mg/kg-day - Milligrams of compound per kilogram of body weight per day.

mg/l - Milligrams of compound per liter of water.

NCP - National Contingency Plan

NOAEL - No Observed Adverse Effect Level - An experimental dose greater than zero at which no statistically significant difference in response can be detected between the control and exposed groups.

Noncarcinogenic Effects - Category of adverse health effects that does not include cancers (e.g., liver effects, changes in blood enzyme levels, variances in body weight).

NRC - Nuclear Regulatory Commission

NTP - National Toxicology Program

pCi/g - picocuries per gram

ppm - part per million

PELCR - Potential Excess Lifetime Cancer Risk - An estimate of the increased probability of developing cancer given exposure to particular doses of particular compounds via specific exposure scenarios. The likelihood, over and above the background cancer rate, that a receptor will develop cancer in his or her lifetime as a result of facility-related exposures to compounds in various environmental media.

PRG - Preliminary Remediation Goal

PTA - Pohakūloa Training Area

Quantitative Risk Assessment - The mathematical and scientific procedure by which compounds present in environmental media are evaluated for their potential to adversely impact the health of individuals who may contact them.

Ra - Radium

Rn - Radon

RCRA - Resource Conservation and Recovery Act

RESRAD - *Res*idual *Rad*ioactivity

Response - Carcinogenic or noncarcinogenic health effect associated with exposure to a compound

RfC - Reference Concentration - An experimentally derived level of a compound in air modified by multiple safety factors of ten. It is the air concentration at which no statistical difference in response is expected to occur for an exposed population. The RfC is a toxicity value for compounds with noncarcinogenic effects via the inhalation route of exposure, and is usually expressed in units of milligrams of compound per cubic meter of air.

RfD - Reference Dose - An experimentally derived level of exposure, modified by multiple safety factors. The RfD is the dose predicted to produce no statistical difference in response for an exposed population. The RfD is a toxicity value for compounds with noncarcinogenic effects via the oral and inhalation routes of exposure, and is expressed in units of milligrams of compound per kilogram of body weight per day.

RME - Reasonable Maximum Exposure

SEIS - Supplemental Environmental Impact Statement

Th - Thorium

Threshold - The level of exposure below which no adverse noncarcinogenic health effects are known or expected to occur.

Total Excess Lifetime Cancer Risk - The sum of all pathway-specific Excess Lifetime Cancer Risks for a given receptor.

Total Hazard Index - The sum of all pathway-specific Hazard Indices for a given receptor.

Uncertainty Factor - An empirically-derived factor that is applied to a NOAEL or LOAEL in order to derive an RfD. Uncertainty factors account for some of the uncertainties associated with extrapolating information in a dose-response study to the general population.

U - Uranium

UCL - Upper Confidence Limit

USEPA - United States Environmental Protection Agency

EXECUTIVE SUMMARY

This report presents the results of a surface soil sampling event, a source determination and background evaluation and Baseline Human Health Risk Assessment (BHHRA) for uranium (U) isotopes along the proposed Saddle Road alignment (State Route 200) bordering Pohakūloa Training Area (PTA). The assessment addresses the public's concern that depleted uranium originating from military operations at PTA may impact the health of those that may be involved in the construction of the proposed alignment as well as those that may use the road in the future. The risk assessment considers both chemical and radiological toxicity from uranium. This document has been prepared in accordance with the provisions of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP).

Site Description

Saddle Road is a narrow, winding, two-lane road with steep grades, sharp curves, poor pavement, and substandard drainage. Parts of the easternmost portion have been widened and repaved by the County of Hawai'i, but until the current effort dating from 1996, no attempt had been made to correct deficiencies in vertical or horizontal curves, which reflected the original path built during World War II. Saddle Road has become increasingly important for access to the U.S. Department of the Army's PTA, Mauna Kea, Mauna Loa, Mauna Kea State Park, outdoor recreation areas used for hunting and gathering, ranch lands, and the communities of Waiki'i Ranch and Kaumana. Its role is increasing as a cross-island transportation route linking East and West Hawai'i for business travel, the transport of goods and services, tourism/recreation, shopping, and to some extent for commuting. Currently, about six miles of the improved Saddle Road have been completed, and another nine-mile section is nearly complete. A roughly five-mile section has been graded and is expected to be complete by the end of 2009, at which time another eight-mile section that is currently being designed and undergoing permit review is expected to begin construction. All of these segments are east of the roughly 12-mile section mauka of Mamalahoa Highway that is the subject of the Supplemental EIS to which this analysis pertains.

Project Background

In August 2007, US Army contractors discovered one intact M101 spotting round during a screening survey of the remote Impact Area at PTA. The recovered fragment consisting of depleted uranium (DU) was nearly completely unoxidized and found lying on a bare rock lava

surface. Subsequent surveys uncovered aluminum firing tubes for the spotting round, but no additional spotting rounds themselves. Recently, ten soil samples were collected by the US Army from sites where sediment had collected from past runoff/erosion events around the perimeter of PTA. Radiometric analysis of those samples found only natural U abundances and $^{234}U/^{238}U$ isotopic composition (Rubin 2008). Irrespective, a portion of the proposed Saddle Road alignment is proposed to transverse the Ke'āmuku Parcel, a former Parker Ranch property recently deeded to the U.S. Army, which is downwind during times when the prevailing regional tradewinds are in effect, particularly at night or in the early morning before daytime heating causes a convectional sea breeze that blows from the west across Keamuku towards the saddle. The Hawai'i State Department of Transportation, in consultation with the Saddle Road Task Force (a citizen group appointed by U.S. Senator Daniel K. Inouye to guide development of the project), determined that it would be prudent to examine the presence and risk of depleted uranium to human receptors who may construct or traverse Saddle Road, as part of the Supplemental Environmental Impact Statement (SEIS) being prepared to address a modified route across this property.

Analytical Methods and Results

In June 2008, concentrations of ^{234}U, ^{235}U and ^{238}U isotopes in surface soil along the proposed Saddle Road alignment were collected by AMEC and analyzed via two analytical methods. The first method to evaluate uranium isotope concentrations, Inductively Coupled Plasma Mass Spectrometry (ICP-MS), was utilized to provide precision and low detection limits for the ^{235}U and ^{238}U isotopes. Results for the ICP-MS method verify the presence of ^{238}U, but resulted in non-detects for the ^{234}U and ^{235}U isotopes indicating that they were either not present or below their respective minimum detection limits. The ICP-MS data was considered but not used in the background analysis and risk assessment as the assessments require data input by activity and/or mass concentration. The second analytical method utilized in this study was Alpha Spectrometry. The alpha spectrometry results were expected to provide the greatest precision and lowest detection limit for the ^{234}U isotope. Results of the alpha spectrometry analysis indicate the presence of all three isotopes in site soils. ^{235}U was detected in only one of the five (5) locations sampled. Given that data for all three isotopes were available for the alpha spectrometry method, data obtained from this method comprised the data set utilized for both the background analyses and human health risk assessment.

Background Analysis

Uranium occurs naturally in trace amounts in Hawaiian rocks, soils and waters at or below

concentrations of 1 to 3 parts per million (ppm) by weight (Rubin 2008). Uranium may also occur in soils due to anthropogenic action, such as from military use or as a byproduct of nuclear energy generation. Determining the source of any uranium isotopes detected along the proposed Saddle Road alignment was one objective of this study. Two methods were employed to evaluate uranium isotope source. The first method compared site-specific total U mass concentrations to naturally occurring U mass concentrations in Hawai‘i. Total U was determined by summing the isotopic concentrations of ^{234}U, ^{235}U and ^{238}U detected at each of the 5 independent sites along the proposed Saddle Road alignment. Results of this analysis indicate that total uranium along the proposed Saddle Road alignment are at or below levels occurring naturally in native Hawaiian soils. Total U based on alpha spectrometry analyses ranged from 0.4 parts per million (ppm) at location DU003 to 1.3 ppm at DU001. The average at all five locations was 0.8 ppm.

The second method used to determine whether detected U originates from natural or DU sources was the evaluation of isotope abundance. Except in extremely rare circumstances (not found in Hawai‘i), natural U dispersed in rocks and soils have a comparatively greater $^{234}U/^{238}U$ and $^{235}U/^{238}U$ ratio than those originating from DU. Although use of the $^{235}U/^{238}U$ is considered a more precise measurement than the $^{234}U/^{238}U$ ratio in isotopic fingerprinting of U contamination, the utility of the $^{234}U/^{238}U$ ratio is significant when ^{235}U data are not available or when concentrations of the ^{235}U isotope are too low to detect. This is the case here and as such, the $^{234}U/^{238}U$ ratio was used as the second method to fingerprint the U source. The naturally occurring $^{234}U/^{238}U$ ratio in soil has been determined to be in the range of 0.5 to 1.2 (Sansone et al. 2001). $^{234}U/^{238}U$ ratios at the Saddle Road alignment ranged from 0.74 to 1.79, with an average ratio across all five (5) locations of 1.16. Assuming the average ratio across the 5 sites is representative of the proposed alignment; these results indicate that the $^{234}U/^{238}U$ isotopic ratio is within the background range.

Baseline Human Health Risk Assessment

A baseline human health risk assessment (BHHRA) was performed to evaluate the potential risk posed by uranium isotopes detected at the proposed Saddle Road alignment. The alignment was evaluated as a single decision unit represented by five (5) distinct sampling locations. Receptors were assumed to be exposed to the lesser of the maximum concentration of each isotope detected or the 95% UCL of the mean. Risks were evaluated for the following receptors:

- A construction worker scenario assumed to be on site for 8 hours a day for 250 days in 1 year and assumed to contact surface and subsurface soil.

- A recreational user of the road assumed to frequent the Site 350 days a year for 2 hours a day, as child for 6 years and as an adult for 24 years, totaling a 30 year recreational tenure. Recreational receptors were assumed to contact just the surface soil

Potential estimated lifetime cancer risks were calculated using the RESidual RADioactivity (RESRAD) computer code, Version 6.4, developed by Argonne National Laboratory (ANL 2007). Carcinogenic risks were compared to the USEPA regulatory level of concern of 10^{-6} and 10^{-4}. Estimated noncarcinogenic risks posed from the chemical toxicity of Uranium are presented as total site Hazard Indices and were calculated by summing the pathway specific Hazard Quotients. A total Hazard Index of 1 was considered to be the regulatory level of concern.

The results for each receptor are presented below. Of the receptors analyzed, none were found to exceed the most conservative USEPA lifetime cancer risk regulatory level of concern of 10^{-6} or the noncarcinogenic Hazard Index regulatory level of concern of 1.

Construction worker

The Construction Worker scenario is assumed to be on site for 8 hours a day for 250 days in 1 year and contact surface and subsurface soil. The construction worker was found to have a carcinogenic risk of 1E-06, and a noncarcinogenic risk of 4E-03.

Recreational/Commuter

This receptor is a user of the road on a daily basis. The recreational receptor is assumed to frequent the Site 350 days a year for 2 hours a day, as child for 6 years and as an adult for 24 years, totaling a 30 year recreational tenure. Recreational receptors were assumed to contact just the surface soil. The carcinogenic risk associated with this receptor were found to be 3E-07 for the Child Receptor and 9E-07 for the Adult Receptor. These carcinogenic risks can be summed for a total carcinogenic risk of a 1E-06 for the full 30 year tenure. The noncarcinogenic risk was calculated to be 3E-03 for the Child Receptor and 1E-03 for the Adult Receptor.

Lead Analysis

In addition to the Uranium investigation and risk assessment, surface soils at all five (5) sample locations were analyzed for lead. Laboratory results can be found in Appendix A. Results were compared to the USEPA Region 9 residential Preliminary Remediation Goals (PRGs) for lead in soil of 400 mg/kg. The maximum lead concentration detected at any site was 3.3 mg/kg at

sampling location DU004. All lead values were well below the screening level criteria and was excluded from further analysis.

Conclusions

Based on the available surface soil data collected in June 2008 at five (5) locations along the proposed alignment, it has been determined that uranium detected at the site originates from natural sources. Potential noncancer health risks from the ingestion, inhalation and dermal contact of soil along the proposed alignment are below USEPA's acceptable risk level of concern. Potential cancer risks from radiological activity of the detected U isotopes are below the most conservative regulatory criteria.

SECTION 1
INTRODUCTION

This report presents the results of a surface soil sampling event, a source determination and background evaluation, and a Baseline Human Health Risk Assessment for uranium (U) isotopes along the proposed Saddle Road alignment (State Route 200) bordering Pohakūloa Training Area (PTA). The assessment addresses the public's concern that depleted uranium originating from military operations at PTA may impact the health of those that may be involved in the construction of the proposed alignment as well as those that may use the road in the future. The risk assessment considers both chemical and radiological toxicity from uranium. This evaluation was prepared for the State of Hawai'i Department of Transportation, Highways Division and the U.S. Department of Transportation, Federal Highway Administration Central Federal Lands Highway Division.

1.1 General Site Setting

The Site is contained within or directly adjacent to the Ke'āmuku parcel, a 23,977-acre property (tax map key [TMK]: 3rd Div., 6-7-001:003) purchased in 2006 from Parker Ranch by the U.S. Army as an addition to its Pohakūloa Training Area (PTA) (Figure 1 taken from Geometrician 2007). Although planned for military use, the Army currently allows grazing on the parcel as a fire mitigation measure. The parcel is bordered by the existing Saddle Road, the Waiki'i Ranch subdivision and nearby homes and farms on the north, by the remainder of PTA on the east, by the Pu'uanahulu Game Management Area on the south, and by private, undeveloped lands across Māmalahoa Highway on the west (Geometrician 2007).

1.2 Description of Problem

A surface soils assessment, source analysis and baseline human health risk assessment was requested to support a Supplemental Environmental Impact Statement (SEIS) that is being prepared for the Saddle Road extension and realignment, which will eventually bisect a portion of the PTA northwest of MP42 (proposed W-3 route) or possibly south of the W-3 route (proposed W-7 route. Note: W-7 is in the conceptual stage). These two areas (W-3 and W-7) are in proximity to Ke'āmuku on the western side of PTA.

In August, 2007, U.S. Army contractors discovered depleted uranium (DU) fragments at PTA. Although the Army acknowledges that DU material is considered a chemical hazard, the Army maintains that DU does not pose a risk to public health and that insufficient quantities have been detected to pose a risk to human health. Sampling and analytical data for DU are not available in

areas where the proposed Saddle Road extension is to be constructed. In the absence of analytical data, the source of U as well as the potential risks to human receptors (construction workers that will be involved in the construction of the Saddle Road extension or occupants of vehicles that may use the road in the future) cannot be determined.

The objective of this study was therefore to gather analytical data of sufficient quality and quantity necessary to support a background source evaluation and human health risk assessment. The background evaluation is designed to determine whether the source of uranium at the site was naturally occurring or if anthropogenic depleted uranium sources also contribute to uranium presence. The human health risk assessment determines the degree of risk, if any, that uranium and poses for construction workers and users/commuters who may use Saddle Road in the future.

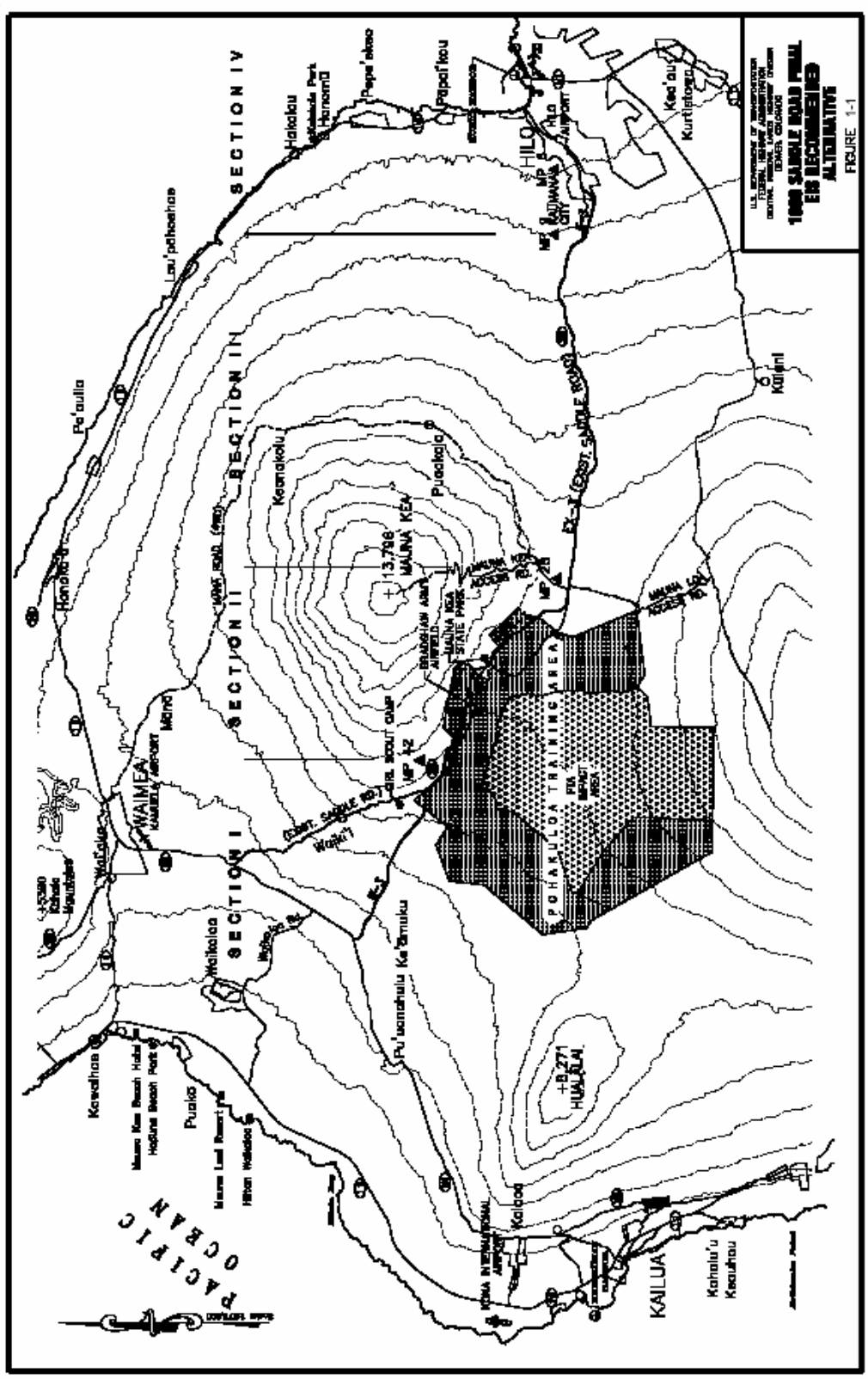

Figure 1: Site Location Map

SECTION 2
SITE DESCRIPTION

This section presents background information relevant to the project including site history, descriptions of geology and soils, hydrogeology, hydrology, and climate.

2.1 Site History

A portion of the proposed Saddle Road alignment is proposed to transverse the Ke'āmuku Parcel, a former Parker Ranch property recently deeded to the U.S. Army, which is downwind from PTA. The Site is currently zoned for agricultural use and it is assumed to have been used for agricultural use throughout most of its recent history. The US Army conducted training at PTA during the mid-1960s using the M101 spotting round of the Davy Crockett Weapon System. The M101 spotting round was a small (20mm) low speed (velocity) projectile that weighed approximately 1 pound. Each round contained approximately one half pound D38 U Alloy (92% DU and 8% molybdenum) (Rubin 2008). This spotting round was designed to mirror the flight characteristics of larger caliber rounds and was fired to identify the correct range and bearing for those larger caliber rounds. These rounds typically broke into large fragments after use.

In August 2007, U.S. Army contractors discovered one intact M101 spotting round during a screening survey of the remote Impact Area at PTA. The recovered fragment consisting of depleted uranium (DU) was nearly completely unoxidized and found lying on a bare rock lava surface. Subsequent surveys uncovered aluminum firing tubes for the spotting round, but no additional spotting rounds themselves. Recently, ten soil samples were collected from sites where sediment had collected from past runoff/erosion events around the perimeter of PTA. Radiometric analysis of those samples found only natural U abundances and $^{234}U/^{238}U$ isotopic composition (Rubin 2008). No sampling has been performed along the proposed alignment.

2.2 Geology and Soils

The Site is situated on late Pleistocene and Holocene lava flows from Mauna Kea covered with volcanic ash deposits (MacDonald 1983; Wolfe 1996). The topography reflects the hummocky character of lava flows. The only major relief features are found in a few gulches and at several 100-foot plus high cinder cones, both of which are concentrated in the northern part of Ke'āmuku. The surface has weathered through time to produce deep, well-drained soils (Geometrician 2007). Soil types anticipated to be encountered during this sampling effort include: Kilohana loamy fine sand, Pu'u Pa extremely stony very fine sandy loam, very stony

land, and Kaimū extremely stony peat. In general, these soils exhibit fairly rapid permeability, slow runoff, and slight erosion potential (USDA 1973).

2.3 Hydrogeology

According to Mink and Lau (1990), the area of concern overlies two different aquifers, the Anaehoʻomalu aquifer system (Northwest Mauna Loa aquifer sector) and the Waimea aquifer system (West Mauna Kea aquifer sector). The aquifers are both classified as unconfined, high level aquifers in dike compartments and/or flank lava deposits. They are considered irreplaceable, fresh water aquifers (< 250 milligrams per liter [mg/L] chloride content) with high vulnerability to contamination due to its proximity to the surface. Groundwater from portions of these aquifers is currently used as a drinking water source.

2.4 Hydrology

According to maps in the Atlas of Hawaiʻi, 3rd ed. (Juvik 1998), annual rainfall averages approximately 25 inches in Keʻāmuku overall, being slightly greater at higher elevations and less at lower elevations. Although no perennial streams, lakes, springs, or wetlands are present, the Keʻāmuku property includes a number of ephemeral drainages mapped on U.S. Geological Survey (USGS) maps. These originate on the steep slopes of Mauna Kea and cross the existing Saddle Road at various bridges, culverts and dips in the road. There is a distinct shift in the amount of dissection in the Keʻāmuku property from north to south, as the terrain changes from highly-dissected, older Mauna Kea lava flows with many ephemeral streams in the north to younger, lightly-dissected flows with few ephemeral streams in the south. The very youngest Mauna Kea flows are found on the southern margin of the Keʻāmuku property, where the W-7 alignment is located. South of this are Mauna Loa lava flows, which also lack any stream dissection (Geometrician 2007).

Since there are no perennial stream channels within the Keʻāmuku area, no baseline data on surface water quality are available. All of the drainages within the study corridor ultimately discharge to the ocean or to littoral springs through subsurface flow (Geometrician 2007).

The only baseline water quality data available for Keʻāmuku are from required water sampling of a 2,500-foot deep well that supplies water for the Waikiʻi Ranch subdivision. The well is located within 200 feet of the existing Saddle Road and has been consistently found to meet all of the federal standards for safe drinking water. There is no recorded contamination associated with this well (Geometrician 2007). A second well which goes to a depth of 4,300 feet is also located in Waikiʻi. No further information is provided for this well.

2.5 Climate

The average maximum daily temperature in the Keʻāmuku area varies from about 70 to 80 degrees Fahrenheit, with an average minimum of 60 to 70 degrees. Keʻāmuku on average receives about 25 inches of rainfall annually, with greater totals at higher elevations and less at lower ones, according to maps in the Atlas of Hawaiʻi, 3rd ed. (Juvik 1998). Winds vary between northeast trades funneled through the saddle between Mauna Loa and Mauna Kea and upslope winds generated by heating of the land surface. Light and variable "kona" winds occasionally replace this pattern, most often in winter. According to site data, Morning winds are easterly at 15 to 25 knots (17-1/4 to 28-3/4 mph) and afternoon winds are westerly at 15 to 20 knots (17-1/4 to 23 mph). The entire Keʻāmuku parcel is subject to fog, which above 4,000 feet in elevation is frequent (Geometrician 2007).

SECTION 3
SOIL SAMPLING PROGRAM AND RESULTS

The surface soil sampling program is described in its entirety in Final Sampling and Analysis Plan (SAP), Depleted Uranium Risk Assessment (AMEC 2008). The Final SAP describes sample locations, sampling methods, data quality objectives, data quality indicators, desired levels of detection and analytical laboratory Standard Operating Procedures.

Briefly, in June 2008, five (5) surface soil samples were collected, during a single environmental site investigation along the proposed Saddle Road alignment per the AMEC 2008 protocol (Figure 2). The soil samples were analyzed for Uranium by Alpha Spectrometry by USEPA Method EML A-01-R MOD, by ICP-MS by USEPA method SW846 6020, and for Percent Moisture by USEPA method MCAWW 160.3 MOD. Soil samples were also analyzed for Lead by USEPA method SW846 6020.

Results

Analytical laboratory data sheets are provided in Appendix A. Lead and Uranium were analyzed for and detected in surface soil at the Site. Summary analytical results are provided in Table 1.

The first method to evaluate uranium isotope concentrations, Inductively Coupled Plasma Mass Spectrometry (ICP-MS) was utilized to provide precision and low detection limits for the ^{235}U and ^{238}U isotopes. Results for the ICP-MS method verify the presence of ^{238}U, but resulted in non-detects for the ^{234}U and ^{235}U isotopes indicating that they were either not present or below their respective minimum detection limits. These data were considered but not used in the background analysis and risk assessment because the assessments require data input by activity and/or mass concentration. The second analytical method utilized in this study was Alpha Spectrometry. The alpha spectrometry results were expected to provide the greatest precision and lowest detection limit for the ^{234}U isotope. Results of the alpha spectrometry analysis indicate the presence of all three isotopes in site soils. ^{235}U was detected in only one of the 5 locations sampled. Given that data for all three isotopes were available for the alpha spectrometry method, data obtained from this method comprised the data set utilized for both the background analyses and human health risk assessment.

Table 1: Summary of Analytical Results

		ICP-MS	Radiochemistry				Lead
Sample ID	Isotope	Concentration (ppb)	Isotope	Result (pCi/g)	Mass Concentration (ppb)	$^{234}U/^{238}U$ Activity Ratio**	Concentration (mg/kg)
DU0001	234	ND	234	**0.436**	**0.0701**	1.184783	3.0
	235	ND	235/236	ND	NA		
	238	**160**	238	**0.368**	**1094.66**		
DU0002	234	ND	234	**0.157**	**0.0252**	1.180451	2.8
	235	ND	235/236	ND	NA		
	238	**130**	238	**0.133**	**395.62**		
DU0003	234	ND	234	**0.118**	**0.019**	1.787879	1.8
	235	ND	235/236	ND	NA		
	238	**64**	238	**0.066 (J)**	**196.32**		
DU0004	234	ND	234	**0.144**	**0.0231**	1.107692	3.3
	235	ND	235/236	ND	NA		
	238	**100**	238	**0.13**	**386.7**		
DU0005	234	ND	234	**0.199**	**0.032**	0.739777	3.0
	235	ND	235/236	ND	NA		
	238	**140**	238	**0.269**	**800.17**		
DU0006*	234	ND	234	**0.123**	**0.0198**	1.008197	2.0
	235	ND	235/236	**0.018 (J)**	**8.29**		
	238	**100**	238	**0.122**	**362.9**		
DU0007*	234	ND	234	**0.127**	**0.0204**	0.824675	2.4
	235	ND	235/236	ND	NA		
	238	**110**	238	**0.154**	**458.09**		

*Samples DU0006 and DU0007 are replicate samples of DU0002.

**Natural 234/238 Uranium Activity Ratio Ranges from 0.5 to 1.2

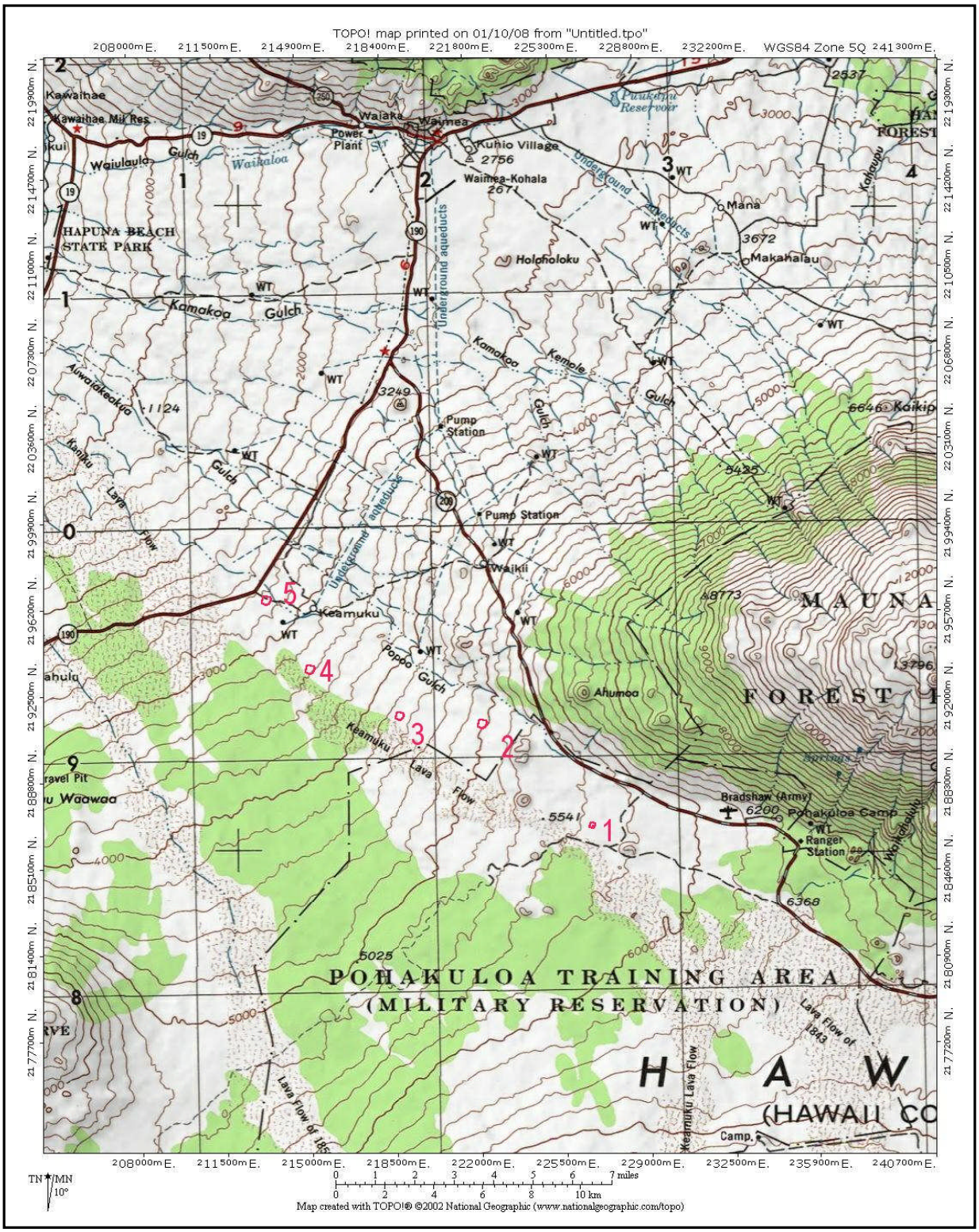

Figure 2: Sample Location Map

SECTION 4
BACKGROUND EVALUATION

Two methods can be utilized to determine whether detected U originates from natural or DU or enriched U (EU) sources. The first method involves a simple comparison of site U concentrations to U concentrations found in typical unimpacted environmental media. The second method compares isotopic abundance (isotope ratios) from site-specific media to the isotope abundance in typical unimpacted environmental media. This study utilized both methods of evaluation. The following sections provide detailed information regarding sources of radiation in the environment, a description of depleted and enriched uranium (DU and EU), and a site-specific source analysis of U at the proposed Saddle Road alignment. Sections 4.1, 4.2, and 4.3 have been taken from Rubin (2008) and are consistent with Sansone et al. (2001), Stegnar and Benedik (2001), and ATSDR (1999).

4.1 Sources of Radiation in the Environment

U is a naturally occurring heavy metal. Rocks, soil, coral, water, air, plants and animals all contain varying amounts of U. Natural U is a mixture of three types (or isotopes) of U, written as ^{234}U, ^{235}U, and ^{238}U. Although these isotopes are different radioactive materials with differing radioactive properties, they are the same chemically. Because U normally occurs at very low concentration in natural materials at Earth's surface, (less than 5 parts per million by weight, ppm), geochemists refer to it as a "trace element". U ores and U rich minerals do not occur in Hawai'i, but U is dispersed at low abundance in normal rock forming minerals.

There are many sources of radioactivity in the environment besides U – some are natural and some are manmade. An environmental assessment typically considers both natural and contaminant sources of radioactivity. There are multiple natural radiation sources that humans come in contact with every day. Those most relevant to this assessment include the chemical elements thorium, radium, radon, potassium and carbon, which have the chemical symbols Th, Ra, Rn, K and C. Th is a heavy metal like U that occurs in rocks and soils at similar concentration to U. Th has one major isotope (^{232}Th) and several minor ones, all of which are radioactive. Ra is a natural radioactive byproduct from the decay of U (and to a much lesser extent, Th). It is in the same chemical family as the element calcium (Ca), and occurs at low levels in many materials at Earth's surface.

Radon is a radioactive gas formed from Ra that continually seeps out of rocks, soils and waters. All of the atoms of U, Th, Ra, and Rn on Earth are radioactive. K and C are slightly different:

these two elements are very common in materials found at Earth's surface, including the human body, yet they are only mildly radioactive because just a small fraction of the K and C atoms are radioactive (these radioactive isotopes are written as ^{40}K and ^{14}C). Both elements are mostly made up of stable (non-radioactive) isotopes; some forms of carbon (such as coal and petroleum) have no ^{14}C in them.

The atomic age brought many new sources of radioactivity into our world. For instance, atmospheric atomic bomb tests in the 20th century produced radioactive isotopes of plutonium, strontium, cesium, and iodine (to name just a few) that were previously extremely rare or not found on Earth. Many of these bomb-test isotopes have since decayed away, although the longest-lived isotopes can still be found at shallow depths in soils, lake sediments, and glaciers around the world. Other modern activities also occasionally release artificial radio-isotopes into the environment, including everything from the nuclear power industry to nuclear medicine to the manufacture and disposal of household smoke detectors. A person exposed to high levels of radioactivity close to the source can suffer numerous possible toxic effects that depend on the type of radioactive material. This is why users of radioactive materials follow strict protocols (based on time, distance, and shielding) to minimize negative impacts on themselves or the general public, and why, for instance, highly radioactive patients undergoing nuclear medicine therapy are kept away from the general public.

4.2 Natural, Depleted, and Enriched Uranium

New forms of U with isotopic compositions that differ greatly from natural U are another development of the atomic age. An industrial process called enrichment is used to concentrate ^{234}U and ^{235}U producing enriched uranium (EU) used for nuclear fuel. The material leftover from the enrichment process is called DU because it has lower concentrations of these two isotopes than natural uranium. DU is thus a modified form of U from which these lighter and more radioactive isotopes have been partially removed, creating a substance that has more ^{238}U than natural U. The resultant change in the isotopic composition makes it possible to distinguish naturally occurring U from enriched and depleted forms.

EU is more radioactive than natural U, with more highly enriched forms being more radioactive than less enriched forms. Depending on the percent enrichment, EU can be used as nuclear fuel for power plants (less enriched, sometimes called "low EU") or atomic weapons (more enriched, sometimes called "high EU"). DU has numerous civilian and military uses that on occasion cause it to be introduced into the environment. Civilian uses include radiation shielding, gyroscopes, and stabilizers in aircraft. Past and present military uses include spotting rounds,

munitions and as shielding in armored vehicles.

4.3 U Mass Concentration

Uranium occurs naturally in trace amounts in Hawaiian rocks, soils and waters at or below concentrations of 1 to 3 parts per million (ppm) by weight (Rubin 2008). The sum of the 3 most prevalent isotopes (^{234}U, ^{235}U and ^{238}U) can be used as to estimate total U concentrations. If site-specific U concentrations are significantly greater than representative background U concentrations, one can surmise that additional sources of U exist.

4.4 Isotopic Fingerprinting

The proportions of U isotopes in a substance can be used to determine the source of the U it contains. If environmental U contamination is suspected, isotopic tests can determine if the U came from natural U ore or from non-natural DU or EU. Except in extremely rare cases (not found in Hawai‘i), natural U dispersed in rocks, soils and waters at earth's surface today have the same $^{235}U/^{238}U$ radioactivity ratio, even if the U concentration (by weight) is different between them. This fact provides a fingerprint of natural U isotopic composition. DU has comparatively less ^{235}U and EU has more, giving this material non-natural $^{235}U/^{238}U$ ratio. There have been slight variations in the ^{235}U depletion level in DU manufactured in different places and times, but normally ^{235}U has been reduced by at least 70% from its natural value. ^{234}U is affected even more by depletion and enrichment than ^{235}U. However, unlike ^{235}U, the amount of ^{234}U in a natural material can vary relative to the amount of ^{238}U due to natural processes, making the $^{234}U/^{238}U$ ratio less precise but still useful for isotopic fingerprinting of U contamination. The reason $^{234}U/^{238}U$ varies in nature and $^{235}U/^{238}U$ does not is that most ^{234}U in a rock has been produced there from decay of ^{238}U and its immediate daughters, causing slight radiation damage to the place in a mineral where it resides. ^{235}U and ^{238}U are not decay products of other isotopes on Earth so there is no radiation damage to their mineral residence sites.

The radiation damage from ^{234}U production increases with the age of the rock, causing that ^{234}U atom to be more easily leached from the rock during rock weathering. The water that does the leaching usually ends up with elevated $^{234}U/^{238}U$ and the rock and soil residues usually have lower ratios, although secondary mineral formation can affect rock and water ratios as well. Recoil of ^{234}U atoms as they are produced can also push "extra" ^{234}U into soil water. The changes in $^{234}U/^{238}U$ from natural processes are usually smaller than the changes caused by the manufacture of DU and EU, so $^{234}U/^{238}U$ is still useful for fingerprinting of U contamination in nature.

Contamination generally results in elevated U concentrations, although if U is leaching from the environment almost as fast as the contaminant is added, the isotopic composition is affected but the overall U concentration may not change as dramatically. If the contamination is from natural U (e.g., some phosphorous fertilizers or U ores) the U concentration will change but the isotopic composition will not. The isotopic composition will change if contamination is from DU or EU. If DU or EU contamination is present, U in environmental samples will be mixtures of natural and contaminant U, with intermediate isotopic composition, except in extremely contaminated cases. Mixing follows predictable trajectories. Laboratory measurements of U concentration and isotopic composition are used to determine the type and amount of contamination.

4.5 Site Specific U Source Identification

Section 4.5.1 describes the site specific analysis of U mass concentration while sections 4.5.2 describes the use of isotopic fingerprinting to determine whether U at the site is from natural or anthropogenic sources.

4.5.1 U Mass Concentration

Uranium occurs naturally in trace amounts in Hawaiian rocks, soils and waters at or below concentrations of 1 to 3 parts per million (ppm) by weight (Rubin 2008). Total U at the site was determined by summing the isotopic concentrations of ^{234}U, ^{235}U and ^{238}U detected at each of the 5 independent sites along the proposed Saddle Road alignment. Results of this analysis indicate that total uranium along the proposed Saddle Road alignment are at or below levels occurring naturally in native Hawaiian soils. Total U based on alpha spectometry analyses ranged from 0.4 parts per million (ppm) at location DU003 to 1.3 ppm at DU001. The average at all five (5) locations was 0.8 ppm.

4.5.2 Isotopic Fingerprinting

The second method used to determine whether detected U originates from natural or DU sources was the evaluation of isotope abundance. Except in extremely rare circumstances (not found in Hawai‘i), natural U dispersed in rocks and soils have a comparatively greater $^{234}U/^{238}U$ and $^{235}U/^{238}U$ ratio than those originating from DU. Although use of the $^{235}U/^{238}U$ is considered a more precise measurement than the $^{234}U/^{238}U$ ratio in isotopic fingerprinting of U contamination, the utility of the $^{234}U/^{238}U$ ratio is significant when ^{235}U data are not available or when concentrations of the ^{235}U isotope are too low to detect. This is the case here and as such, the $^{234}U/^{238}U$ ratio was used as the second method to fingerprint U source. Naturally occurring $^{234}U/^{238}U$ ratio in soil has been determined to be in the range of 0.5 to 1.2 (Sansone et al. 2001).

$^{234}U/^{238}U$ ratios at the Saddle Road alignment ranged from 0.74 to 1.79, with an average ratio across all five (5) locations of 1.16. Assuming the average ratio across the five (5) sites is representative of the proposed alignment, these results indicate that the $^{234}U/^{238}U$ isotopic ratio is within the background range.

SECTION 5
Baseline Human Health Risk Assessment

This section describes the HHRA processes and methodologies used to identify the hazards associated with potential uranium exposures for identified receptors. Information available regarding depleted uranium use was evaluated, a site characterization plan was formulated and implemented, constituents of potential concern (COPCs) were selected for quantitative risk assessment, receptors identified, and risk quantified. Additionally, a screening level lead assessment was performed to determine potential human health risk from lead detected at the site.

5.1 Hazard Identification

In the Hazard Identification step, analytical data are evaluated and constituents of potential concern (COPC) are selected for quantitative risk assessment. Data have been collected during a single phase of investigation. Samples assessed include on-Site surface soil data only. In this risk assessment, subsurface soil concentrations were assumed to be equal to surface soil concentrations. This assumption was considered conservative (protective of human health) because the mobility of U in soils is considered low and it likely that subsurface soil concentrations would be reduced in comparison to surface soils at the same location (Rubin 2008).

5.1.1 Summary of Available Site Data

Data were collected during a single post-remedial phase of investigation in June 2008. Environmental surface soil samples were collected from 10,000 square foot areas at five (5) distinct locations along the proposed alignment. Sampling locations can be found on Figure 2.

The soil samples were analyzed for Uranium by Alpha Spectrometry by USEPA Method EML A-01-R MOD, by ICP-MS by USEPA method SW846 6020, and for Percent Moisture by USEPA method MCAWW 160.3 MOD. Soil samples were also analyzed for Lead by USEPA method SW846 6020.

5.1.2 Selection of COPCs

Based on the nature of the site, problem and need to address public concerns two chemicals were analyzed and considered for evaluation. They included lead and three U isotopes (^{234}U, ^{235}U and ^{238}U). Other chemicals may be present at the Site but were not included in this assessment.

5.1.3 Analysis of Lead

All five (5) soil sample locations were analyzed for lead. Results of the Analysis can be found in Appendix A. Results were compared to the USEPA Region 9 Preliminary Remediation Goals (PRGs) for lead in soil of 400 mg/kg. Of the five (5) soil sample locations, the maximum detected was 3.3 mg/kg at sampling location DU004 falling well below the PRG. Due to these low levels, lead was excluded from any further additional analysis.

5.1.4 Analysis of Uranium

Five (5) soil samples were analyzed for uranium by both Alpha Spectrometry and Inductively Coupled Plasma Mass Spectrometry (ICP-MS). ICP-MS analysis is generally considered to have the greatest precision and lowest detection limits for detecting the ^{235}U and ^{238}U isotopes. The ICP-MS results provided Non Detects for all the samples for the ^{234}U and ^{235}U isotopes. The highest reading for the ^{238}U isotope was 0.16 mg/kg at sampling location DU001.

Soil samples were also analyzed by Alpha Spectrometry to determine radiological activity. Alpha Spectrometry is considered to have greater precision and lower detection limits for the ^{234}U. The highest detected ^{234}U isotope was 0.436 pCi/g at sampling location DU001. The Alpha Spectrometry also has readings as high as 0.018 for ^{235}U at sampling location DU002, and 0.368 pCi/g for ^{235}U at sampling location DU001. It should be noted though that all ^{235}U results were still below the reporting limit.

Activity determined in the alpha spectrometry analysis was converted to a mass concentration by via the following formula:

$$U_{Total} = \left(\frac{^{234}U}{6{,}250\, pCi/\mu g} \right) + \left(\frac{^{235}U}{2.16\, pCi/\mu g} \right) + \left(\frac{^{238}U}{3.36\, pCi/\mu g} \right)$$

where:

U_{Total} = Total mass concentration of uranium (mg/kg)

^{234}U, ^{235}U, and ^{238}U = Isotopic radioactivity concentration (pCi/g)

Based on conversion above, the highest mass concentration detected using Alpha Spectrometry analysis was 1.095 ppm at sampling location DU001. Because the results from the Alpha Spectrometry analysis provide evaluation of the progeny Uranium, and overall recorded higher

activity and resulting mass concentrations, in order to be conservative, these results were used in lieu of ICP-MS results in the BHHRA.

5.2 Dose-Response Assessment

The purpose of the Dose-Response Assessment is to identify both the types of adverse health effects a COPC may potentially cause, as well as the relationship between the amount of COPCs to which receptors may be exposed (dose) and the likelihood of an adverse health effect (response). The USEPA characterizes adverse health effects as either carcinogenic or noncarcinogenic and dose-response relationships are defined for oral and inhalation routes of exposure. The results of the toxicity assessment, when combined with the results of the exposure assessment (Section 5.3), provide an estimate of potential risk.

This section provides dose-response information for COPCs evaluated in the risk assessment for the Site. Section 5.2.1 describes the USEPA approach for developing noncarcinogenic dose-response values. The carcinogenic dose-response relationships developed by USEPA are discussed in Section 5.2.2. Noncarcinogenic and carcinogenic dose-response values used in this risk assessment are presented in Table 2. Dose-response information used in this risk assessment was obtained from the following sources:

- USEPA's Integrated Risk Information System (IRIS) (USEPA 2008);
- Agency for Toxic Substances & Disease Registry's Minimal Risk Levels (MRLs) for Hazardous Substances (ATSDR 2007);
- USEPA Region IX's Preliminary Remediation Goals (USEPA 2004).

5.2.1 Noncarcinogenic Dose-Response

Constituents with known or potential noncarcinogenic effects are assumed to have a dose below which no adverse effect occurs or, conversely, above which an effect may be seen. This dose is called the "threshold dose". In laboratory experiments, this dose is known as the "no observed adverse effects level" (NOAEL). The lowest dose at which an adverse effect is seen is called the lowest observed adverse effects level (LOAEL). By applying uncertainty factors to the NOAEL or the LOAEL, the USEPA (and other regulatory agencies from which toxicity values used in this assessment were acquired) have developed reference doses (RfDs) for chronic exposures to constituents with potential noncarcinogenic effects.

Table 2: Noncarcinogenic and Carcinogenic Dose Response

	Constituent	
	Uranium	
Oral CSF ***(mg/kg-d)^-1***	NA	a
Inhalation CSF ***(mg/kg-d)^-1***	NA	a
Inhalation URF ***(ug/m^3)^-1***	NA	a
Oral TDI/RfD ***(mg/kg-d)***	3.00E-03	a
Inhalation TC/RfC ***(ug/m^3)***	3.00E-01	b
Inhalation RFDi ***(mg/kg/day)***	8.60E-05	c

NA - Not Applicable
(a) U.S. EPA (2008). IRIS.
(b) ATSDR MRLs (2008)
(c) Derived from Inhalation RfC.

Uncertainty factors account for unknowns associated with the dose-response value, such as the effect of using an animal study to derive a human dose-response value, extrapolating from the high doses used in the laboratory experiment to the low doses typically encountered in environmental settings, and evaluating sensitive subpopulations. For constituents with potential noncarcinogenic effects, the RfD provides reasonable certainty that if the specified exposure dose is below the RfD, then no noncarcinogenic health effects are expected to occur even if daily exposure were to occur for a lifetime. RfDs are expressed in terms of milligrams of constituent per kilogram of body weight per day (mg/kg-day). The oral RfD for Uranium is 3E-03 mg/kg-day (IRIS 2008) and is used for oral and dermal routes of exposure. The inhalation RfD used was 8.6E-05 mg/kg-day and was derived from the ATSDR MRL inhalation reference concentration.

5.2.2 Carcinogenic Dose-Response

The underlying assumption of regulatory risk assessment for constituents with known or assumed potential carcinogenic effects is that no threshold dose exists. In other words, it is assumed that a finite level of risk is associated with any dose above zero. For carcinogenic effects, the USEPA uses a two-step evaluation in which the constituent is assigned a weight-of-evidence classification, and then a cancer slope factor (CSF) is calculated.

The weight-of-evidence classification summarizes the evidence about the likelihood of the constituent being a human carcinogen. Group A constituents are classified as human carcinogens, Group B constituents are probable human carcinogens, Group C constituents are possible human carcinogens, Group D constituents are not classifiable as to human carcinogenicity, and, for Group E constituents, there is evidence of noncarcinogenicity for humans.

In the second part of the evaluation, CSFs are calculated for constituents that are known or probable human carcinogens. The USEPA has developed computerized models that extrapolate observed responses at high doses used in animal studies to predicted responses in humans at the low doses encountered in environmental situations. The models developed by the USEPA assume no threshold and use animal or human data to develop an estimate of the carcinogenic potency of a constituent. The USEPA refers to this numerical estimate as the CSF. The computerized models used by USEPA assume that carcinogenic dose-response is linear at low doses.

Uranium itself is not considered to be carcinogenic when inhaled ingested or contacted dermally. However, its radiological activity is assumed to have carcinogenic effects. Potential carcinogenic risks are therefore addressed using Argonne National Laboratory (ANL 2007) RESidual RADioactivity (RESRAD) computer code, Version 6.4. This software was developed in coordination with the Department of Energy (DOE), USEPA, and Nuclear Regulatory Commission (NRC), as a tool for predicting human health risks due to residual radioactivity in soils. The code uses radionuclide CSFs presented in Federal Guidance Report (FGR) No. 13 (USEPA 2002), which incorporate HEAST 2001 risk coefficient values.

RESRAD's computer code was developed to provide site-specific residual radioactive material guidelines as well as radiation dose and excess lifetime cancer risk to a chronic exposure. RESRAD uses a pathway analysis method in which the relation between radionuclide concentrations in soil and the does to a member of a critical population group is expressed as a pathway sum, which is the sum of products of "pathway factors." Pathway factors correspond to

pathway segments connecting compartments in the environment between which radionuclides can be transported or radiation emitted. Radiation doses, health risks, soil guidelines and media concentrations are calculated over user-specified time intervals. The source is adjusted over time to account for radioactive decay and ingrowth, leaching, erosion, and mixing. With few exceptions, all RESRAD default parameters were used without site-specific modification. Site-specific exposure factors used in the RESRAD assessment are described in Section 5.5.

5.3 Exposure Assessment

The risk assessment process requires the creation of exposure scenarios to assess the potential for adverse health effects from constituents at or near the Site. While these scenarios represent hypothetical people and activities, they reflect the physical description of the Site and the surrounding residential, industrial and commercial areas, as well as the activities that may typically occur in these areas. Both current and reasonably foreseeable future potential exposures are evaluated.

In this assessment, past and current uses of the subject site were analyzed in order to determine the potential exposure scenarios relevant for the site. The exposure assessment is divided into seven subsections. Section 5.3.1 describes the potential receptors and exposure scenarios selected for evaluation in the risk assessment. Section 5.3.3 presents the potential exposure pathways evaluated for the Site. Section 5.3.4 describes the conceptual site model. Section 5.4 describes the statistical methods used to estimate exposure-point concentrations. Section 5.5 describes exposure factors used in the risk assessment. Absorption adjustment factors are discussed in Section 5.6 and dermal permeability constants are discussed in Section 5.7. Section 5.8 describes the methods used to estimate potential exposure doses.

5.3.1 Potential Exposure Scenarios

In creating potential exposure scenarios for evaluation in the risk assessment, the likelihood of potential exposure to Site-related constituents via many pathways was considered. Some pathways were excluded from further analysis because the route of exposure was physically impossible or highly unlikely given the conditions of the Site. Based on information about land use, topography, and current Site conditions, current and future exposure scenarios were developed for the Site.

5.3.2 Current and Future Exposure Scenarios

As described in Section 1.1 the Site is located in and around the PTA (Figure 1). A general

description of the property and an account of its history are provided. Likely current and future exposure scenarios evaluated include adult construction workers, working on the road, and a commuter, who uses the road on a daily basis. Construction workers were assumed to work on the site and excavate a large area for construction for 8 hours a day, 250 days a year for 1 year. Construction workers are expected to be exposed to both surface and subsurface soils, inhalation of soil derived dust, and any external gamma radiation. Recreational users are commuters assumed to contact surficial soils, breath soil derived dust, and are exposed to external radiation for 2 hours a day for 350 days per year for 30 years, 6 as a child and 24 as an adult.

5.3.3 Identification of Potential Exposure Pathways

As described in Risk Assessment Guidance for Superfund: Volume I - Human Health Evaluation Manual (USEPA 1989), four elements must be present in order for a potential human exposure pathway to be complete:

1. a source and mechanism of constituent release to the environment;
2. an environmental transport medium (e.g., soil, water or soil vapor);
3. an exposure point, or point of potential contact with the potentially affected medium; and
4. a receptor (e.g., human) with a route of exposure at the point of contact.

Potential exposure pathways are the mechanisms by which potential receptors may be exposed to constituents. The potential exposure pathways included in this assessment were selected based on the most likely mechanisms of exposure and observations at the Site. The most likely potential exposure pathways at the Site are ingestion of and dermal contact with soil, exposure via inhalation of soil-derived dust, and exposure to external gamma radiation. A Conceptual Site Model summarizing exposure pathways is provided in Figure 3

5.3.4 Conceptual Site Model

The CSM presents potential sources, release mechanisms, transport media, routes of migration through the environment, exposure media, and potential human receptors. The Conceptual Site Model also presents the possible human receptors evaluated in this assessment, and the potential exposure pathways available to these receptors.

5.4 Exposure Point Concentrations

Exposure point concentrations for constituents detected in media at the Site were estimated using

all relevant analytical data collected (as representative of current site conditions) from the single site investigation described in Section 3. As described, samples were collected from the surface soil only.

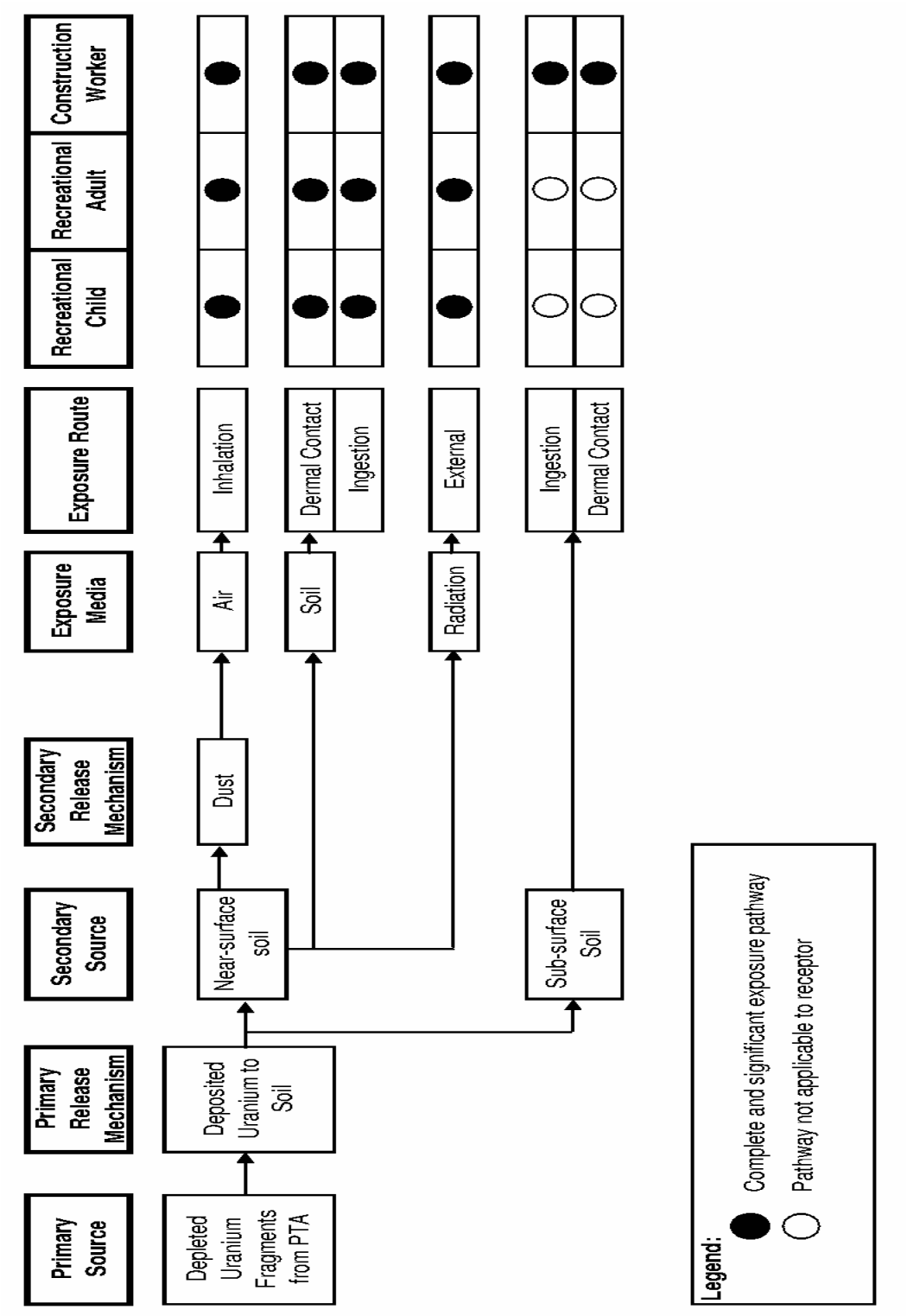

Figure 3: Conceptual Site Model

Surface soil samples were used to estimate exposure point concentrations for direct contact exposure, inhalation of soil derived dust, and external radiation for these scenarios. For direct contact to construction workers, surface soil samples were conservatively used to estimate subsurface soil concentrations assuming the highest concentration of contaminants would be found at the surface as potential contamination was a result of deposition.

In calculating exposure point concentrations, all replicate samples were averaged. Summary statistics (minimum, maximum, mean, standard deviation, frequency of detection, and 95% upper confidence limit on the arithmetic mean concentration [95% UCL]) were calculated for each U isotope detected in soil from the Site. The 95% UCL was calculated using USEPA's ProUCL software Version 4.0 (USEPA 2007). The USEPA has determined that the average concentration of a COPC represents a reasonable estimate of the concentration in an environmental medium that a receptor may potentially contact when that contact occurs at random over an extended period of time. For estimating exposures to COPCs in environmental media, USEPA has proposed various ways of estimating the exposure point concentration to account for the uncertainty due to incomplete sampling and/or analytical data variability. These range from using the maximum concentration when few samples have been collected from a potential exposure area to various methods of estimating a 95% UCL on the mean concentration.

For data with a normal distribution, the 95% UCL of the mean is calculated using the t-distribution (Student's t-statistic) in the following algorithm:

$$95\%\ \ UCL\ (ppm) = x + \frac{s\,t}{\sqrt{n}}$$

where:

x = arithmetic mean concentration (mg/Kg)

s = standard deviation (mg/Kg)

t = Student's *t* distribution statistic

n = number of data points

For data that are log-normally distributed, USEPA recommends the use of the Land method based on the *H*-statistic for determining the 95% UCL of the mean. The algorithm supplied by USEPA for determining the 95% UCL when data are log-normally distributed is:

$$UCL = e^{(x + 0.5s^2 + \frac{sH}{\sqrt{n-1}})}$$

where:

x = arithmetic mean concentration (mg/Kg)

s = standard deviation of log transformed data (mg/Kg)

H = Land distribution statistic

n = number of data points

The H-statistic frequently estimates a 95% UCL of the mean that is greater than the maximum concentration observed at a site when the input data are highly variable (i.e., when the relative standard deviation (RSD) exceeds 100%) and, in some cases, estimates concentrations in excess of one part per part. In these cases, the biased estimates of the "average" concentration are likely reflecting datasets that include many samples collected from areas of higher concentrations and fewer samples collected from areas of lower concentrations. This is the case at most sites where sampling efforts have intentionally been focused in areas of expected contamination and their immediate vicinity, but often not in other portions of a site where concentrations are likely to be lower but where potential exposure may occur at equal or even higher frequency. In this case, the data distribution is controlled by the sampling strategy rather than any distribution in nature. That is, areas of high concentration are more frequently represented than areas of lower concentration, even though both may be equally likely to represent a contact point by a hypothetical receptor. Therefore, the estimated exposure point concentration is biased high and does not represent the actual concentration that the receptor "encounters." The "distribution" observed in the biased dataset similarly does not represent the actual distribution of concentrations across the entire site or exposure area. Furthermore, a large part of the error in applying the H statistic lies in the inability of the algorithm to properly calculate the arithmetic mean when the data are not lognormally distributed.

If the data were non-parametric in distribution (i.e., not normal or lognormal in distribution), the data were further evaluated to determine if the sample results represent highly skewed distributions. For datasets that are neither normal nor lognormal or are highly skewed in distribution, the 95% UCL on the mean was based on the higher of the values from the percentile or standard bootstrapping techniques. In cases where sufficient data to calculate a 95% UCL of the mean were not available, the exposure point concentration was based on the maximum detected concentration.

Appendix A presents the analytical results and summary statistics for each constituent detected in soil samples collected from the site. The 95% UCL was calculated for each isotope from the Alpha Spectrometry analysis. For ^{235}U and ^{238}U the calculated UCL exceeded the maximum value detected so the maximum detected activity was used as the EPC. For ^{234}U, the data was found to be normally distributed and the EPC was based on the calculated t-statistic. Table 3 provides a summary of estimated exposure point concentrations used in the quantitative risk assessment for each sampling location.

Table 3: Exposure Point Concentrations

	EPC for Soil (mg/kg)	*EPCs for Soil (pCi/g)*			*EPC Mass Conversion (mg/kg)*		
Chemical	*Total*	*234 U*	*235 U*	*238 U*	*234 U*	*235 U*	*238 U*
Uranium	0.925	0.436	0.006	0.310	0.0001	0.0028	0.9226
		Mass Percentage				*Activity Ratio*	
		234 U	*235 U*	*238 U*		*234/238*	*235/238*
		7.54E-05	3.00E-03	9.97E-01		1.41E+00	1.94E-02

5.5 Exposure Factors

The exposure factors used in the quantitative risk assessment are summarized in Table 4.

Individual exposure factors are discussed below.

5.5.1 Body Weight

Body weights were derived from USEPA Exposure Factors Handbook (USEPA 1997) by averaging the male and female data for mean body weight. The average adult body weight used in this risk assessment was 71.8 kg. The average child body weight used in this risk assessment was 16 kg.

5.5.2 Duration of Exposure

Exposure durations were taken from USEPA Exposure Factors Handbook (USEPA 1997). It is important to note that USEPA (1997) states that the average occupation job tenure is 6.6 years, which contrasts significantly from the standard default worker duration of 25 years. This value is the upper bound occupation job tenure, which is consistent with a Reasonable Maximum Exposure (RME) scenario.

Table 4: Exposure Factors

	Parameter (units)	Soil/ Deposited Dust	Rationale
Child – Recreational	Exposure Time - vapor (hr/d)	2	Activity Specific Value
	Exposure Time - dust (hr/d)	2	Activity Specific Value
	Exposure Time - dermal-water (hr/d)	NA	Activity Specific Value
	Exposure Frequency - dermal (event/d)	1	AMEC Assumption
	Exposure Frequency (d/y)	52	Activity Specific Value
	Exposure Duration (y)	6	Activity Specific Value
	Body Weight (kg)	16	USEPA - Exposure Factors (1997)
	Averaging Period - Cancer (d)	25550	USEPA - 70 years
	Averaging Period - Noncancer (d)	2190	Based on Exposure Duration
	Ingestion Rate (mg/d) or (L/d)	200	USEPA - Exposure Factors (1997)
	Inhalation Rate (m^3/hr)	0.417	USEPA - Exposure Factors (1997)
	Fraction from Site (unitless)	1	Activity Specific Value
	Surface Area Exposed (cm^2/d)	2800	USEPA - Region IX PRG
	Soil-to-Skin Adherence Factor (mg/cm^2)	0.29	USEPA - Exposure Factors (1997)
Adult – Recreational	Exposure Time - vapor (hr/d)	2	Activity Specific Value
	Exposure Time - dust (hr/d)	2	Activity Specific Value
	Exposure Time - dermal-water (hr/d)	NA	Activity Specific Value
	Exposure Frequency - dermal (event/d)	1	AMEC Assumption
	Exposure Frequency (d/y)	52	Activity Specific Value
	Exposure Duration (y)	24	Activity Specific Value
	Body Weight (kg)	71.8	USEPA - Exposure Factors (1997)
	Averaging Period - Cancer (d)	25550	USEPA - 70 years
	Averaging Period - Noncancer (d)	8760	Based on Exposure Duration
	Ingestion Rate (mg/d) or (L/d)	100	USEPA - Exposure Factors (1997)
	Inhalation Rate (m^3/hr)	0.833	USEPA - Exposure Factors (1997)
	Fraction from Site (unitless)	1	Activity Specific Value
	Surface Area Exposed (cm^2/d)	5700	USEPA - Region IX PRG
	Soil-to-Skin Adherence Factor (mg/cm^2)	0.29	USEPA - Exposure Factors (1997)
Construction Worker	Exposure Time - vapor (hr/d)	8	Activity Specific Value
	Exposure Time - dust (hr/d)	8	Activity Specific Value
	Exposure Time - dermal-water (hr/d)	NA	Activity Specific Value
	Exposure Frequency - dermal (event/d)	1	AMEC Assumption
	Exposure Frequency (d/y)	250	Activity Specific Value
	Exposure Duration (y)	1	Activity Specific Value
	Body Weight (kg)	71.8	USEPA - Exposure Factors (1997)
	Averaging Period - Cancer (d)	25550	USEPA - 70 years
	Averaging Period - Noncancer (d)	365	Based on Exposure Duration
	Ingestion Rate (mg/d) or (L/d)	330	USEPA - Exposure Factors (1997)
	Inhalation Rate (m^3/hr)	0.833	USEPA - Exposure Factors (1997)
	Fraction from Site (unitless)	1	Activity Specific Value
	Surface Area Exposed (cm^2/d)	3300	USEPA - Region IX PRG
	Soil-to-Skin Adherence Factor (mg/cm^2)	0.29	USEPA - Exposure Factors (1997)

The construction worker scenario assumes an exposure duration for a single year. For the recreational user scenario, it is assumed that a visitor would be exposed to the environmental media for multiple years. The recreational scenario is split, assuming 6 years as a child and 24 years as an adult totaling a 30-year tenure.

5.5.3 Exposure Frequency

The exposure frequency for the on-site worker is a standard Human Health Evaluation Manual: Supplemental Guidance: *Standard Default Exposure Factors* (USEPA 1991a) and Exposure Factors Handbook (USEPA 1997). The Construction worker it is assumed a 250 day exposure frequency for the year they are on site. For the recreational scenario, an exposure frequency of 350 days per year is assumed.

5.5.4 Amount of Soil and Sediment Ingested

In the interest of health protectiveness, AMEC has assumed that the typical adult soil ingestion rate for all workers to be 330 mg/day, recreational adults to be 100 mg/day, and 200 mg/day for recreational children.

5.5.5 Body Surface Area Exposed to Soil/Groundwater

USEPA Region 9 PRG Guidance for Dermal Exposure Pathway (2004) recommends that the skin surface area for recreational adults be set as 5,700 cm^2. This guidance also recommends a surface area for contact for recreational children of 2,900 cm^2 and a surface area for construction workers of 3,300 cm^2.

5.5.6 Lifetime

For carcinogenic risk assessment, the lifetime average daily dose must be calculated. Based on recent studies, the Exposure Factors Handbook (USEPA 1997) recommends that risk assessors use the default value of 70 years.

5.5.7 Soil Adherence Rate

The mean adherence value from USEPA (1997) (0.29 mg/cm^2) is assumed in this risk assessment.

5.6 Relative Absorption Factors

To estimate the potential risk to human health that may be posed by the presence of COPC in soil, it is necessary first to estimate the potential exposure dose of each COPC. The potential exposure dose is similar to the administered dose or applied dose in a laboratory experiment. The animal-derived cancer slope factors (CSFs) and reference doses (RfDs) used in quantitative risk assessment are based on applied doses in most cases. However, the efficiency of COPC absorption via a particular route and from a particular matrix (e.g., soil, water) at the Site may differ from the absorption efficiency for the exposure route and matrix used in the experimental study that serves as the basis for the CSF or RfD. As recommended by USEPA (1989), Relative Absorption Factors (RAFs) for Site-related COPCs have been derived and used in the calculation of potential exposure doses presented above.

RAFs allow risk assessors to make appropriate adjustments if the efficiency of absorption is known to or expected to differ because of physiological effects and/or matrix or vehicle effects. RAFs can be less than one or greater than one, depending on the COPC and potential routes of exposure at a site.

When RfDs and CSFs are based on administered doses, the RAF is calculated as the ratio of the estimated absorption for the site-specific medium and route of potential exposure, to the known or estimated absorption for the laboratory study from which the RfD or CSF was derived. When absorption from the site-specific exposure is assumed to be the same as absorption in the laboratory study, then the RAF is 1.0. This assessment conservatively assumes absorption from all pathways (oral, inhalation and dermal) are equal to the oral absorption from the toxicity study in which the RFD was derived. All RAFs in this assessment were therefore conservatively set at 1.0 including the RAF for the dermal pathway. This almost certainly overestimates absorption and risk. It should also be noted that the Health Effects Assessment Summary Tables (HEAST) - Radionuclides Table (2001) provides a Gastrointestinal (GI) absorption fraction for Uranium of .02. This GI absorption factor represents the fraction of the radionuclide that may be absorbed from the gastrointestinal (GI) tract into blood following an oral intake.

5.7 Method to Estimate Average Daily Dose

Reasonable maximum exposure (RME) scenarios are evaluated in this risk assessment. Conservative exposure assumptions are used to construct a reasonable maximum exposure scenario. Most individuals will not be subject to all the conditions that comprise the RME scenario. Individuals who do not meet all conditions in the RME scenario have lower potential exposures to constituents, and therefore, lower potential risks associated with those exposures.

The Chronic Average Daily Dose (CADD) is an estimate of a receptor's potential daily intake from exposure to constituents with potential noncarcinogenic effects. Note that Average Daily Dose is a term used in risk assessment and does not represent a true average because the assumptions used to derive it do not represent "averages". According to USEPA (1989), the exposure dose should be calculated by averaging over the period of time for which the receptor is assumed to be exposed. The CADD for each constituent via each route of exposure is compared to the RfD for that constituent to estimate the potential hazard index due to exposure to that constituent via that route of exposure. Hazard indices are presented and discussed in Section 5.1

For constituents with potential carcinogenic effects, the Lifetime Average Daily Dose (LADD) is an estimate of potential daily intake over the course of a lifetime. The LADD was not calculated in this assessment as it was assumed that there presently exists no carcinogenic effects from the chemical exposure to Uranium. Carcinogenic risks in this assessment were based on the radiological effects associated with the COPC.

The equations for estimating a receptor's potential chronic average daily dose and the exposure parameters used are discussed in the following paragraphs. The calculations for all receptors evaluated in this risk assessment are presented in Appendix B (Risk Characterization Spreadsheets).

Ingestion & Dermal Contact with Soil & Sediment

$$\text{ADD (mg/kg - day)} = \frac{C \times [(IR \times FI \times RAF_o) + (SA \times AF \times FA \times RAF_d \times EFD)] \times EF \times ED \times CF}{BW \times AT}$$

where:

ADD = Average Daily Dose (mg/kg-day)

C = Chemical Concentration (mg/kg)

IR = Ingestion Rate (mg/day)

FI = Fraction Ingested from Site (unitless)

RAF_o = Relative Absorption Factor (Oral-Soil) (unitless)

SA = Skin Surface Area (cm2)

AF = Adherence Factor (mg/cm2/event)

FA = Fraction Absorbed from Site (unitless)

RAF_d = Relative Absorption Factor (Dermal-Soil) (unitless)

EFD = Exposure Frequency - Dermal (event/day)

EF = Exposure Frequency (days/year)

ED = Exposure Duration (years)

CF = Conversion factor (kg/mg)

BW = Body Weight (kg)

AT = Averaging Time (days) (ED x 365 days/yr, noncancer) (75 yr. x 365 days/yr, cancer)

Inhalation of Soil Derived Dust

$$\text{ADD (mg/kg - day)} = \frac{C_{dust} \times IR \times RAF_i \times ET \times EF \times ED}{AT \times BW}$$

where :

ADD = Average Daily Dose (mg/kg-day)

C_{dust} = Chemical Concentration (mg/kg)

IR = Ingestion Rate (mg/day)

RAF_i = Relative Absorption Factor (Inhalation) (unitless)

ET = Exposure Time - dust (hr/d)

EF = Exposure Frequency (days/year)

ED = Exposure Duration (years)

BW = Body Weight (kg)

AT = Averaging Time (days) (ED x 365 days/yr, noncancer) (75 yr. x 365 days/yr, cancer)

SECTION 6
RISK CHARACTERIZATION

Risk characterization is the step in the risk assessment process that combines the results of the exposure assessment and the toxicity assessment for each COPC to estimate the potential for carcinogenic and noncarcinogenic human health effects from chronic exposure to that constituent. This section summarizes the results of the risk characterization.

6.1 Noncarcinogenic Risk Assessment

The noncarcinogenic risk assessment for Uranium is generally characterized by combining exposure assumptions and toxicity data to derive Hazard Quotients (HQs) or Hazard Indices (HI). Noncarcinogenic health effects are estimated by comparing the Chronic Average Daily Dose (CADD) for each constituent with the Reference Dose for that constituent. The resulting ratio, which is unitless, is known as the Hazard Quotient (HQ) for that constituent. The HQ is calculated using the following formula:

Hazard Quotient

$$A = B \div C$$

where:

A = Hazard Quotient (unitless);

B = Chronic Average Daily Dose (mg/kg-day); and

C = Reference Dose (mg/kg-day).

When the Hazard Quotient for a given constituent and pathway does not exceed 1, the Reference Dose has not been exceeded, and no adverse noncarcinogenic health effects are expected to occur as a result of exposure to that constituent via that pathway. The HQs for each constituent are summed to yield the HI for that pathway. A Total HI is then calculated for each exposure medium by summing the pathway-specific HIs. A Total HI that does not exceed 1 indicates that no adverse noncarcinogenic health effects are expected to occur as a result of that receptor's potential exposure to the environmental medium evaluated.

Hazard Indices associated with each receptor are presented below. Summary data is provided in Table 5.

Table 5
Summary of Potential Hazard Indices

	Hazard Index		
Compound	***Child Recreational***	***Adult Recreational***	***Construction Worker***
Uranium	**3.E-03**	**1.E-03**	**4.E-03**

Construction Worker

The Construction Worker scenario assumed that the worker is on site for 8 hours a day for 250 days in 1 year and assumed to contact surface and subsurface soil. The construction worker was found to have a noncarcinogenic HI of 4E-03, well below the USEPA accepted criteria of 1.

Recreational/Commuter

This receptor is a user of the road on a daily basis. The recreational receptor is assumed to frequent the Site 350 days a year for 2 hours a day, as child for 6 years and as an adult for 24 years, totaling a 30 year recreational tenure. Recreational receptors were assumed to contact just the surface soil. The noncarcinogenic risk for this receptor was calculated to be 3E-03 for the Child Receptor and 1E-03 for the Adult Receptor. The higher of the two noncarcinogenic calculated risk is used to estimate the risk for the recreational/commuter receptor. Therefore the noncarcinogenic risk for the full 30 year tenure would be as a child at 3E-03, well below the USEPA accepted criteria of 1.

6.2 Carcinogenic Risk

U is not considered to be carcinogenic. However, the radiological activity of its isotopes and daughter products is considered potentially cancer causing. The RESidual RADioactivity (RESRAD) computer code, Version 6.4 (ANL 2007), was used to estimate the radiological dose and total PELCR for both potential receptors. RESRAD was developed by ANL, in conjunction with the Department of Energy (DOE), USEPA and the Nuclear Regulatory Commission (NRC) as a tool for predicting human health risks due to radioactivity in soils. The code uses radionuclide CSFs presented in Federal Guidance Report (FGR) No. 13 (USEPA 2002), which incorporates HEAST 2001 risk coefficient values.

To determine the dose and total excess cancer risk per unit concentration of U, the EPC in pCi/g was used as the source term for each uranium isotope. Where available, site specific data was

incorporated into the model. Site specific parameters include the following:

Pathways – External Gamma, Inhalation, and Soil Ingestion

Cover/Hydrology – Windspeed was adjusted to a site specific value of 9.163 m/s (20.5 mph)

– Precipitation was adjusted to a site specific value of 0.635 m/year

Occupancy – Inhalation rate adjusted to be receptor dependent, 0.833 m^3 per hour for adults and construction workers, and 0.417 m^3 for children.

– Period of exposure adjusted to be site and receptor specific, 350 days per year for children/adults, and 250 days per year for the worker

– Exposure duration adjusted to 6 years for children, 24 for adults, and 25 for the worker

– Outdoor time fraction adjusted to 1, assuming that all exposure would be outdoors

Where site-specific parameters were not available, the RESRAD default parameters were used as model input values. Results from the RESRAD analysis can be found in Appendix C.

In evaluating dose and risk due to the external gamma pathway, it was assumed that all receptors received their exposure while outdoors. For each receptor, the maximum dose-to-source ratios and risk-to-source ratios over a period of 1,000 years were obtained from the corresponding RESRAD dose and health risk output report. Risks from each isotope and their progeny were summed to obtain the total risk for each receptor.

Construction Worker

The Construction Worker scenario was assumed to be on site for 8 hours a day for 250 days in 1 year and assumed to contact surface and subsurface soil. Carcinogenic risk for the construction worker was 1E-06.

Recreational/Commuter

This receptor is a user of the road on a daily basis. The recreational receptor is assumed to use the proposed alignment 350 days a year for 2 hours a day, as child for 6 years and as an adult for 24 years, totaling a 30 year recreational tenure. Recreational receptors were assumed to contact

surface soil only. The carcinogenic risk associated with this receptor was found to be 3E-07 for the Child Receptor and 9E-07 for the Adult Receptor. These carcinogenic risks can be summed for a total carcinogenic risk of a 1E-06 for the full 30-year tenure.

A summary of results from the RESRAD analysis can be found on Table 6. A final summary of both the chemical and radiological risk assessment can be found on Table 7.

Table 6: Summary of RESRAD Analysis

		Ac-227	Pa-231	Pb-210	Ra-226	Th-230	U-234	U-235	U-238	Total
Construction Worker	*Ground*	1.14E-11	5.01E-12	2.91E-15	3.44E-11	9.44E-13	2.57E-09	7.53E-08	8.06E-07	9.E-07
	Inhalation	1.01E-14	1.69E-14	1.29E-16	7.06E-16	2.37E-13	1.71E-09	2.11E-11	1.03E-09	3.E-09
	Soil	4.41E-13	7.11E-13	2.05E-13	1.83E-13	1.18E-11	8.34E-08	1.17E-09	7.49E-08	2.E-07
	Total Excess Lifetime Cancer Risk	1.18E-11	5.74E-12	2.08E-13	3.46E-11	1.30E-11	8.77E-08	7.65E-08	8.82E-07	**1.E-06**
Child Recreational	*Ground*	1.90E-13	2.98E-13	1.10E-17	4.85E-13	5.52E-14	6.31E-10	1.85E-08	1.98E-07	2.E-07
	Inhalation	3.55E-16	2.10E-15	1.02E-18	2.10E-17	2.91E-14	8.80E-10	1.09E-11	5.32E-10	1.E-09
	Soil	6.25E-15	3.58E-14	6.59E-16	2.19E-15	5.86E-13	1.74E-08	2.44E-10	1.56E-08	3.E-08
	Total Excess Lifetime Cancer Risk	1.97E-13	3.35E-13	6.71E-16	4.88E-13	6.70E-13	1.89E-08	1.87E-08	2.14E-07	**3.E-07**
Adult Recreational	*Ground*	1.02E-11	4.63E-12	2.49E-15	3.05E-11	8.71E-13	2.47E-09	7.23E-08	7.75E-07	8.E-07
	Inhalation	3.80E-14	6.54E-14	4.62E-16	2.63E-15	9.19E-13	6.89E-09	8.53E-11	4.17E-09	1.E-08
	Soil	1.67E-13	2.79E-13	7.43E-14	6.87E-14	4.62E-12	3.40E-08	4.79E-10	3.05E-08	7.E-08
	Total Excess Lifetime Cancer Risk	1.04E-11	4.97E-12	7.73E-14	3.05E-11	6.41E-12	4.34E-08	7.29E-08	8.10E-07	**9.E-07**

Table 7: Final Summary

Excess Lifetime Cancer Risk				*Hazard Index*		
Construction Worker	*Recreational Child*	*Recreational Adult*	*Total Recreational Scenario*	*Construction Worker*	*Recreational Child*	*Recreational Adult*
1.E-06	**3.E-07**	**9.E-07**	**1.E-06**	**4.E-03**	**3.E-03**	**1.E-03**

SECTION 7
UNCERTAINTY ANALYSIS

Within any of the four steps of the risk assessment process, assumptions must be made due to a lack of absolute scientific knowledge. Some of the assumptions are supported by considerable scientific evidence, while others have less support. Every assumption introduces some degree of uncertainty into the risk assessment process. Conservative assumptions are made throughout the risk assessment to ensure that public health is protected. Therefore, when all of the assumptions are combined, it is much more likely that actual risks, if any, are overestimated rather than underestimated.

The assumptions that introduce the greatest amount of uncertainty in this risk assessment are discussed in this section. They are discussed in general terms, because, for most of the assumptions, there is not enough information to assign a numerical value that can be factored into the calculation of risk.

7.1 Hazard Identification

During the Hazard Identification step, media and constituents of concern are selected for inclusion in the quantitative risk assessment. In this assessment only lead and U were selected as COPCs. Uncertainty may be introduced due to this decision as additional chemicals may be present, but were not evaluated. Additionally, the analytical methods used to determine the concentration of lead or U may introduce significant uncertainty into the risk assessment process. To reduce laboratory method uncertainty, samples were analyzed by two independent methods. They included ICP-MS and Alpha Spectrometry. ICP-MS was theoretically more precise and provided lower detection limits for ^{235}U and ^{238}U isotopes. Alpha Spectrometry was theoretically more precise and provided lower detection limits for ^{234}U. The results indicate that ICP-MS was not the more sensitive method for any isotope, and the differences observed between methods provides some uncertainty as to the validity of our results. To address this uncertainty, this assessment utilized the alpha spectrometry results which overall provided more detailed results as well as higher activity and resulting mass concentrations. Using the higher results may potentially overestimate the actual risk.

7.2 Dose-Response Assessment

Dose-response values are usually based on limited toxicological data. For this reason, a margin of safety is built into estimates of both carcinogenic and noncarcinogenic risk, and actual risks

are lower than those estimated. The two major areas of uncertainty introduced in the dose-response assessment are: (1) animal to human extrapolation; and (2) high to low dose extrapolation. These are discussed below.

Human dose-response values are often extrapolated, or estimated, using the results of animal studies. Extrapolation from animals to humans introduces a great deal of uncertainty in the risk assessment because in most instances, it is not known how differently a human may react to the constituent compared to the animal species used to test the constituent. The procedures used to extrapolate from animals to humans involve conservative assumptions and incorporate several uncertainty factors that overestimate the adverse effects associated with a specific dose. As a result, overestimation of the potential for adverse effects to humans is more likely than underestimation.

Predicting potential health effects from the exposure to media on-Site requires the use of models to extrapolate the observed health effects from the high doses used in laboratory studies to the anticipated human health effects from low doses experienced in the environment. The models contain conservative assumptions to account for the large degree of uncertainty associated with this extrapolation (especially for potential carcinogens in the radiological risk assessment) and therefore, tend to be more likely to overestimate than underestimate the risks.

This risk assessment also utilized a conservative set of assumptions when evaluating the bioavailable fraction of COPCs available for absorption by the human body. Relative absorption factors (RAFs) estimate the amount a chemical that is absorbed by the body through different routes of exposure. As very little literature was available on the bioaccessible fraction from Uranium, AMEC used default ingestion, dermal and inhalation absorption fractions of 1, meaning the absorption in the animal study used to derive the toxicity value is identical to that in humans. More realistic bioavailable fractions for these pathways could be derived and would most likely reduce the estimate risk derived in this assessment.

7.3 Exposure Assessment

During the exposure assessment, average daily doses of COPCs to which receptors are potentially exposed are estimated, which involves assumptions about how often exposure occurs. Such assumptions include location, accessibility, and use of an area. With this in mind, the receptor, or person who may potentially be exposed, and the location of exposure, were both defined for this risk assessment. The locations where certain activities were assumed to take place have been purposely selected to be consistent with the use of the Site.

The potential intake rates and exposure frequencies and durations assumed in the risk assessment were considered to be conservative. For example, a potential recreational scenario was assumed to be present at the Site in which a person may be present for 2 hours per day, 350 days per year for 6 years as a child and another 24 as an adult. Such assumptions almost certainly overestimate actual exposures. If more realistic and reasonable potential exposure assumptions had been employed in the risk assessment, the estimated risks would have been lower, perhaps substantially lower. The construction worker scenario assumed an 8-hour workday, 250 days per year, for 1 year.

Exposure point concentrations are estimated values of what is a Reasonable Maximum Exposure across the entire site. Given that these are estimates, a significant amount of uncertainty can be introduced into the assessment. For the soil pathways, the surface soil was assumed to be equivalent to the subsurface soil. This assumes that all Uranium is evenly distributed to depth in the contaminated zone. This could potentially overestimate any exposure to subsurface soils assuming the highest concentrations would be at the surface due to deposition.

Exposure Point Concentrations were also taken from either the calculated using a 95% UCL or the maximum detected activity between the five samples. With very few samples, the variability was high, and in most cases resulted in the EPC being taken from at or near the maximum activity detected. This more than likely overestimated actual site concentrations but, as the site was evaluated as a single decision unit, using statistical analysis to generalize the actual concentrations across the site could possibly overestimate or underestimate the calculated risk.

Additional uncertainty is also introduced by assuming non-detect laboratory results as present as zero. This assumption was based on the very limited and low concentrations detected across the site. Extensive analysis was performed on the sample results before making this assumption. Using half detection limits as a surrogate detection to calculate Exposure Point Concentrations resulted in unrealistic data results especially in the ICP-MS analysis. As there is no effective way to determine actual concentrations of contaminants below the reporting limit of the laboratory, this may potentially underestimate the concentration of contaminants.

Other exposure factors including inhalation rate, ingestion rate, soil adherence factor and body weight were all based on recommendation from the EPA Exposure Factors Handbook (1997), which as closely represent actual site values as reasonably available.

7.4 Risk Characterization

The risk of adverse human health effects depends on estimated levels of exposure and on dose-

response relationships. Once exposure to, and risk from, each of the selected constituents is calculated, the total risk posed by exposure to Site-related COPCs is determined by combining the health risk contributed by each constituent. Where COPCs do not interact, do not affect the same target organ or do not have the same mechanism of action, summing the risks for multiple COPCs results in an overestimate of risk posed by the Site. Because U and lead were assessed separately, little uncertainty is added in this phase of the assessment.

SECTION 8
CONCLUSIONS

This study has assessed the potential human health risks associated with Uranium and Lead exposures from surface soils at the proposed Saddle road alignment. Lead concentrations in all samples were well below the USEPA Region IX residential PRG of 400 parts per million, with the maximum lead concentration detected at any location of 3.3 mg/kg at sampling location DU004.

Included in this study was a uranium background level assessment to assess whether onsite uranium was from natural or anthropogenic sources. Two methods were employed to evaluate uranium isotope source. The first method compared site-specific total U mass concentrations to naturally occurring U mass concentrations in Hawai‘i. Total U was determined by summing the isotopic concentrations of ^{234}U, ^{235}U and ^{238}U detected at 5 independent sites along the proposed Saddle Road alignment. Results of this analysis indicated that total uranium along the proposed Saddle Road alignment are at or below levels occurring naturally in native Hawaiian soils. Total U based on alpha spectroscopy analyses ranged from 0.4 parts per million (ppm) at location DU003 to 1.3 ppm at DU001. The average at all five (5) locations was 0.8 ppm. The second method used to determine whether detected U originates from natural or DU sources was the evaluation of isotope abundance. Except in extremely rare circumstances (not found in Hawai‘i), natural U dispersed in rocks and soils have a comparatively greater $^{234}U/^{238}U$ and $^{235}U/^{238}U$ ratio than those originating from DU. Although use of the $^{235}U/^{238}U$ is considered a more precise measurement than the $^{234}U/^{238}U$ ratio in isotopic fingerprinting of U contamination, its utility is significant when ^{235}U data are not available or when concentrations of the ^{235}U isotope are too low to detect. This is the case here and as such, the $^{234}U/^{238}U$ ratio was used as the second method to fingerprint U source. The naturally occurring $^{234}U/^{238}U$ ratio in soil has been determined to be in the range of 0.5 to 1.2 (Sansone et al. 2001). $^{234}U/^{238}U$ ratios at the Saddle Road alignment ranged from 0.74 to 1.79, with an average ratio across all five (5) locations of 1.16. These results indicate that the $^{234}U/^{238}U$ isotopic ratio across the proposed alignment is within the background range.

A baseline human health risk assessment (BHHRA) was performed to evaluate the potential risk posed by uranium isotopes detected at the proposed Saddle Road alignment. The alignment was evaluated as a single decision unit represented by five distinct sampling locations. Receptors were assumed to be exposed to either the maximum concentration of each isotope

detected or the 95% UCL of the mean. Risks were evaluated for the following receptors:

- A construction worker scenario assumed to be on site for 8 hours a day for 250 days in 1 year and assumed to contact surface and subsurface soil.
- A recreational user of the road assumed to frequent the Site 350 days a year for 2 hours a day, as child for 6 years and as an adult for 24 years, totaling a 30 year recreational tenure. Recreational receptors were assumed to contact just the surface soil

The Construction Worker scenario assumed to be on site for 8 hours a day for 250 days in 1 year and assumed to contact surface and subsurface soil. The construction worker was found to have a carcinogenic risk of 1E-06, and a noncarcinogenic risk of 4E-03.

The recreational receptor was assumed to frequent the Site 350 days a year for 2 hours a day, as child for 6 years and as an adult for 24 years, totaling a 30 year recreational tenure. Recreational receptors were assumed to contact only surficial soils. The carcinogenic risk associated with this receptor was found to be 3E-07 for the Child Receptor and 9E-07 for the Adult Receptor. These carcinogenic risks can be summed for a total carcinogenic risk of a 1E-06 for the full 30 year tenure. The noncarcinogenic risk was calculated to be 3E-03 for the Child Receptor and 1E-03 for the Adult Receptor. The higher of the two noncarcinogenic calculated risk is used to estimate the risk for the recreational/commuter receptor. Therefore the noncarcinogenic risk for the full 30 year tenure would be as a child at 3E-03.

Based on the available surface soil data collected in June 2008 at five (5) locations along the proposed alignment, it has been determined that uranium detected at the site originates from natural sources. Potential noncancer health risks from the ingestion, inhalation and dermal contact of soil along the proposed alignment are below USEPA's acceptable risk level of concern. Potential cancer risks from radiological activity of the detected U isotopes are below the most conservative regulatory criteria.

SECTION 9
REFERENCES

AMEC 2008. *Sampling and Analysis Plan, Depleted Uranium Risk Assessment. Keʻāmuku Parcel, South Kohala District. Hawaiʻi Island, State of Hawaiʻi.*

ANL 2007. *RESRAD Computer Code, Version 6.4.* Argonne National Laboratory. December 19, 2007.

ATSDR 1999. *Toxicological Profile for Uranium*. US Department of Health and Human Services.

ATSDR 2008. *Minimal Risk Levels (MRLs) for Hazardous Substances*. US Department of Health and Human Services. http://www.atsdr.cdc.gov/mrls/#bookmark01. As of August 2008.

Geometrician 2007. *Supplemental Environmental Impact Statement Preparation Notice, Saddle Road (State Route 200), Mamalahoa Highway (State Route 190) to Milepost 42, County of Hawaiʻi, State of Hawaiʻi. FHWA Project No. 200(00).*

Juvik, S.P., and Juvik, J.O. (eds.) 1998. *Atlas of Hawai'i*, Third Edition. University of Hawai'i Press, Honolulu.

MacDonald, B., Abbott, A., and Peterson, F. 1983. *Volcanoes in the sea, 2nd ed*. Honolulu, University of Hawai'i Press, Honolulu.

Mink, J. F. and S. L. Lau 1993. *Aquifer Identification and Classification for the Island of Hawaiʻi: Groundwater Protection Strategy for Hawaiʻi.* Water Resources Research Center, University of Hawaiʻi at Manoa,

Rubin, Kenneth H., Ph.D. 2008. *Depleted Uranium, Natural Uranium and Other Naturally Occurring Radioactive Elements in Hawaiian Environments.*

Sansone, U., Stellato, L., Jia, G., Rosamilia, S., Gaudino, S., Barbizzi, S., and Belli, M. 2001. *Levels of Depleted Uranium in Kosovo Soils.*

Stegnar, Peter and Benedik, Ljudmila 2001. *Depleted Uranium in the Environment – An Issue of Concern?*

USDA 1972. *Soil Survey of Islands of Kauai, Oahu, Maui, Molokai, and Lanai, State of Hawaiʻi.* United States Soil Conservation Service Washington, DC

USEPA 1989. *Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A),* EPA 540/1-89/002, PB90-155581.

USEPA 1991. *Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual, Supplemental Guidance. Standard Default Exposure Factors – Interim Final.* OSWER Directive 9285.6-03.

USEPA 1997. *Exposure Factors Handbook*, Volumes I, II, and III, USEPA/600/P-95/002Fa-c, EPA, Office of Research and Development, Washington, DC.

USEPA 2001. *Health Effects Assessment Summary Tables.* Online database maintained by USEPA. (http://www.epa.gov/radiation/heast). As of April 2001.

USEPA 2002. *Federal Guidance Report No. 13: Cancer Risk Coefficients for Environmental Exposure to Radionuclides.* EPA-402/R-99-001.

USEPA 2004. *EPA Region 9 Preliminary Remediation Goal Tables and User's Guide.* U.S. Environmental Protection Agency Region 9.

USEPA 2007. *ProUCL Version 4.0, a Statistical Software*, National Exposure Research Lab, EPA, Las Vegas Nevada. ProUCL 3.0 can be freely downloaded from the EPA website: http://www.epa.gov/nerlesd1/tsc/tsc.htm

USEPA 2008. *Integrated Risk Information System.* Online database maintained by USEPA. (http://www.epa.gov/iris). As of July 2006

Wolfe, E.W., and J. Morris. 1996. *Geologic Map of the Island of Hawai'i.* USGS Misc Investigations Series Map I-2524-A. Washington, D.C.: U.S. Geological Survey.

Appendix **A**

ANALYTICAL SAMPLING RESULTS

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

ANALYTICAL REPORT

PROJECT NO. PTA DU SAMPLING

Soil Sampling

Lot #: F8F190108

Jamie Anderson

AMEC Earth & Environmental
Airport Industrial Center
3375 Koapaka St., Ste F251
Honolulu, HI 96819

TESTAMERICA LABORATORIES, INC.

for Kay Clay
Project Manager

July 3, 2008

Case Narrative
LOT NUMBER: **F8F190108**

This report contains the analytical results for the seven samples received under chain of custody by TestAmerica St. Louis on June 18, 2008. These samples are associated with your Soil Sampling project.

The analytical results included in this report meet all applicable quality control procedure requirements except as noted on the following page.

The test results in this report meet all NELAP requirements for parameters in which accreditations are held by TestAmerica St. Louis. Any exceptions to NELAP requirements are noted in the case narrative. The case narrative is an integral part of this report.

All chemical analysis results are based upon sample as received, wet weight, unless noted otherwise. All radiochemistry results are based upon sample as dried and ground with the exception of tritium, unless requested wet weight by the client.

Observations/Nonconformances
Reference the chain of custody and condition upon receipt report for any variations on receipt conditions and temperature of samples on receipt.

ICP-MS (6020)
Batch: 8176078
1) The samples were analyzed at a dilution due to high concentrations of target analytes. The reporting limit has been adjusted only for those targets reported from the dilution run.

2) The ICB was above the reporting limit for uranium 238. However, the bracketing CCB's are all within limits. The CCB's are sampled from the same cup as the ICB, indicating the ICB failure is an anomaly. The sample results will be reported with this narrative.

3) The MS (MSD) recovery for uranium 235 and 238 is outside the established QC limits. The RPD is within method acceptance criteria indicating a possible matrix interference. Method performance is demonstrated by acceptable LCS recovery.

Affected Samples:
F8F190108 (1): DU 001
F8F190108 (2): DU 002
F8F190108 (3): DU 003
F8F190108 (4): DU 004
F8F190108 (5): DU 005
F8F190108 (6): DU 006
F8F190108 (7): DU 007

METHODS SUMMARY

F8F190108

PARAMETER	ANALYTICAL METHOD	PREPARATION METHOD
Isotopic Uranium by Alpha Spectroscopy	EML A-01-R MOD	
ICP-MS (6020)	SW846 6020	
Percent Moisture	MCAWW 160.3 MOD	MCAWW 160.3 MOD

References:

EML "ENVIRONMENTAL MEASUREMENTS LABORATORY PROCEDURES MANUAL" HASL-300 28TH EDITION, VOLUME I and II DEPARTMENT OF ENERGY

MCAWW "Methods for Chemical Analysis of Water and Wastes", EPA-600/4-79-020, March 1983 and subsequent revisions.

SW846 "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods", Third Edition, November 1986 and its updates.

SAMPLE SUMMARY

F8F190108

WO #	SAMPLE#	CLIENT SAMPLE ID	SAMPLED DATE	SAMP TIME
KP7GK	001	DU 001	06/11/08	12:00
KP7HT	002	DU 002	06/11/08	15:15
KP7HX	003	DU 003	06/11/08	14:30
KP7H0	004	DU 004	06/11/08	13:32
KP7H1	005	DU 005	06/11/08	12:45
KP7H2	006	DU 006	06/11/08	15:15
KP7H4	007	DU 007	06/11/08	15:15

NOTE(S):

- The analytical results of the samples listed above are presented on the following pages.
- All calculations are performed before rounding to avoid round-off errors in calculated results.
- Results noted as "ND" were not detected at or above the stated limit.
- This report must not be reproduced, except in full, without the written approval of the laboratory.
- Results for the following parameters are never reported on a dry weight basis: color, corrosivity, density, flashpoint, ignitability, layers, odor, paint filter test, pH, porosity pressure, reactivity, redox potential, specific gravity, spot tests, solids, solubility, temperature, viscosity, and weight.

AMEC Earth & Environmental

Client Sample ID: DU 001

TOTAL Metals

Lot-Sample #...: F8F190108-001 **Matrix.....:** SOLID
Date Sampled...: 06/11/08 12:00 **Date Received..:** 06/18/08
% Moisture.....: 1.0

PARAMETER	RESULT	REPORTING LIMIT	UNITS	METHOD	PREPARATION-ANALYSIS DATE	WORK ORDER #
Prep Batch #...: 8176078						
Lead	**3.0**	**0.76**	**mg/kg**	**SW846 6020**	**06/24-07/01/08**	**KP7GK1AD**
		Dilution Factor: 2.5		Analysis Time..: 00:36		
Uranium 234	ND	0.0051	mg/kg	SW846 6020	06/24-07/01/08	KP7GK1AF
		Dilution Factor: 1		Analysis Time..: 16:09		
Uranium 235	ND	0.0051	mg/kg	SW846 6020	06/24-07/01/08	KP7GK1AG
		Dilution Factor: 1		Analysis Time..: 16:09		
Uranium 238	**0.16**	**0.0051**	**mg/kg**	**SW846 6020**	**06/24-07/01/08**	**KP7GK1AH**
		Dilution Factor: 1		Analysis Time..: 16:09		

NOTE(S):

Results and reporting limits have been adjusted for dry weight.

AMEC Earth & Environmental

Client Sample ID: DU 001

General Chemistry

Lot-Sample #...: F8F190108-001 **Work Order #...:** KP7GK **Matrix.....:** SOLID
Date Sampled...: 06/11/08 12:00 **Date Received..:** 06/18/08
% Moisture.....: 1.0

PARAMETER	RESULT	RL	UNITS	METHOD	PREPARATION-ANALYSIS DATE	PREP BATCH #
Percent Moisture	**1.0**	**0.10**	**%**	**MCAWW 160.3 MOD**	**06/20-06/23/08**	**8172171**

Dilution Factor: 1 Analysis Time..: 00:00

AMEC Earth & Environmental

Client Sample ID: DU 002

TOTAL Metals

Lot-Sample #...: F8F190108-002 **Matrix.....:** SOLID
Date Sampled...: 06/11/08 15:15 **Date Received..:** 06/18/08
% Moisture.....: 5.2

PARAMETER	RESULT	REPORTING LIMIT	UNITS	METHOD	PREPARATION-ANALYSIS DATE	WORK ORDER #
Prep Batch #...: 8176078						
Lead	**2.8**	**0.79**	**mg/kg**	**SW846 6020**	**06/24-07/01/08**	**KP7HT1AD**
		Dilution Factor: 2.5		Analysis Time..: 01:00		
Uranium 234	ND	0.0053	mg/kg	SW846 6020	06/24-07/01/08	KP7HT1AF
		Dilution Factor: 1		Analysis Time..: 16:32		
Uranium 235	ND	0.0053	mg/kg	SW846 6020	06/24-07/01/08	KP7HT1AG
		Dilution Factor: 1		Analysis Time..: 16:32		
Uranium 238	**0.13**	**0.0053**	**mg/kg**	**SW846 6020**	**06/24-07/01/08**	**KP7HT1AH**
		Dilution Factor: 1		Analysis Time..: 16:32		

NOTE(S):

Results and reporting limits have been adjusted for dry weight.

AMEC Earth & Environmental

Client Sample ID: DU 002

General Chemistry

Lot-Sample #...: F8F190108-002 **Work Order #...:** KP7HT **Matrix.....:** SOLID
Date Sampled...: 06/11/08 15:15 **Date Received..:** 06/18/08
% Moisture.....: 5.2

PARAMETER	RESULT	RL	UNITS	METHOD	PREPARATION-ANALYSIS DATE	PREP BATCH #
Percent Moisture	**5.2**	**0.10**	**%**	**MCAWW 160.3 MOD**	**06/20-06/23/08**	**8172171**

Dilution Factor: 1 Analysis Time..: 00:00

AMEC Earth & Environmental

Client Sample ID: DU 003

TOTAL Metals

Lot-Sample #...: F8F190108-003 **Matrix.....:** SOLID
Date Sampled...: 06/11/08 14:30 **Date Received..:** 06/18/08
% Moisture.....: 10

PARAMETER	RESULT	REPORTING LIMIT	UNITS	METHOD	PREPARATION-ANALYSIS DATE	WORK ORDER #
Prep Batch #...: 8176078						
Lead	**1.8**	**0.84**	**mg/kg**	**SW846 6020**	**06/24-07/01/08**	**KP7HX1AD**
		Dilution Factor: 2.5		Analysis Time..: 01:04		
Uranium 234	ND	0.0056	mg/kg	SW846 6020	06/24-07/01/08	KP7HX1AF
		Dilution Factor: 1		Analysis Time..: 16:37		
Uranium 235	ND	0.0056	mg/kg	SW846 6020	06/24-07/01/08	KP7HX1AG
		Dilution Factor: 1		Analysis Time..: 16:37		
Uranium 238	**0.064**	**0.0056**	**mg/kg**	**SW846 6020**	**06/24-07/01/08**	**KP7HX1AH**
		Dilution Factor: 1		Analysis Time..: 16:37		

NOTE(S):

Results and reporting limits have been adjusted for dry weight.

AMEC Earth & Environmental

Client Sample ID: DU 003

General Chemistry

Lot-Sample #...: F8F190108-003 **Work Order #...:** KP7HX **Matrix.....:** SOLID
Date Sampled...: 06/11/08 14:30 **Date Received..:** 06/18/08
% Moisture.....: 10

PARAMETER	RESULT	RL	UNITS	METHOD	PREPARATION-ANALYSIS DATE	PREP BATCH #
Percent Moisture	**10.2**	**0.10**	**%**	**MCAWW 160.3 MOD**	**06/20-06/23/08**	**8172171**

Dilution Factor: 1 Analysis Time..: 00:00

AMEC Earth & Environmental

Client Sample ID: DU 004

TOTAL Metals

Lot-Sample #...: F8F190108-004 **Matrix.....:** SOLID
Date Sampled...: 06/11/08 13:32 **Date Received..:** 06/18/08
% Moisture.....: 23

PARAMETER	RESULT	REPORTING LIMIT	UNITS	METHOD	PREPARATION-ANALYSIS DATE	WORK ORDER #
Prep Batch #...: 8176078						
Lead	**3.3**	**0.98**	**mg/kg**	**SW846 6020**	**06/24-07/01/08**	**KP7H01AD**
		Dilution Factor: 2.5		Analysis Time..: 01:08		
Uranium 234	ND	0.0065	mg/kg	SW846 6020	06/24-07/01/08	KP7H01AF
		Dilution Factor: 1		Analysis Time..: 16:43		
Uranium 235	ND	0.0065	mg/kg	SW846 6020	06/24-07/01/08	KP7H01AG
		Dilution Factor: 1		Analysis Time..: 16:43		
Uranium 238	**0.10**	**0.0065**	**mg/kg**	**SW846 6020**	**06/24-07/01/08**	**KP7H01AH**
		Dilution Factor: 1		Analysis Time..: 16:43		

NOTE(S):

Results and reporting limits have been adjusted for dry weight.

AMEC Earth & Environmental

Client Sample ID: DU 004

General Chemistry

Lot-Sample #...: F8F190108-004 **Work Order #...:** KP7H0 **Matrix.....:** SOLID
Date Sampled...: 06/11/08 13:32 **Date Received..:** 06/18/08
% Moisture.....: 23

PARAMETER	RESULT	RL	UNITS	METHOD	PREPARATION-ANALYSIS DATE	PREP BATCH #
Percent Moisture	**23.3**	**0.10**	**%**	**MCAWW 160.3 MOD**	**06/20-06/23/08**	**8172171**

Dilution Factor: 1 Analysis Time..: 00:00

AMEC Earth & Environmental

Client Sample ID: DU 005

TOTAL Metals

Lot-Sample #...: F8F190108-005 **Matrix.....:** SOLID
Date Sampled...: 06/11/08 12:45 **Date Received..:** 06/18/08
% Moisture.....: 16

PARAMETER	RESULT	REPORTING LIMIT	UNITS	METHOD	PREPARATION-ANALYSIS DATE	WORK ORDER #
Prep Batch #...: 8176078						
Lead	**3.0**	**0.89**	**mg/kg**	**SW846 6020**	**06/24-07/01/08**	**KP7H11AD**
		Dilution Factor: 2.5		Analysis Time..: 01:12		
Uranium 234	ND	0.006	mg/kg	SW846 6020	06/24-07/01/08	KP7H11AF
		Dilution Factor: 1		Analysis Time..: 16:48		
Uranium 235	ND	0.006	mg/kg	SW846 6020	06/24-07/01/08	KP7H11AG
		Dilution Factor: 1		Analysis Time..: 16:48		
Uranium 238	**0.14**	**0.006**	**mg/kg**	**SW846 6020**	**06/24-07/01/08**	**KP7H11AH**
		Dilution Factor: 1		Analysis Time..: 16:48		

NOTE(S):

Results and reporting limits have been adjusted for dry weight.

AMEC Earth & Environmental

Client Sample ID: DU 005

General Chemistry

Lot-Sample #...: F8F190108-005 **Work Order #...:** KP7H1 **Matrix.....:** SOLID
Date Sampled...: 06/11/08 12:45 **Date Received..:** 06/18/08
% Moisture.....: 16

PARAMETER	RESULT	RL	UNITS	METHOD	PREPARATION-ANALYSIS DATE	PREP BATCH #
Percent Moisture	**16.1**	**0.10**	**%**	**MCAWW 160.3 MOD**	**06/20-06/23/08**	**8172171**

Dilution Factor: 1 Analysis Time..: 00:00

AMEC Earth & Environmental

Client Sample ID: DU 006

TOTAL Metals

Lot-Sample #...: F8F190108-006 **Matrix.....:** SOLID
Date Sampled...: 06/11/08 15:15 **Date Received..:** 06/18/08
% Moisture.....: 5.8

PARAMETER	RESULT	REPORTING LIMIT	UNITS	METHOD	PREPARATION-ANALYSIS DATE	WORK ORDER #
Prep Batch #...: 8176078						
Lead	**2.0**	**0.80**	**mg/kg**	**SW846 6020**	**06/24-07/01/08**	**KP7H21AD**
		Dilution Factor: 2.5		Analysis Time..: 01:15		
Uranium 234	ND	0.0053	mg/kg	SW846 6020	06/24-07/01/08	KP7H21AF
		Dilution Factor: 1		Analysis Time..: 17:13		
Uranium 235	ND	0.0053	mg/kg	SW846 6020	06/24-07/01/08	KP7H21AG
		Dilution Factor: 1		Analysis Time..: 17:13		
Uranium 238	**0.10**	**0.0053**	**mg/kg**	**SW846 6020**	**06/24-07/01/08**	**KP7H21AH**
		Dilution Factor: 1		Analysis Time..: 17:13		

NOTE(S):

Results and reporting limits have been adjusted for dry weight.

AMEC Earth & Environmental

Client Sample ID: DU 006

General Chemistry

Lot-Sample #...: F8F190108-006 **Work Order #...:** KP7H2 **Matrix.....:** SOLID
Date Sampled...: 06/11/08 15:15 **Date Received..:** 06/18/08
% Moisture.....: 5.8

PARAMETER	RESULT	RL	UNITS	METHOD	PREPARATION-ANALYSIS DATE	PREP BATCH #
Percent Moisture	**5.8**	**0.10**	**%**	**MCAWW 160.3 MOD**	**06/20-06/23/08**	**8172171**

Dilution Factor: 1 Analysis Time..: 00:00

AMEC Earth & Environmental

Client Sample ID: DU 007

TOTAL Metals

Lot-Sample #...: F8F190108-007 **Matrix.....:** SOLID
Date Sampled...: 06/11/08 15:15 **Date Received..:** 06/18/08
% Moisture.....: 6.3

PARAMETER	RESULT	REPORTING LIMIT	UNITS	METHOD	PREPARATION-ANALYSIS DATE	WORK ORDER #
Prep Batch #...: 8176078						
Lead	**2.4**	**0.80**	**mg/kg**	**SW846 6020**	**06/24-07/01/08**	**KP7H41AD**
		Dilution Factor: 2.5		Analysis Time..: 01:19		
Uranium 234	ND	0.0053	mg/kg	SW846 6020	06/24-07/01/08	KP7H41AF
		Dilution Factor: 1		Analysis Time..: 17:18		
Uranium 235	ND	0.0053	mg/kg	SW846 6020	06/24-07/01/08	KP7H41AG
		Dilution Factor: 1		Analysis Time..: 17:18		
Uranium 238	**0.11**	**0.0053**	**mg/kg**	**SW846 6020**	**06/24-07/01/08**	**KP7H41AH**
		Dilution Factor: 1		Analysis Time..: 17:18		

NOTE(S):

Results and reporting limits have been adjusted for dry weight.

AMEC Earth & Environmental

Client Sample ID: DU 007

General Chemistry

Lot-Sample #...: F8F190108-007 **Work Order #...:** KP7H4 **Matrix.....:** SOLID
Date Sampled...: 06/11/08 15:15 **Date Received..:** 06/18/08
% Moisture.....: 6.3

PARAMETER	RESULT	RL	UNITS	METHOD	PREPARATION-ANALYSIS DATE	PREP BATCH #
Percent Moisture	**6.3**	**0.10**	**%**	**MCAWW 160.3 MOD**	**06/20-06/23/08**	**8172171**

Dilution Factor: 1 Analysis Time..: 00:00

METHOD BLANK REPORT

TOTAL Metals

Client Lot #...: F8F190108 **Matrix.....:** SOLID

PARAMETER	RESULT	REPORTING LIMIT	UNITS	METHOD	PREPARATION-ANALYSIS DATE	WORK ORDER #
MB Lot-Sample #: F8F240000-078 **Prep Batch #...:** 8176078						
Lead	ND	0.30	mg/kg	SW846 6020	06/24-07/01/08	KQF4L1AA
		Dilution Factor: 1				
		Analysis Time..: 00:28				
Uranium 234	ND	0.005	mg/kg	SW846 6020	06/24-07/01/08	KQF4L1AC
		Dilution Factor: 1				
		Analysis Time..: 15:58				
Uranium 235	ND	0.005	mg/kg	SW846 6020	06/24-07/01/08	KQF4L1AD
		Dilution Factor: 1				
		Analysis Time..: 15:58				
Uranium 238	ND	0.005	mg/kg	SW846 6020	06/24-07/01/08	KQF4L1AE
		Dilution Factor: 1				
		Analysis Time..: 15:58				

NOTE(S):

Calculations are performed before rounding to avoid round-off errors in calculated results.

LABORATORY CONTROL SAMPLE EVALUATION REPORT

TOTAL Metals

Client Lot #...: F8F190108 **Matrix.....:** SOLID

PARAMETER	PERCENT RECOVERY	RECOVERY LIMITS	METHOD	PREPARATION-ANALYSIS DATE	WORK ORDER #
LCS Lot-Sample#: F8F240000-078 **Prep Batch #...:** 8176078					
Lead	105	(82 - 118)	SW846 6020	06/24-07/01/08	KQF4L1AF
		Dilution Factor: 12.5	Analysis Time..: 00:32		
Uranium 235	104	(80 - 120)	SW846 6020	06/24-07/01/08	KQF4L1AH
		Dilution Factor: 1	Analysis Time..: 16:03		
Uranium 238	103	(80 - 120)	SW846 6020	06/24-07/01/08	KQF4L1AJ
		Dilution Factor: 1	Analysis Time..: 16:03		

NOTE(S):

Calculations are performed before rounding to avoid round-off errors in calculated results.

MATRIX SPIKE SAMPLE EVALUATION REPORT

TOTAL Metals

Client Lot #...: F8F190108 **Matrix.....:** SOLID
Date Sampled...: 06/11/08 12:00 **Date Received..:** 06/18/08

PARAMETER	PERCENT RECOVERY	RECOVERY LIMITS	RPD	RPD LIMITS	METHOD	PREPARATION-ANALYSIS DATE	WORK ORDER #
MS Lot-Sample #: F8F190108-001 **Prep Batch #...:** 8176078							
						% Moisture.....: 1.0	
Lead	100	(75 - 125)			SW846 6020	06/24-07/01/08	KP7GK1AL
	91	(75 - 125)	8.6	(0-30)	SW846 6020	06/24-07/01/08	KP7GK1AM
		Dilution Factor: 2.5					
		Analysis Time..: 00:44					
Uranium 235	44	(75 - 125)			SW846 6020	06/24-07/01/08	KP7GK1AN
	42	(75 - 125)		(0-30)	SW846 6020	06/24-07/01/08	KP7GK1AP
		Dilution Factor: 1					
		Analysis Time..: 16:20					
Uranium 238	37	(75 - 125)			SW846 6020	06/24-07/01/08	KP7GK1AQ
	35	(75 - 125)		(0-30)	SW846 6020	06/24-07/01/08	KP7GK1AR
		Dilution Factor: 1					
		Analysis Time..: 16:20					

NOTE(S):

Calculations are performed before rounding to avoid round-off errors in calculated results.

Results and reporting limits have been adjusted for dry weight.

SAMPLE DUPLICATE EVALUATION REPORT

General Chemistry

Client Lot #...: F8F190108 **Work Order #...:** KP7H4-SMP KP7H4-DUP **Matrix.....:** SOLID

Date Sampled...: 06/11/08 15:15 **Date Received..:** 06/18/08

% Moisture.....: 6.3

PARAM	RESULT	DUPLICATE RESULT	UNITS	RPD	RPD LIMIT	METHOD	PREPARATION-ANALYSIS DATE	PREP BATCH #
Percent Moisture						SD Lot-Sample #: F8F190108-007		
	6.3	7.5	%	17	(0-30)	MCAWW 160.3 MOD	06/20-06/23/08	8172171

Dilution Factor: 1 Analysis Time..: 00:00

AMEC Earth & Environmental

Client Sample ID: DU 001

Radiochemistry

Lab Sample ID: F8F190108-001
Work Order: KP7GK
Matrix: SOLID

Date Collected: 06/11/08 1200
Date Received: 06/18/08 0915

Parameter	Result	Qual	Total Uncert. (2 σ+/-)	RL	MDC	Prep Date	Analysis Date
Iso URANIUM (LONG CT) DOE A-01-R MOD				**pCi/g**		**Batch # 8175252**	**Yld % 80**
Uranium 234	**0.436**		**0.096**	0.100	**0.024**	**06/23/08**	**06/26/08**
Uranium 235/236	0.014	U	0.020	0.100	0.031	06/23/08	06/26/08
Uranium 238	**0.368**		**0.087**	0.100	**0.024**	**06/23/08**	**06/26/08**

NOTE(S)

Data are incomplete without the case narrative.

MDC is determined by instrument performance only.
Bold results are greater than the MDC

U Result is less than the sample detection limit.

AMEC Earth & Environmental

Client Sample ID: DU 001 DUP

Radiochemistry

Lab Sample ID: F8F190108-001X
Work Order: KP7GK
Matrix: SOLID

Date Collected: 06/11/08 1200
Date Received: 06/18/08 0915

Parameter	Result	Qual	Total Uncert. (2 σ+/-)	RL	MDC	Prep Date	Analysis Date
Iso URANIUM (LONG CT) DOE A-01-R MOD				**pCi/g**		**Batch # 8175252**	**Yld % 82**
Uranium 234	**0.300**		**0.076**	0.100	**0.025**	**06/23/08**	**06/26/08**
Uranium 235/236	0.003	U	0.011	0.100	0.028	06/23/08	06/26/08
Uranium 238	**0.298**		**0.076**	0.100	**0.027**	**06/23/08**	**06/26/08**

NOTE(S)

Data are incomplete without the case narrative.

MDC is determined by instrument performance only.
Bold results are greater than the MDC

U Result is less than the sample detection limit.

AMEC Earth & Environmental

Client Sample ID: DU 002

Radiochemistry

Lab Sample ID: F8F190108-002
Work Order: KP7HT
Matrix: SOLID

Date Collected: 06/11/08 1515
Date Received: 06/18/08 0915

Parameter	Result	Qual	Total Uncert. (2 σ+/-)	RL	MDC	Prep Date	Analysis Date
Iso URANIUM (LONG CT) DOE A-01-R MOD				**pCi/g**		**Batch # 8175252**	**Yld % 92**
Uranium 234	**0.157**		**0.051**	0.100	**0.024**	**06/23/08**	**06/26/08**
Uranium 235/236	0.008	U	0.013	0.100	0.021	06/23/08	06/26/08
Uranium 238	**0.133**		**0.047**	0.100	**0.025**	**06/23/08**	**06/26/08**

NOTE(S)

Data are incomplete without the case narrative.

MDC is determined by instrument performance only.
Bold results are greater than the MDC

U Result is less than the sample detection limit.

AMEC Earth & Environmental

Client Sample ID: DU 003

Radiochemistry

Lab Sample ID: F8F190108-003
Work Order: KP7HX
Matrix: SOLID

Date Collected: 06/11/08 1430
Date Received: 06/18/08 0915

Parameter	Result	Qual	Total Uncert. (2 σ+/-)	RL	MDC	Prep Date	Analysis Date
Iso URANIUM (LONG CT) DOE A-01-R MOD				**pCi/g**		**Batch # 8175252**	**Yld % 83**
Uranium 234	**0.118**		**0.047**	0.100	**0.029**	**06/23/08**	**06/26/08**
Uranium 235/236	0.017	U	0.022	0.100	0.031	06/23/08	06/26/08
Uranium 238	**0.066**	**J**	**0.035**	0.100	**0.023**	**06/23/08**	**06/26/08**

NOTE(S)

Data are incomplete without the case narrative.

MDC is determined by instrument performance only.
Bold results are greater than the MDC

J Result is greater than sample detection limit but less than stated reporting limit.
U Result is less than the sample detection limit.

AMEC Earth & Environmental

Client Sample ID: DU 004

Radiochemistry

Lab Sample ID: F8F190108-004
Work Order: KP7H0
Matrix: SOLID

Date Collected: 06/11/08 1332
Date Received: 06/18/08 0915

Parameter	Result	Qual	Total Uncert. (2 σ+/-)	RL	MDC	Prep Date	Analysis Date
Iso URANIUM (LONG CT) DOE A-01-R MOD				**pCi/g**		**Batch # 8175252**	**Yld % 87**
Uranium 234	**0.144**		**0.050**	0.100	**0.025**	**06/23/08**	**06/26/08**
Uranium 235/236	0.0050	U	0.0099	0.100	0.013	06/23/08	06/26/08
Uranium 238	**0.130**		**0.047**	0.100	**0.018**	**06/23/08**	**06/26/08**

NOTE(S)

Data are incomplete without the case narrative.

MDC is determined by instrument performance only.
Bold results are greater than the MDC

U Result is less than the sample detection limit.

AMEC Earth & Environmental

Client Sample ID: DU 005

Radiochemistry

Lab Sample ID: F8F190108-005
Work Order: KP7H1
Matrix: SOLID

Date Collected: 06/11/08 1245
Date Received: 06/18/08 0915

Parameter	Result	Qual	Total Uncert. (2 σ+/-)	RL	MDC	Prep Date	Analysis Date
Iso URANIUM (LONG CT) DOE A-01-R MOD				**pCi/g**		**Batch # 8175252**	**Yld % 76**
Uranium 234	**0.199**		**0.062**	0.100	**0.026**	**06/23/08**	**06/26/08**
Uranium 235/236	0.01	U	0.016	0.100	0.025	06/23/08	06/26/08
Uranium 238	**0.269**		**0.073**	0.100	**0.026**	**06/23/08**	**06/26/08**

NOTE(S)

Data are incomplete without the case narrative.

MDC is determined by instrument performance only.
Bold results are greater than the MDC

U Result is less than the sample detection limit.

AMEC Earth & Environmental

Client Sample ID: DU 006

Radiochemistry

Lab Sample ID: F8F190108-006
Work Order: KP7H2
Matrix: SOLID

Date Collected: 06/11/08 1515
Date Received: 06/18/08 0915

Parameter	Result	Qual	Total Uncert. (2 σ+/-)	RL	MDC	Prep Date	Analysis Date
Iso URANIUM (LONG CT) DOE A-01-R MOD				**pCi/g**		**Batch # 8175252**	**Yld % 72**
Uranium 234	**0.123**		**0.049**	0.100	**0.013**	**06/23/08**	**06/26/08**
Uranium 235/236	**0.018**	**J**	**0.020**	0.100	**0.016**	**06/23/08**	**06/26/08**
Uranium 238	**0.122**		**0.049**	0.100	**0.021**	**06/23/08**	**06/26/08**

NOTE(S)

Data are incomplete without the case narrative.

MDC is determined by instrument performance only.
Bold results are greater than the MDC

J Result is greater than sample detection limit but less than stated reporting limit.

AMEC Earth & Environmental

Client Sample ID: DU 007

Radiochemistry

Lab Sample ID: F8F190108-007
Work Order: KP7H4
Matrix: SOLID

Date Collected: 06/11/08 1515
Date Received: 06/18/08 0915

Parameter	Result	Qual	Total Uncert. (2 σ+/-)	RL	MDC	Prep Date	Analysis Date
Iso URANIUM (LONG CT) DOE A-01-R MOD			pCi/g		Batch # 8175252		Yld % 79
Uranium 234	**0.127**		**0.048**	0.100	**0.012**	**06/23/08**	**06/26/08**
Uranium 235/236	0.0	U	0.0055	0.100	0.015	06/23/08	06/26/08
Uranium 238	**0.154**		**0.054**	0.100	**0.026**	**06/23/08**	**06/26/08**

NOTE(S)

Data are incomplete without the case narrative.

MDC is determined by instrument performance only.
Bold results are greater than the MDC

U Result is less than the sample detection limit.

METHOD BLANK REPORT

Radiochemistry

Client Lot ID: F8F190108
Matrix: SOLID

Parameter	Result	Qual	Total Uncert. (2 σ+/-)	RL	MDC	Prep Date	Lab Sample ID Analysis Date
Iso URANIUM (LONG CT) DOE A-01-R MOD			**pCi/g**	**Batch # 8175252**		**Yld % 87**	**F8F230000-252B**
Uranium 234	0.007	U	0.015	0.100	0.027	06/23/08	06/26/08
Uranium 235/236	-0.0012	U	0.0025	0.100	0.023	06/23/08	06/26/08
Uranium 238	0.003	U	0.015	0.100	0.033	06/23/08	06/26/08

NOTE(S)

Data are incomplete without the case narrative.

MDC is determined using instrument performance only
Bold results are greater than the MDC

U Result is less than the sample detection limit.

Laboratory Control Sample Report

Radiochemistry

Client Lot ID: F8F190108
Matrix: SOLID

Parameter	Spike Amount	Result	Total Uncert. (2 σ+/-)	MDC	% Yld	% Rec	Lab Sample ID QC Control Limits
Iso URANIUM (LONG CT) DOE A-01-R MOD		**pCi/g**		**A-01-R MOD**			**F8F230000-252C**
Uranium 234	19.6	20.1	2.8	0.3	86	103	(70 - 122)
Uranium 238	19.6	17.4	2.5	0.3	86	89	(69 - 119)
	Batch #:	8175252		**Analysis Date:**	06/26/08		

NOTE(S)

MDC is determined by instrument performance only
Calculations are performed before rounding to avoid round-off error in calculated results

DUPLICATE EVALUATION REPORT

Radiochemistry

Client Lot ID: F8F190108
Matrix: SOLID

Date Sampled: 06/11/08
Date Received: 06/18/08

Parameter	SAMPLE Result		Total Uncert. (2σ+/-)	% Yld	DUPLICATE Result		Total Uncert. (2 σ+/-)	% Yld	QC Sample ID Precision	
Iso URANIUM (LONG CT) DOE A-01-R MOD			**pCi/g**		**A-01-R MOD**				**F8F190108-001**	
Uranium 234	**0.436**		**0.096**	80	**0.300**		**0.076**	82	37	%RPD
Uranium 235/236	0.014	U	0.020	80	0.003	U	0.011	82	139	%RPD
Uranium 238	**0.368**		**0.087**	80	**0.298**		**0.076**	82	21	%RPD
	Batch #:		8175252 (Sample)		8175252 (Duplicate)					

NOTE(S)

Data are incomplete without the case narrative.
Calculations are performed before rounding to avoid round-off error in calculated results

U Result is less than the sample detection limit.

is
er Trail North

, MO 63045
.298.8566 fax 314.298.8757

cwl 3270

Chain of Custody Record

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

TestAmerica Laboratories, Inc.

Client Contact	Project Manager: Russell Okoji	Site Contact:	Date: 6/11/08	COC No: 001
irth & Environmental	Tel/Fax: 808-391-9906	Lab Contact:	Carrier: FedEx	1 of 1 COCs
paka Street, Suite F251	Analysis Turnaround Time			Job No.
HI 96819	Calendar (C) or Work Days (W) Standard			
-2462 Phone	TAT if different from Below			SDG No.
-5379 FAX	☐ 2 weeks			
ame: PTA DU Sampling	☐ 1 week			
	☐ 2 days			
	☐ 1 day			

Sample Identification	Sample Date	Sample Time	Sample Type	Matrix	# of Cont.	Filtered Sample	* Lead by ICP-MS (6020A)	* Isotopic Uranium by ICP-MS (6020A)	Isotopic Uranium by Alpha Spec.	* Long Count (U234, U235, U238)	Prep - Dry and Grind	* Prep - Total Dissolution Prep	Sample Specific Notes:
DU 001	6/11/2008	12:00	Composite	Soil	1		X	X	X	X	X	X	
DU 002	6/11/2008	3:15	Composite	Soil	1		X	X	X	X	X	X	
DU 003	6/11/2008	2:30	Composite	Soil	1		X	X	X	X	X	X	
DU 004	6/11/2008	1:32	Composite	Soil	1		X	X	X	X	X	X	
DU 005	6/11/2008	12:45	Composite	Soil	1		X	X	X	X	X	X	MS/MSD
DU 006	6/11/2008	3:15	Composite	Soil	1		X	X	X	X	X	X	
DU 007	6/11/2008	3:15	Composite	Soil	1		X	X	X	X	X	X	

Bag

06.18.08

tion Used: Ice

Hazard Identification
t-Hazard ☐ Flammable ☐ Skin Irritant Poison B ☐ Unknown ☐

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
☐ Return To Client ☒ Disposal By Lab ☐ Archive For _____ Months

nstructions/QC Requirements & Comments: Conduct MS/MSD on DU 005. Dry and grind all soil before subsampling.

hed by: Jamie L Anderson	Company: AMEC	Date/Time: 6/16/08 @ 13:00	Received by:	Company: TA-STL	Date/Time: 06.18.08 0915
hed by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
hed by:	Company:	Date/Time:	Received by:	Company:	Date/Time:

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Lot #(s): - 3270 - F8F190108

Condition Upon Receipt Form

Client: AMEC COC/RFA No: 001 Date: 06.18.08
Quote No: 79901 Initiated By: Time: 0915

Shipping Information

Shipper Name: FedX
Shipping # (s):*
1. 7920 7241 6660 6.
2. 7. Multiple Packages Y (N)
3. 8. Sample Temperature (s):**
4. 9. 1. 4 6.
5. 10. 2. 7.
3. 8.
4. 9.
5. 10.

*Numbered shipping lines correspond to Numbered Sample Temp lines

**Sample must be received at 4°C ± 2°C- If not, note contents below. Temperature variance does NOT affect the following: Metals-Liquid or Rad tests- Liquid or Solids

Condition (Circle "Y" for yes, "N" for no and "N/A" for not applicable):

1.	(Y) N	Are there custody seals present on the cooler?	8.	Y (N)	Are there custody seals present on bottles?
2.	Y (N) N/A	Do custody seals on cooler appear to be tampered with?	9.	Y N (N/A)	Do custody seals on bottles appear to be tampered with?
3.	(Y) N	Were contents of cooler frisked after opening, but before unpacking?	10.	Y N (N/A)	Was sample received with proper pH[1]? (If not, make note below)
4.	(Y) N	Sample received with Chain of Custody?	11.	Y N	If N/A- Was pH taken by original TestAmerica lab?
5.	(Y) N N/A	Does the Chain of Custody match sample ID's on the container(s)?	12.	(Y) N	Sample received in proper containers?
6.	Y (N)	Was sample received broken?	13.	Y N (N/A)	Headspace in VOA or TOX liquid samples? (If Yes, note sample ID's below)
7.	(Y) N	Is sample volume sufficient for analysis?	14.	Y N (N/A)	Was Internal COC/Workshare received?

[1] For DOE-AL (Pantex, LANL, Sandia) sites, pH of ALL containers received must be verified, EXCEPT VOA, TOX and soils.

Notes:

Corrective Action:
☐ Client Contact Name: Informed by:
☐ Sample(s) processed "as is"
☐ Sample(s) on hold until: If released, notify:

Appendix **B**

CHEMICAL ASSESSMENT RISK CHARACTERIZATION SPREADSHEETS

Uranium Soils Investigation
Baseline Human Health Risk Assessment
Saddle Road
October 2009

APPENDIX C
SUMMARY OF POTENTIAL CANCER RISKS AND HAZARD INDICES
CONSTRUCTION WORKER

SADDLE ROAD

	Excess Lifetime Cancer Risk					Hazard Index				
Compound	Soil	Sediment	Groundwater	Surface Water	Total	Soil	Sediment	Groundwater	Surface Water	Total
Uranium	NA	NA	NA	NA	NA	3.82E-03	NA	NA	NA	3.82E-03

CONSTRUCTION WORKER SOIL EXPOSURES
RISK CHARACTERIZATION
SADDLE ROAD

Scenario:	Subactivity name
Receptor:	Construction Worker
Medium:	Soil
Exposure Pathway:	Ingestion and Dermal Contact

ADD (mg/kg-day) = $\frac{CS \times [(IR \times FI \times RAF) + (SA \times AF \times FA \times RAF \times EFD)] \times EF \times ED \times CF}{BW \times AT}$

Hazard Quotient (HQ) = ADD (mg/kg-day) / RfD (mg/kg-day)
Cancer Risk (ELCR) = ADD (mg/kg-day) * CSF [1/(mg/kg-day)]

Parameter (units)	Value
ADD: Average Daily Dose (mg/kg-day)	See Below
CS: Chemical Concentration in Soil (mg/kg)	Chemical-Specific
IR: Ingestion Rate (mg/day)	330
RAF: Relative Absorption Factor (Oral-Soil) (unitless)	Chemical-Specific
FI: Fraction Ingested from Site (unitless)	1
SA: Skin Surface Area (cm2)	3300
AF: Adherence Factor (mg/cm2/event)	0.29
RAF: Relative Absorption Factor (Dermal-Soil) (unitless)	Chemical-Specific
FA: Fraction Absorbed from Site (unitless)	1
EFD: Exposure Frequency - Dermal (event/day)	1
EF: Exposure Frequency (days/year)	250
ED: Exposure Duration (years)	1
BW: Body Weight (kg)	71.8
AT: Averaging Time (days) (ED x 365 days/yr, noncancer)	365
AT: Averaging Time (days) (75 yr. x 365 days/yr, cancer)	25550
CF: Conversion factor (kg/mg)	1.00E-06
RfD: Reference Dose (mg/kg-day)	Chemical-Specific
CSF: Cancer Slope Factor [1/(mg/kg-day)]	Chemical-Specific

		Noncancer Hazard Quotient					Excess Lifetime Cancer Risk				
Compound	Soil Concentration (mg/kg)	Oral-Soil RAF (noncancer)	Dermal-Soil RAF (noncancer)	ADD (noncancer) (mg/kg-day)	Chronic TDI/RfD (mg/kg-day)	Soil HQ	Oral-Soil RAF (cancer)	Dermal-Soil RAF (cancer)	ADD (cancer) (mg/kg-day)	CSF [1/(mg/kg-day)]	Soil Risk
Uranium	9.25E-01	1	1	1.14E-05	3.00E-03	3.79E-03	1	1	NA	NA	NA
						3.79E-03					0.00E+00

CONSTRUCTION WORKER - SOIL EXPOSURES
RISK CHARACTERIZATION
SADDLE ROAD

Scenario:	Subactivity name
Receptor:	Construction Worker
Medium:	Dust from soil
Exposure Pathway:	Inhalation

ADD (mg/kg/day) = $\frac{\text{Cdust x IR x RAF x ET x EF x ED}}{\text{AT x BW}}$

Hazard Quotient (HQ) = ADD (mg/kg/day) / RfDi (mg/kg/day)
Cancer Risk (ELCR) = ADD (mg/kg/day) * CSFi [1/(mg/kg/day)]

Parameter (units)	Value
ADD: Average Daily Dose (mg/kg/day)	See Below
CS: Chemical Concentration in Soil (mg/kg)	Chemical-Specific
Cdust: Concentration of dust-bound chemical in air (mg/m3)	Calculated
RAF: Relative Absorption Factor (Inhalation) (unitless)	Chemical-Specific
ET: Exposure Time - dust (hr/d)	8
EF: Exposure Frequency (days/year)	250
ED: Exposure Duration (years)	1
IR: Inhalation Rate (m3/hr)	0.833
AT: Averaging Time (days) (ED x 365 days/yr, noncancer)	365
AT: Averaging Time (days) (75 yr. x 365 days/yr, cancer)	25550
BW: Body Weight (kg)	71.8
RfDi: Reference Dose Inhalation (mg/kg/day)	Chemical-Specific
CSFi: Cancer Slope Factor Inhalation [1/(mg/kg/day)]	Chemical-Specific

			Noncancer Hazard Quotient				Excess Lifetime Cancer Risk			
Compound	Soil Concentration (mg/kg)	Chemical Concentration in Air (mg/m3)	Inhalation RAF (noncancer)	ADD (noncancer) (mg/kg/day)	RFDi (non-cancer) (mg/kg/day)	Soil-Dust HQ	Inhalation RAF (cancer)	ADD (cancer) (mg/kg/day)	CSFi [1/(mg/kg/day)]	Soil- Dust Risk
Uranium	9.25E-01	4.63E-08	1	2.94E-09	8.60E-05	3.42E-05	1	NA	NA	NA
						3.42E-05				0.00E+00

APPENDIX C
SUMMARY OF POTENTIAL CANCER RISKS AND HAZARD INDICES
CHILD-SUBACTIVITY
SADDLE ROAD

	Excess Lifetime Cancer Risk					Hazard Index				
Compound	Soil	Sediment	Groundwater	Surface Water	Total	Soil	Sediment	Groundwater	Surface Water	Total
Uranium	NA	NA	NA	NA	NA	2.78E-03	NA	NA	NA	2.78E-03

CHILD - SUBACTIVITY - SOIL EXPOSURES
RISK CHARACTERIZATION
SADDLE ROAD

Scenario:	Subactivity name
Receptor:	Child
Medium:	Soil
Exposure Pathway:	Ingestion and Dermal Contact

$$\text{ADD (mg/kg-day)} = \frac{CS \times [(IR \times FI \times RAF) + (SA \times AF \times FA \times RAF \times EFD)] \times EF \times ED \times CF}{BW \times AT}$$

Hazard Quotient (HQ) = ADD (mg/kg-day) / RfD (mg/kg-day)
Cancer Risk (ELCR) = ADD (mg/kg-day) * CSF [1/(mg/kg-day)]

Parameter (units)	Value
ADD: Average Daily Dose (mg/kg-day)	See Below
CS: Chemical Concentration in Soil (mg/kg)	Chemical-Specific
IR: Ingestion Rate (mg/day)	200
RAF: Relative Absorption Factor (Oral-Soil) (unitless)	Chemical-Specific
FI: Fraction Ingested from Site (unitless)	1
SA: Skin Surface Area (cm2)	2800
AF: Adherence Factor (mg/cm2/event)	0.29
RAF: Relative Absorption Factor (Dermal-Soil) (unitless)	Chemical-Specific
FA: Fraction Absorbed from Site (unitless)	1
EFD: Exposure Frequency - Dermal (event/day)	1
EF: Exposure Frequency (days/year)	52
ED: Exposure Duration (years)	6
BW: Body Weight (kg)	16
AT: Averaging Time (days) (ED x 365 days/yr, noncancer)	2190
AT: Averaging Time (days) (75 yr. x 365 days/yr, cancer)	25550
CF: Conversion factor (kg/mg)	1.00E-06
RfD: Reference Dose (mg/kg-day)	Chemical-Specific
CSF: Cancer Slope Factor [1/(mg/kg-day)]	Chemical-Specific

		Noncancer Hazard Quotient					Excess Lifetime Cancer Risk				
Compound	Soil Concentration (mg/kg)	Oral-Soil RAF (noncancer)	Dermal-Soil RAF (noncancer)	ADD (noncancer) (mg/kg-day)	Chronic TDI/RfD (mg/kg-day)	Soil HQ	Oral-Soil RAF (cancer)	Dermal-Soil RAF (cancer)	ADD (cancer) (mg/kg-day)	CSF [1/(mg/kg-day)]	Soil Risk
Uranium	9.25E-01	1	1	8.34E-06	3.00E-03	2.78E-03	1	1	NA	NA	NA
						2.78E-03					0.00E+00

CHILD - SUBACTIVITY - SOIL EXPOSURES
RISK CHARACTERIZATION
SADDLE ROAD

Scenario:	Subactivity name
Receptor:	Child
Medium:	Dust from soil
Exposure Pathway:	Inhalation

ADD (mg/kg/day) = $\frac{\text{Cdust x IR x RAF x ET x EF x ED}}{\text{AT x BW}}$

Hazard Quotient (HQ) = ADD (mg/kg/day) / RfDi (mg/kg/day)
Cancer Risk (ELCR) = ADD (mg/kg/day) * CSFi [1/(mg/kg/day)]

Parameter (units)	Value
ADD: Average Daily Dose (mg/kg/day)	See Below
CS: Chemical Concentration in Soil (mg/kg)	Chemical-Specific
Cdust: Concentration of dust-bound chemical in air (mg/m3)	Calculated
RAF: Relative Absorption Factor (Inhalation) (unitless)	Chemical-Specific
ET: Exposure Time - dust (hr/d)	2
EF: Exposure Frequency (days/year)	52
ED: Exposure Duration (years)	6
IR: Inhalation Rate (m3/hr)	0.417
AT: Averaging Time (days) (ED x 365 days/yr, noncancer)	2190
AT: Averaging Time (days) (75 yr. x 365 days/yr, cancer)	25550
BW: Body Weight (kg)	16
RfDi: Reference Dose Inhalation (mg/kg/day)	Chemical-Specific
CSFi: Cancer Slope Factor Inhalation [1/(mg/kg/day)]	Chemical-Specific

			Noncancer Hazard Quotient				Excess Lifetime Cancer Risk			
Compound	Soil Concentration (mg/kg)	Chemical Concentration in Air (mg/m3)	Inhalation RAF (noncancer)	ADD (noncancer) (mg/kg/day)	RFDi (non-cancer) (mg/kg/day)	Soil-Dust HQ	Inhalation RAF (cancer)	ADD (cancer) (mg/kg/day)	CSFi [1/(mg/kg/day)]	Soil- Dust Risk
Uranium	9.25E-01	4.63E-08	1	3.43E-10	8.60E-05	3.99247E-06	1	NA	NA	NA
						3.99E-06				0.00E+00

APPENDIX C
SUMMARY OF POTENTIAL CANCER RISKS AND HAZARD INDICES
ADULT -SUBACTIVITY
SADDLE ROAD

	Excess Lifetime Cancer Risk					Hazard Index				
Compound	Soil	Sediment	Groundwater	Surface Water	Total	Soil	Sediment	Groundwater	Surface Water	Total
Uranium	NA	NA	NA	NA	NA	1.07E-03	NA	NA	NA	1.07E-03

ADULT - SUBACTIVITY - SOIL EXPOSURES
RISK CHARACTERIZATION
SADDLE ROAD

Scenario:	Subactivity name
Receptor:	Adult Resident
Medium:	Soil
Exposure Pathway:	Ingestion and Dermal Contact

ADD (mg/kg-day) = $\frac{CS \times [(IR \times FI \times RAF) + (SA \times AF \times FA \times RAF \times EFD)] \times EF \times ED \times CF}{BW \times AT}$

Hazard Quotient (HQ) = ADD (mg/kg-day) / RfD (mg/kg-day)
Cancer Risk (ELCR) = ADD (mg/kg-day) * CSF [1/(mg/kg-day)]

Parameter (units)	Value
ADD: Average Daily Dose (mg/kg-day)	See Below
CS: Chemical Concentration in Soil (mg/kg)	Chemical-Specific
IR: Ingestion Rate (mg/day)	100
RAF: Relative Absorption Factor (Oral-Soil) (unitless)	Chemical-Specific
FI: Fraction Ingested from Site (unitless)	1
SA: Skin Surface Area (cm2)	5700
AF: Adherence Factor (mg/cm2/event)	0.29
RAF: Relative Absorption Factor (Dermal-Soil) (unitless)	Chemical-Specific
FA: Fraction Absorbed from Site (unitless)	1
EFD: Exposure Frequency - Dermal (event/day)	1
EF: Exposure Frequency (days/year)	52
ED: Exposure Duration (years)	24
BW: Body Weight (kg)	71.8
AT: Averaging Time (days) (ED x 365 days/yr, noncancer)	8760
AT: Averaging Time (days) (75 yr. x 365 days/yr, cancer)	25550
CF: Conversion factor (kg/mg)	1.00E-06
RfD: Reference Dose (mg/kg-day)	Chemical-Specific
CSF: Cancer Slope Factor [1/(mg/kg-day)]	Chemical-Specific

		Noncancer Hazard Quotient					Excess Lifetime Cancer Risk				
Compound	Soil Concentration (mg/kg)	Oral-Soil RAF (noncancer)	Dermal-Soil RAF (noncancer)	ADD (noncancer) (mg/kg-day)	Chronic TDI/RfD (mg/kg-day)	Soil HQ	Oral-Soil RAF (cancer)	Dermal-Soil RAF (cancer)	ADD (cancer) (mg/kg-day)	CSF [1/(mg/kg-day)]	Soil Risk
Uranium	9.25E-01	1	1	3.22E-06	3.00E-03	1.07E-03	1	1	NA	NA	NA
						1.07E-03					0.00E+00

ADULT - SUBACTIVITY - SOIL EXPOSURES
RISK CHARACTERIZATION
SADDLE ROAD

Scenario:	Subactivity name
Receptor:	Adult Resident
Medium:	Dust from soil
Exposure Pathway:	Inhalation

ADD (mg/kg/day) = $\frac{\text{Cdust x IR x RAF x ET x EF x ED}}{\text{AT x BW}}$

Hazard Quotient (HQ) = ADD (mg/kg/day) / RfDi (mg/kg/day)
Cancer Risk (ELCR) = ADD (mg/kg/day) * CSFi [1/(mg/kg/day)]

Parameter (units)	Value
ADD: Average Daily Dose (mg/kg/day)	See Below
CS: Chemical Concentration in Soil (mg/kg)	Chemical-Specific
Cdust: Concentration of dust-bound chemical in air (mg/m3)	Calculated
RAF: Relative Absorption Factor (Inhalation) (unitless)	Chemical-Specific
ET: Exposure Time - dust (hr/d)	2
EF: Exposure Frequency (days/year)	52
ED: Exposure Duration (years)	24
IR: Inhalation Rate (m3/hr)	0.833
AT: Averaging Time (days) (ED x 365 days/yr, noncancer)	8760
AT: Averaging Time (days) (75 yr. x 365 days/yr, cancer)	25550
BW: Body Weight (kg)	71.8
RfDi: Reference Dose Inhalation (mg/kg/day)	Chemical-Specific
CSFi: Cancer Slope Factor Inhalation [1/(mg/kg/day)]	Chemical-Specific

			Noncancer Hazard Quotient				Excess Lifetime Cancer Risk			
Compound	Soil Concentration (mg/kg)	Chemical Concentration in Air (mg/m3)	Inhalation RAF (noncancer)	ADD (noncancer) (mg/kg/day)	RFDi (non-cancer) (mg/kg/day)	Soil-Dust HQ	Inhalation RAF (cancer)	ADD (cancer) (mg/kg/day)	CSFi [1/(mg/kg/day)]	Soil- Dust Risk
Uranium	9.25E-01	4.63E-08	1	1.53E-10	8.60E-05	1.78E-06	1	NA	NA	NA
						1.78E-06				0.00E+00

Appendix **C**

RADIOLOGICAL ASSESSMENT RISK CHARACTERIZATION REPORTS

Uranium Soils Investigation
Baseline Human Health Risk Assessment
Saddle Road
October 2009

RESRAD
CONSTRUCTION WORKER

Uranium Soils Investigation
Baseline Human Health Risk Assessment
Saddle Road
October 2009

Intrisk : Construction Worker Receptor
File : C:\RESRAD_FAMILY\RESRAD\USERFILES\SITE1.RAD

Table of Contents

Part III: Intake Quantities and Health Risk Factors

Cancer Risk Slope Factors Summary Table
Risk Library: FGR 13 Morbidity

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	2.13E-07	1.49E-07	SLPF(1,2)
Sf-2	Pa-231	7.62E-08	7.62E-08	SLPF(2,2)
Sf-2	Pb-210+D	3.08E-08	1.58E-08	SLPF(3,2)
Sf-2	Ra-226+D	2.83E-08	2.82E-08	SLPF(4,2)
Sf-2	Th-230	3.40E-08	3.40E-08	SLPF(5,2)
Sf-2	U-234	2.78E-08	2.78E-08	SLPF(6,2)
Sf-2	U-235+D	2.50E-08	2.50E-08	SLPF(7,2)
Sf-2	U-238	2.36E-08	2.36E-08	SLPF(8,2)
Sf-2	U-238+D	2.36E-08	2.36E-08	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	2.66E-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	6.53E-10	2.45E-10	SLPF(1,5)
Sf-3	Pa-231	2.26E-10	2.26E-10	SLPF(2,5)
Sf-3	Pb-210+D	3.44E-09	1.18E-09	SLPF(3,5)
Sf-3	Ra-226+D	5.15E-10	5.14E-10	SLPF(4,5)
Sf-3	Th-230	1.19E-10	1.19E-10	SLPF(5,5)

Cancer Risk Slope Factors Summary Table (continued)
Risk Library: FGR 13 Morbidity

Menu	Parameter	Current Value	Base Case*	Parameter Name
Sf-3	U-234	9.55E-11	9.55E-11	SLPF(6,5)
Sf-3	U-235+D	9.76E-11	9.44E-11	SLPF(7,5)
Sf-3	U-238	8.66E-11	8.66E-11	SLPF(8,5)
Sf-3	U-238+D	1.21E-10	8.66E-11	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.

Risk Slope and Environmental Transport Factors for the Ground Pathway

Nuclide (i)	Slope(i)* t=	ETFG(i,t) At Time in Years (dimensionless) 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	9.567E-01	9.567E-01	9.567E-01	9.567E-01	9.567E-01	9.567E-01	9.567E-01	9.567E-01
At-218	3.570E-09	9.702E-01	9.702E-01	9.702E-01	9.702E-01	9.702E-01	9.702E-01	9.702E-01	9.702E-01
Bi-210	2.760E-09	9.450E-01	9.450E-01	9.450E-01	9.450E-01	9.450E-01	9.450E-01	9.450E-01	9.450E-01
Bi-211	1.880E-07	9.453E-01	9.453E-01	9.453E-01	9.453E-01	9.453E-01	9.453E-01	9.453E-01	9.453E-01
Bi-214	7.480E-06	9.401E-01	9.401E-01	9.401E-01	9.401E-01	9.401E-01	9.401E-01	9.401E-01	9.400E-01
Fr-223	1.400E-07	9.502E-01	9.502E-01	9.502E-01	9.502E-01	9.502E-01	9.502E-01	9.502E-01	9.502E-01
Pa-231	1.390E-07	9.456E-01	9.456E-01	9.456E-01	9.456E-01	9.456E-01	9.456E-01	9.456E-01	9.456E-01
Pa-234	8.710E-06	9.400E-01	9.400E-01	9.400E-01	9.400E-01	9.400E-01	9.400E-01	9.400E-01	9.400E-01
Pa-234m	6.870E-08	9.393E-01	9.393E-01	9.393E-01	9.393E-01	9.393E-01	9.393E-01	9.393E-01	9.393E-01
Pb-210	1.410E-09	9.813E-01	9.813E-01	9.813E-01	9.813E-01	9.813E-01	9.813E-01	9.813E-01	9.813E-01
Pb-211	2.290E-07	9.399E-01	9.399E-01	9.399E-01	9.399E-01	9.399E-01	9.399E-01	9.399E-01	9.399E-01
Pb-214	9.820E-07	9.456E-01	9.456E-01	9.456E-01	9.456E-01	9.456E-01	9.456E-01	9.456E-01	9.456E-01
Po-210	3.950E-11	9.390E-01	9.390E-01	9.390E-01	9.390E-01	9.390E-01	9.390E-01	9.390E-01	9.390E-01
Po-211	3.580E-08	9.360E-01	9.360E-01	9.360E-01	9.360E-01	9.360E-01	9.360E-01	9.360E-01	9.360E-01
Po-214	3.860E-10	9.360E-01	9.360E-01	9.360E-01	9.360E-01	9.360E-01	9.360E-01	9.360E-01	9.360E-01
Po-215	7.480E-10	9.410E-01	9.410E-01	9.410E-01	9.410E-01	9.410E-01	9.410E-01	9.410E-01	9.410E-01
Po-218	4.260E-11	9.390E-01	9.390E-01	9.390E-01	9.390E-01	9.390E-01	9.390E-01	9.390E-01	9.390E-01
Ra-223	4.340E-07	9.496E-01	9.496E-01	9.496E-01	9.496E-01	9.496E-01	9.496E-01	9.496E-01	9.496E-01
Ra-226	2.290E-08	9.524E-01	9.524E-01	9.524E-01	9.524E-01	9.524E-01	9.524E-01	9.524E-01	9.524E-01
Rn-219	2.250E-07	9.461E-01	9.461E-01	9.461E-01	9.461E-01	9.461E-01	9.461E-01	9.461E-01	9.461E-01
Rn-222	1.740E-09	9.370E-01	9.370E-01	9.370E-01	9.370E-01	9.370E-01	9.370E-01	9.370E-01	9.370E-01
Th-227	3.780E-07	9.508E-01	9.508E-01	9.508E-01	9.508E-01	9.508E-01	9.508E-01	9.508E-01	9.508E-01
Th-230	8.190E-10	9.588E-01	9.588E-01	9.588E-01	9.588E-01	9.588E-01	9.588E-01	9.588E-01	9.588E-01
Th-231	2.450E-08	9.599E-01	9.599E-01	9.599E-01	9.599E-01	9.599E-01	9.599E-01	9.599E-01	9.599E-01
Th-234	1.630E-08	9.610E-01	9.610E-01	9.610E-01	9.610E-01	9.610E-01	9.610E-01	9.610E-01	9.610E-01
Tl-207	1.520E-08	9.403E-01	9.403E-01	9.403E-01	9.403E-01	9.403E-01	9.403E-01	9.403E-01	9.403E-01
Tl-210	0.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-234	2.520E-10	9.643E-01	9.643E-01	9.643E-01	9.643E-01	9.643E-01	9.643E-01	9.643E-01	9.643E-01
U-235	5.180E-07	9.520E-01	9.520E-01	9.520E-01	9.520E-01	9.520E-01	9.520E-01	9.520E-01	9.520E-01
U-238	4.990E-11	9.912E-01	9.912E-01	9.912E-01	9.912E-01	9.912E-01	9.912E-01	9.912E-01	9.912E-01

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

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-	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total
Nuclide	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
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	2.529E-03	0.000E+00	0.000E+00	0.000E+00	3.597E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	3.597E+01
U-235	3.480E-05	0.000E+00	0.000E+00	0.000E+00	4.950E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	4.950E-01
U-238	1.798E-03	0.000E+00	0.000E+00	0.000E+00	2.558E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.558E+01

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

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	Radionuclides							
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

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 Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Ac-227	1.139E-11	0.0000	1.012E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.414E-13	0.0000
Pa-231	5.014E-12	0.0000	1.686E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.112E-13	0.0000
Pb-210	2.907E-15	0.0000	1.287E-16	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.049E-13	0.0000
Ra-226	3.438E-11	0.0000	7.062E-16	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.829E-13	0.0000
Th-230	9.444E-13	0.0000	2.372E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.181E-11	0.0000
U-234	2.572E-09	0.0025	1.707E-09	0.0016	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.340E-08	0.0797
U-235	7.526E-08	0.0719	2.113E-11	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.173E-09	0.0011
U-238	8.061E-07	0.7705	1.032E-09	0.0010	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.489E-08	0.0716
Total	8.840E-07	0.8449	2.760E-09	0.0026	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.595E-07	0.1524

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-	Water		Fish		Plant		Meat		Milk		All Pathways**	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.184E-11	0.0000
Pa-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.742E-12	0.0000
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.080E-13	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.456E-11	0.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.299E-11	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	0.0000	8.768E-08	0.0838
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	7.646E-08	0.0731
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	8.821E-07	0.8431
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	1.046E-06	1.0000

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

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

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	2.483E-14	4.982E-16	6.246E-19	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	2.483E-14	4.982E-16	6.246E-19	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

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

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-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
U-234	2.608E-09	0.0025	1.707E-09	0.0016	2.533E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.341E-08	0.0797
U-235	7.528E-08	0.0719	2.115E-11	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.175E-09	0.0011
U-238	8.061E-07	0.7705	1.032E-09	0.0010	3.171E-19	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.490E-08	0.0716
Total	8.840E-07	0.8449	2.760E-09	0.0026	2.533E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.595E-07	0.1524

Intrisk : Construction Worker Receptor
File : C:\RESRAD_FAMILY\RESRAD\USERFILES\SITE1.RAD

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-	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	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	8.773E-08	0.0838
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	7.648E-08	0.0731
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	8.821E-07	0.8431
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.046E-06	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+00 years

Radio-	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total
Nuclide	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
Ac-227	1.156E-11	0.000E+00	0.000E+00	0.000E+00	1.644E-07	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.644E-07
Pa-231	7.347E-10	0.000E+00	0.000E+00	0.000E+00	1.045E-05	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.045E-05
Pb-210	5.063E-14	0.000E+00	0.000E+00	0.000E+00	7.201E-10	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	7.201E-10
Ra-226	4.924E-12	0.000E+00	0.000E+00	0.000E+00	7.003E-08	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	7.003E-08
Th-230	2.274E-08	0.000E+00	0.000E+00	0.000E+00	3.234E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	3.234E-04
U-234	2.523E-03	0.000E+00	0.000E+00	0.000E+00	3.589E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	3.589E+01
U-235	3.472E-05	0.000E+00	0.000E+00	0.000E+00	4.938E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	4.938E-01
U-238	1.794E-03	0.000E+00	0.000E+00	0.000E+00	2.551E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.551E+01

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

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	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	2.723E-06	2.658E-08	1.988E-11	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	2.723E-06	2.658E-08	1.988E-11	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

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

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 Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Ac-227	1.269E-11	0.0000	1.127E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.918E-13	0.0000
Pa-231	5.406E-12	0.0000	1.818E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.669E-13	0.0000
Pb-210	3.378E-15	0.0000	1.496E-16	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.381E-13	0.0000
Ra-226	3.863E-11	0.0000	7.934E-16	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.055E-13	0.0000
Th-230	1.019E-12	0.0000	2.560E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.274E-11	0.0000
U-234	2.566E-09	0.0025	1.703E-09	0.0016	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.321E-08	0.0797
U-235	7.509E-08	0.0719	2.108E-11	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.171E-09	0.0011
U-238	8.043E-07	0.7705	1.029E-09	0.0010	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.472E-08	0.0716
Total	8.820E-07	0.8449	2.754E-09	0.0026	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.591E-07	0.1524

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 risk	Water fract.	Fish risk	Fish fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	All Pathways** risk	All Pathways** fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.319E-11	0.0000
Pa-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.191E-12	0.0000
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.416E-13	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.883E-11	0.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.402E-11	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	0.0000	8.748E-08	0.0838
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	7.628E-08	0.0731
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	8.800E-07	0.8431
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	1.044E-06	1.0000

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

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	Radionuclides Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	2.790E-14	5.597E-16	7.017E-19	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	2.790E-14	5.597E-16	7.017E-19	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

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

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 Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground risk	Ground fract.	Inhalation risk	Inhalation fract.	Radon risk	Radon fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	Soil risk	Soil fract.
U-234	2.606E-09	0.0025	1.703E-09	0.0016	2.846E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.322E-08	0.0797
U-235	7.510E-08	0.0720	2.111E-11	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.172E-09	0.0011
U-238	8.043E-07	0.7705	1.029E-09	0.0010	3.705E-19	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.472E-08	0.0716
Total	8.820E-07	0.8449	2.754E-09	0.0026	2.846E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.591E-07	0.1524

Intrisk : Construction Worker Receptor
File : C:\RESRAD_FAMILY\RESRAD\USERFILES\SITE1.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+00 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	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	8.753E-08	0.0839
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	7.630E-08	0.0731
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	8.800E-07	0.8431
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.044E-06	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= 3.000E+00 years

Radio-	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total
Nuclide	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
Ac-227	1.011E-10	0.000E+00	0.000E+00	0.000E+00	1.439E-06	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.439E-06
Pa-231	2.194E-09	0.000E+00	0.000E+00	0.000E+00	3.120E-05	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	3.120E-05
Pb-210	1.342E-12	0.000E+00	0.000E+00	0.000E+00	1.909E-08	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.909E-08
Ra-226	4.419E-11	0.000E+00	0.000E+00	0.000E+00	6.284E-07	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	6.284E-07
Th-230	6.806E-08	0.000E+00	0.000E+00	0.000E+00	9.680E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	9.680E-04
U-234	2.511E-03	0.000E+00	0.000E+00	0.000E+00	3.572E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	3.572E+01
U-235	3.456E-05	0.000E+00	0.000E+00	0.000E+00	4.915E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	4.915E-01
U-238	1.786E-03	0.000E+00	0.000E+00	0.000E+00	2.540E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.540E+01

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

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	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	2.443E-05	2.384E-07	1.784E-10	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	2.443E-05	2.384E-07	1.784E-10	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

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

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 Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Ac-227	1.553E-11	0.0000	1.380E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.019E-13	0.0000
Pa-231	6.185E-12	0.0000	2.080E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.774E-13	0.0000
Pb-210	4.482E-15	0.0000	1.985E-16	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.160E-13	0.0000
Ra-226	4.808E-11	0.0000	9.875E-16	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.557E-13	0.0000
Th-230	1.168E-12	0.0000	2.934E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.460E-11	0.0000
U-234	2.554E-09	0.0025	1.695E-09	0.0016	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.282E-08	0.0797
U-235	7.473E-08	0.0719	2.098E-11	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.165E-09	0.0011
U-238	8.005E-07	0.7705	1.024E-09	0.0010	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.437E-08	0.0716
Total	8.778E-07	0.8449	2.741E-09	0.0026	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.584E-07	0.1524

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 risk	Water fract.	Fish risk	Fish fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	All Pathways** risk	All Pathways** fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.614E-11	0.0000
Pa-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.083E-12	0.0000
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.207E-13	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.833E-11	0.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.607E-11	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	0.0000	8.707E-08	0.0838
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	7.592E-08	0.0731
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	8.759E-07	0.8430
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	1.039E-06	1.0000

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

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

Radon Pathway	Radionuclides Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	3.472E-14	6.966E-16	8.733E-19	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	3.472E-14	6.966E-16	8.733E-19	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

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

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 risk	Ground fract.	Inhalation risk	Inhalation fract.	Radon risk	Radon fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	Soil risk	Soil fract.
U-234	2.603E-09	0.0025	1.695E-09	0.0016	3.542E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.283E-08	0.0797
U-235	7.476E-08	0.0720	2.101E-11	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.167E-09	0.0011
U-238	8.005E-07	0.7705	1.025E-09	0.0010	4.968E-19	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.437E-08	0.0716
Total	8.778E-07	0.8449	2.741E-09	0.0026	3.542E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.584E-07	0.1524

Intrisk : Construction Worker Receptor
File : C:\RESRAD_FAMILY\RESRAD\USERFILES\SITE1.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+00 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	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	8.713E-08	0.0839
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	7.594E-08	0.0731
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	8.759E-07	0.8430
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.039E-06	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+01 years

Radio-	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total
Nuclide	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
Ac-227	1.021E-09	0.000E+00	0.000E+00	0.000E+00	1.452E-05	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.452E-05
Pa-231	7.192E-09	0.000E+00	0.000E+00	0.000E+00	1.023E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.023E-04
Pb-210	4.669E-11	0.000E+00	0.000E+00	0.000E+00	6.641E-07	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	6.641E-07
Ra-226	4.859E-10	0.000E+00	0.000E+00	0.000E+00	6.910E-06	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	6.910E-06
Th-230	2.250E-07	0.000E+00	0.000E+00	0.000E+00	3.200E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	3.200E-03
U-234	2.470E-03	0.000E+00	0.000E+00	0.000E+00	3.513E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	3.513E+01
U-235	3.400E-05	0.000E+00	0.000E+00	0.000E+00	4.835E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	4.835E-01
U-238	1.756E-03	0.000E+00	0.000E+00	0.000E+00	2.498E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.498E+01

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

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	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	2.685E-04	2.621E-06	1.961E-09	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	2.685E-04	2.621E-06	1.961E-09	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

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

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-	Ground		Inhalation		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Ac-227	2.764E-11	0.0000	2.456E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.071E-12	0.0000
Pa-231	8.853E-12	0.0000	2.977E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.256E-12	0.0000
Pb-210	1.037E-14	0.0000	4.590E-16	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.309E-13	0.0000
Ra-226	9.106E-11	0.0001	1.870E-15	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.843E-13	0.0000
Th-230	1.684E-12	0.0000	4.229E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.105E-11	0.0000
U-234	2.513E-09	0.0025	1.667E-09	0.0016	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.147E-08	0.0797
U-235	7.351E-08	0.0719	2.064E-11	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.146E-09	0.0011
U-238	7.874E-07	0.7704	1.008E-09	0.0010	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.315E-08	0.0716
Total	8.636E-07	0.8449	2.696E-09	0.0026	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.558E-07	0.1524

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 risk	Water fract.	Fish risk	Fish fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	All Pathways** risk	All Pathways** fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.873E-11	0.0000
Pa-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.014E-11	0.0000
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.417E-13	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.154E-11	0.0001
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.316E-11	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	0.0000	8.565E-08	0.0838
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	7.468E-08	0.0731
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	8.616E-07	0.8430
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	1.022E-06	1.0000

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

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	Radionuclides Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	6.574E-14	1.319E-15	1.653E-18	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	6.574E-14	1.319E-15	1.653E-18	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

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

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 Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground risk	Ground fract.	Inhalation risk	Inhalation fract.	Radon risk	Radon fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	Soil risk	Soil fract.
U-234	2.605E-09	0.0025	1.668E-09	0.0016	6.706E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.148E-08	0.0797
U-235	7.355E-08	0.0720	2.069E-11	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.149E-09	0.0011
U-238	7.874E-07	0.7704	1.008E-09	0.0010	1.193E-18	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.316E-08	0.0716
Total	8.636E-07	0.8449	2.696E-09	0.0026	6.706E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.558E-07	0.1524

Intrisk : Construction Worker Receptor
File : C:\RESRAD_FAMILY\RESRAD\USERFILES\SITE1.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+01 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	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	8.576E-08	0.0839
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	7.472E-08	0.0731
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	8.616E-07	0.8430
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.022E-06	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= 3.000E+01 years

Radio-	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total
Nuclide	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
Ac-227	7.112E-09	0.000E+00	0.000E+00	0.000E+00	1.011E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.011E-04
Pa-231	2.058E-08	0.000E+00	0.000E+00	0.000E+00	2.927E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.927E-04
Pb-210	1.063E-09	0.000E+00	0.000E+00	0.000E+00	1.512E-05	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.512E-05
Ra-226	4.245E-09	0.000E+00	0.000E+00	0.000E+00	6.037E-05	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	6.037E-05
Th-230	6.594E-07	0.000E+00	0.000E+00	0.000E+00	9.378E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	9.378E-03
U-234	2.357E-03	0.000E+00	0.000E+00	0.000E+00	3.352E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	3.352E+01
U-235	3.243E-05	0.000E+00	0.000E+00	0.000E+00	4.613E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	4.613E-01
U-238	1.676E-03	0.000E+00	0.000E+00	0.000E+00	2.383E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.383E+01

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

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	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	2.343E-03	2.286E-05	1.711E-08	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	2.343E-03	2.286E-05	1.711E-08	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

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

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 Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Ac-227	7.412E-11	0.0001	6.586E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.873E-12	0.0000
Pa-231	1.599E-11	0.0000	5.378E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.269E-12	0.0000
Pb-210	5.034E-14	0.0000	2.229E-15	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.549E-12	0.0000
Ra-226	2.950E-10	0.0003	6.060E-15	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.569E-12	0.0000
Th-230	3.111E-12	0.0000	7.814E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.890E-11	0.0000
U-234	2.397E-09	0.0025	1.591E-09	0.0016	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.772E-08	0.0797
U-235	7.014E-08	0.0719	1.969E-11	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.094E-09	0.0011
U-238	7.513E-07	0.7702	9.615E-10	0.0010	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.979E-08	0.0716
Total	8.242E-07	0.8450	2.573E-09	0.0026	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.487E-07	0.1524

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 risk	Water fract.	Fish risk	Fish fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	All Pathways** risk	All Pathways** fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.706E-11	0.0001
Pa-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.831E-11	0.0000
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.602E-12	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.966E-10	0.0003
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.279E-11	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	0.0000	8.171E-08	0.0838
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	7.125E-08	0.0730
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	8.220E-07	0.8427
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	9.754E-07	1.0000

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

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

Radon Pathway	Radionuclides Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	2.123E-13	4.258E-15	5.338E-18	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	2.123E-13	4.258E-15	5.338E-18	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

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

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 risk	Ground fract.	Inhalation risk	Inhalation fract.	Radon risk	Radon fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	Soil risk	Soil fract.
U-234	2.695E-09	0.0028	1.591E-09	0.0016	2.165E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.776E-08	0.0797
U-235	7.023E-08	0.0720	1.981E-11	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.099E-09	0.0011
U-238	7.513E-07	0.7702	9.616E-10	0.0010	6.452E-18	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.980E-08	0.0716
Total	8.242E-07	0.8450	2.573E-09	0.0026	2.165E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.487E-07	0.1524

Intrisk : Construction Worker Receptor
File : C:\RESRAD_FAMILY\RESRAD\USERFILES\SITE1.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+01 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	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	8.205E-08	0.0841
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	7.135E-08	0.0731
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	8.220E-07	0.8427
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	9.754E-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+02 years

Radio-	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total
Nuclide	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
Ac-227	3.802E-08	0.000E+00	0.000E+00	0.000E+00	5.407E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	5.407E-04
Pa-231	5.815E-08	0.000E+00	0.000E+00	0.000E+00	8.271E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	8.271E-04
Pb-210	2.369E-08	0.000E+00	0.000E+00	0.000E+00	3.369E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	3.369E-04
Ra-226	4.254E-08	0.000E+00	0.000E+00	0.000E+00	6.050E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	6.050E-04
Th-230	2.028E-06	0.000E+00	0.000E+00	0.000E+00	2.884E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.884E-02
U-234	1.999E-03	0.000E+00	0.000E+00	0.000E+00	2.843E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.843E+01
U-235	2.751E-05	0.000E+00	0.000E+00	0.000E+00	3.913E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	3.913E-01
U-238	1.422E-03	0.000E+00	0.000E+00	0.000E+00	2.022E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.022E+01

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

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	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	2.327E-02	2.271E-04	1.699E-07	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	2.327E-02	2.271E-04	1.699E-07	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

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

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 Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Ac-227	2.580E-10	0.0003	2.292E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.000E-11	0.0000
Pa-231	3.595E-11	0.0000	1.209E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.100E-12	0.0000
Pb-210	5.440E-13	0.0000	2.409E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.835E-11	0.0000
Ra-226	1.824E-09	0.0022	3.747E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.703E-12	0.0000
Th-230	7.608E-12	0.0000	1.911E-12	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.512E-11	0.0001
U-234	2.033E-09	0.0025	1.349E-09	0.0016	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.593E-08	0.0795
U-235	5.950E-08	0.0717	1.670E-11	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.277E-10	0.0011
U-238	6.373E-07	0.7684	8.156E-10	0.0010	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.921E-08	0.0714
Total	7.010E-07	0.8452	2.184E-09	0.0026	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.262E-07	0.1522

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 risk	Water fract.	Fish risk	Fish fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	All Pathways** risk	All Pathways** fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.682E-10	0.0003
Pa-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.117E-11	0.0000
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.892E-11	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.834E-09	0.0022
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.046E-10	0.0001
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	6.931E-08	0.0836
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	6.044E-08	0.0729
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	6.973E-07	0.8408
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	8.294E-07	1.0000

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

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	Radionuclides Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	1.303E-12	2.615E-14	3.278E-17	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	1.303E-12	2.615E-14	3.278E-17	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

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

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 Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground risk	Ground fract.	Inhalation risk	Inhalation fract.	Radon risk	Radon fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	Soil risk	Soil fract.
U-234	3.865E-09	0.0047	1.351E-09	0.0016	1.330E-12	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.606E-08	0.0796
U-235	5.979E-08	0.0721	1.705E-11	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.428E-10	0.0011
U-238	6.373E-07	0.7684	8.159E-10	0.0010	9.875E-17	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.922E-08	0.0714
Total	7.010E-07	0.8452	2.184E-09	0.0026	1.330E-12	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.262E-07	0.1522

Intrisk : Construction Worker Receptor
File : C:\RESRAD_FAMILY\RESRAD\USERFILES\SITE1.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+02 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	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	7.128E-08	0.0859
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	6.075E-08	0.0733
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	6.973E-07	0.8408
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.294E-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= 3.000E+02 years

Radio-	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total
Nuclide	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
Ac-227	8.883E-08	0.000E+00	0.000E+00	0.000E+00	1.263E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.263E-03
Pa-231	1.088E-07	0.000E+00	0.000E+00	0.000E+00	1.547E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.547E-03
Pb-210	2.337E-07	0.000E+00	0.000E+00	0.000E+00	3.324E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	3.324E-03
Ra-226	2.873E-07	0.000E+00	0.000E+00	0.000E+00	4.087E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	4.087E-03
Th-230	4.891E-06	0.000E+00	0.000E+00	0.000E+00	6.957E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	6.957E-02
U-234	1.249E-03	0.000E+00	0.000E+00	0.000E+00	1.777E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.777E+01
U-235	1.720E-05	0.000E+00	0.000E+00	0.000E+00	2.446E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.446E-01
U-238	8.885E-04	0.000E+00	0.000E+00	0.000E+00	1.264E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.264E+01

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

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	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	1.541E-01	1.504E-03	1.125E-06	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	1.541E-01	1.504E-03	1.125E-06	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

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

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 Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Ac-227	5.402E-10	0.0010	4.799E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.094E-11	0.0000
Pa-231	6.232E-11	0.0001	2.096E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.841E-12	0.0000
Pb-210	4.364E-12	0.0000	1.932E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.077E-10	0.0006
Ra-226	1.054E-08	0.0199	2.165E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.608E-11	0.0001
Th-230	1.702E-11	0.0000	4.274E-12	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.128E-10	0.0004
U-234	1.271E-09	0.0024	8.432E-10	0.0016	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.120E-08	0.0779
U-235	3.719E-08	0.0703	1.044E-11	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.798E-10	0.0011
U-238	3.983E-07	0.7534	5.098E-10	0.0010	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.700E-08	0.0700
Total	4.479E-07	0.8472	1.369E-09	0.0026	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.939E-08	0.1502

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 risk	Water fract.	Fish risk	Fish fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	All Pathways** risk	All Pathways** fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.616E-10	0.0011
Pa-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.137E-11	0.0001
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.122E-10	0.0006
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.060E-08	0.0200
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.341E-10	0.0004
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	4.331E-08	0.0819
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	3.778E-08	0.0715
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	4.358E-07	0.8243
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	5.287E-07	1.0000

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

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	Radionuclides Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	7.382E-12	1.481E-13	1.857E-16	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	7.382E-12	1.481E-13	1.857E-16	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

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

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 Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground risk	Ground fract.	Inhalation risk	Inhalation fract.	Radon risk	Radon fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	Soil risk	Soil fract.
U-234	1.183E-08	0.0224	8.474E-10	0.0016	7.529E-12	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.175E-08	0.0790
U-235	3.779E-08	0.0715	1.113E-11	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.096E-10	0.0012
U-238	3.983E-07	0.7534	5.103E-10	0.0010	1.473E-15	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.703E-08	0.0700
Total	4.479E-07	0.8472	1.369E-09	0.0026	7.530E-12	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.939E-08	0.1502

Intrisk : Construction Worker Receptor
File : C:\RESRAD_FAMILY\RESRAD\USERFILES\SITE1.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-	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	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	5.443E-08	0.1030
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	3.841E-08	0.0727
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	4.358E-07	0.8244
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	5.287E-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-	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total
Nuclide	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
Ac-227	6.086E-08	0.000E+00	0.000E+00	0.000E+00	8.656E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	8.656E-04
Pa-231	6.948E-08	0.000E+00	0.000E+00	0.000E+00	9.882E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	9.882E-04
Pb-210	1.208E-06	0.000E+00	0.000E+00	0.000E+00	1.718E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.718E-02
Ra-226	1.287E-06	0.000E+00	0.000E+00	0.000E+00	1.831E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.831E-02
Th-230	8.696E-06	0.000E+00	0.000E+00	0.000E+00	1.237E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.237E-01
U-234	2.410E-04	0.000E+00	0.000E+00	0.000E+00	3.427E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	3.427E+00
U-235	3.319E-06	0.000E+00	0.000E+00	0.000E+00	4.720E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	4.720E-02
U-238	1.715E-04	0.000E+00	0.000E+00	0.000E+00	2.439E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.439E+00

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

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	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	5.678E-01	5.542E-03	4.146E-06	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	5.678E-01	5.542E-03	4.146E-06	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

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

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-	Ground		Inhalation		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Ac-227	3.585E-10	0.0024	3.185E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.390E-11	0.0001
Pa-231	3.869E-11	0.0003	1.301E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.489E-12	0.0000
Pb-210	2.120E-11	0.0001	9.386E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.494E-09	0.0102
Ra-226	4.474E-08	0.3042	9.189E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.380E-10	0.0016
Th-230	2.952E-11	0.0002	7.413E-12	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.690E-10	0.0025
U-234	2.451E-10	0.0017	1.626E-10	0.0011	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.946E-09	0.0540
U-235	7.176E-09	0.0488	2.014E-12	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.119E-10	0.0008
U-238	7.687E-08	0.5227	9.838E-11	0.0007	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.141E-09	0.0486
Total	1.295E-07	0.8804	2.727E-10	0.0019	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.732E-08	0.1178

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 risk	Water fract.	Fish risk	Fish fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	All Pathways** risk	All Pathways** fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.727E-10	0.0025
Pa-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.431E-11	0.0003
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.517E-09	0.0103
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.497E-08	0.3058
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.060E-10	0.0028
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	8.354E-09	0.0568
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	7.290E-09	0.0496
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	8.411E-08	0.5719
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	1.471E-07	1.0000

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

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

Radon Pathway	Radionuclides Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	2.563E-11	5.142E-13	6.447E-16	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	2.563E-11	5.142E-13	6.447E-16	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

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

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 Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground risk	Ground fract.	Inhalation risk	Inhalation fract.	Radon risk	Radon fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	Soil risk	Soil fract.
U-234	4.501E-08	0.3060	1.716E-10	0.0012	2.613E-11	0.0002	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.003E-08	0.0682
U-235	7.574E-09	0.0515	2.463E-12	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.313E-10	0.0009
U-238	7.689E-08	0.5227	9.871E-11	0.0007	1.373E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.158E-09	0.0487
Total	1.295E-07	0.8802	2.727E-10	0.0019	2.615E-11	0.0002	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.732E-08	0.1177

Intrisk : Construction Worker Receptor
File : C:\RESRAD_FAMILY\RESRAD\USERFILES\SITE1.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-	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	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	5.524E-08	0.3755
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	7.707E-09	0.0524
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	8.415E-08	0.5721
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.471E-07	1.0000

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

RESRAD
CHILD COMMUTER

Uranium Soils Investigation
Baseline Human Health Risk Assessment
Saddle Road
October 2009

Table of Contents

Part III: Intake Quantities and Health Risk Factors

Cancer Risk Slope Factors Summary Table
Risk Library: FGR 13 Morbidity

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	2.13E-07	1.49E-07	SLPF(1,2)
Sf-2	Pa-231	7.62E-08	7.62E-08	SLPF(2,2)
Sf-2	Pb-210+D	3.08E-08	1.58E-08	SLPF(3,2)
Sf-2	Ra-226+D	2.83E-08	2.82E-08	SLPF(4,2)
Sf-2	Th-230	3.40E-08	3.40E-08	SLPF(5,2)
Sf-2	U-234	2.78E-08	2.78E-08	SLPF(6,2)
Sf-2	U-235+D	2.50E-08	2.50E-08	SLPF(7,2)
Sf-2	U-238	2.36E-08	2.36E-08	SLPF(8,2)
Sf-2	U-238+D	2.36E-08	2.36E-08	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	2.66E-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	6.53E-10	2.45E-10	SLPF(1,5)
Sf-3	Pa-231	2.26E-10	2.26E-10	SLPF(2,5)
Sf-3	Pb-210+D	3.44E-09	1.18E-09	SLPF(3,5)
Sf-3	Ra-226+D	5.15E-10	5.14E-10	SLPF(4,5)
Sf-3	Th-230	1.19E-10	1.19E-10	SLPF(5,5)
Sf-3	U-234	9.55E-11	9.55E-11	SLPF(6,5)

Cancer Risk Slope Factors Summary Table (continued)

Risk Library: FGR 13 Morbidity

Menu	Parameter	Current Value	Base Case*	Parameter Name
Sf-3	U-235+D	9.76E-11	9.44E-11	SLPF(7,5)
Sf-3	U-238	8.66E-11	8.66E-11	SLPF(8,5)
Sf-3	U-238+D	1.21E-10	8.66E-11	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.

Risk Slope and Environmental Transport Factors for the Ground Pathway

Nuclide (i)	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	9.567E-01	9.567E-01	9.567E-01	9.567E-01	9.567E-01	9.567E-01	9.567E-01	9.567E-01
At-218	3.570E-09	9.702E-01	9.702E-01	9.702E-01	9.702E-01	9.702E-01	9.702E-01	9.702E-01	9.702E-01
Bi-210	2.760E-09	9.450E-01	9.450E-01	9.450E-01	9.450E-01	9.450E-01	9.450E-01	9.450E-01	9.450E-01
Bi-211	1.880E-07	9.453E-01	9.453E-01	9.453E-01	9.453E-01	9.453E-01	9.453E-01	9.453E-01	9.453E-01
Bi-214	7.480E-06	9.401E-01	9.401E-01	9.401E-01	9.401E-01	9.401E-01	9.401E-01	9.401E-01	9.400E-01
Fr-223	1.400E-07	9.502E-01	9.502E-01	9.502E-01	9.502E-01	9.502E-01	9.502E-01	9.502E-01	9.502E-01
Pa-231	1.390E-07	9.456E-01	9.456E-01	9.456E-01	9.456E-01	9.456E-01	9.456E-01	9.456E-01	9.456E-01
Pa-234	8.710E-06	9.400E-01	9.400E-01	9.400E-01	9.400E-01	9.400E-01	9.400E-01	9.400E-01	9.400E-01
Pa-234m	6.870E-08	9.393E-01	9.393E-01	9.393E-01	9.393E-01	9.393E-01	9.393E-01	9.393E-01	9.393E-01
Pb-210	1.410E-09	9.813E-01	9.813E-01	9.813E-01	9.813E-01	9.813E-01	9.813E-01	9.813E-01	9.813E-01
Pb-211	2.290E-07	9.399E-01	9.399E-01	9.399E-01	9.399E-01	9.399E-01	9.399E-01	9.399E-01	9.399E-01
Pb-214	9.820E-07	9.456E-01	9.456E-01	9.456E-01	9.456E-01	9.456E-01	9.456E-01	9.456E-01	9.456E-01
Po-210	3.950E-11	9.390E-01	9.390E-01	9.390E-01	9.390E-01	9.390E-01	9.390E-01	9.390E-01	9.390E-01
Po-211	3.580E-08	9.360E-01	9.360E-01	9.360E-01	9.360E-01	9.360E-01	9.360E-01	9.360E-01	9.360E-01
Po-214	3.860E-10	9.360E-01	9.360E-01	9.360E-01	9.360E-01	9.360E-01	9.360E-01	9.360E-01	9.360E-01
Po-215	7.480E-10	9.410E-01	9.410E-01	9.410E-01	9.410E-01	9.410E-01	9.410E-01	9.410E-01	9.410E-01
Po-218	4.260E-11	9.390E-01	9.390E-01	9.390E-01	9.390E-01	9.390E-01	9.390E-01	9.390E-01	9.390E-01
Ra-223	4.340E-07	9.496E-01	9.496E-01	9.496E-01	9.496E-01	9.496E-01	9.496E-01	9.496E-01	9.496E-01
Ra-226	2.290E-08	9.524E-01	9.524E-01	9.524E-01	9.524E-01	9.524E-01	9.524E-01	9.524E-01	9.524E-01
Rn-219	2.250E-07	9.461E-01	9.461E-01	9.461E-01	9.461E-01	9.461E-01	9.461E-01	9.461E-01	9.461E-01
Rn-222	1.740E-09	9.370E-01	9.370E-01	9.370E-01	9.370E-01	9.370E-01	9.370E-01	9.370E-01	9.370E-01
Th-227	3.780E-07	9.508E-01	9.508E-01	9.508E-01	9.508E-01	9.508E-01	9.508E-01	9.508E-01	9.508E-01
Th-230	8.190E-10	9.588E-01	9.588E-01	9.588E-01	9.588E-01	9.588E-01	9.588E-01	9.588E-01	9.588E-01
Th-231	2.450E-08	9.599E-01	9.599E-01	9.599E-01	9.599E-01	9.599E-01	9.599E-01	9.599E-01	9.599E-01
Th-234	1.630E-08	9.610E-01	9.610E-01	9.610E-01	9.610E-01	9.610E-01	9.610E-01	9.610E-01	9.610E-01
Tl-207	1.520E-08	9.403E-01	9.403E-01	9.403E-01	9.403E-01	9.403E-01	9.403E-01	9.403E-01	9.403E-01
Tl-210	0.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-234	2.520E-10	9.643E-01	9.643E-01	9.643E-01	9.643E-01	9.643E-01	9.643E-01	9.643E-01	9.643E-01
U-235	5.180E-07	9.520E-01	9.520E-01	9.520E-01	9.520E-01	9.520E-01	9.520E-01	9.520E-01	9.520E-01
U-238	4.990E-11	9.912E-01	9.912E-01	9.912E-01	9.912E-01	9.912E-01	9.912E-01	9.912E-01	9.912E-01

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

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-	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total
Nuclide	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
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	5.313E-03	0.000E+00	0.000E+00	0.000E+00	3.052E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	3.052E+01
U-235	7.312E-05	0.000E+00	0.000E+00	0.000E+00	4.200E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	4.200E-01
U-238	3.778E-03	0.000E+00	0.000E+00	0.000E+00	2.170E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.170E+01

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

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	Radionuclides							
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

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 Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Ac-227	1.899E-13	0.0000	3.545E-16	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.246E-15	0.0000
Pa-231	2.975E-13	0.0000	2.102E-15	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.581E-14	0.0000
Pb-210	1.101E-17	0.0000	1.024E-18	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.585E-16	0.0000
Ra-226	4.854E-13	0.0000	2.095E-17	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.191E-15	0.0000
Th-230	5.521E-14	0.0000	2.913E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.857E-13	0.0000
U-234	6.312E-10	0.0025	8.800E-10	0.0035	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.737E-08	0.0690
U-235	1.847E-08	0.0734	1.089E-11	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.443E-10	0.0010
U-238	1.978E-07	0.7864	5.319E-10	0.0021	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.559E-08	0.0620
Total	2.169E-07	0.8623	1.423E-09	0.0057	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.320E-08	0.1320

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-	Water		Fish		Plant		Meat		Milk		All Pathways**	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.965E-13	0.0000
Pa-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.354E-13	0.0000
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.705E-16	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.876E-13	0.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.701E-13	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	0.0000	1.888E-08	0.0750
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	1.872E-08	0.0744
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	2.139E-07	0.8505
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	2.515E-07	1.0000

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

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

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	7.374E-16	1.479E-17	1.855E-20	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	7.374E-16	1.479E-17	1.855E-20	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

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

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-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
U-234	6.317E-10	0.0025	8.801E-10	0.0035	7.522E-16	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.737E-08	0.0690
U-235	1.847E-08	0.0734	1.089E-11	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.444E-10	0.0010
U-238	1.978E-07	0.7864	5.319E-10	0.0021	2.271E-21	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.559E-08	0.0620
Total	2.169E-07	0.8623	1.423E-09	0.0057	7.522E-16	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.320E-08	0.1320

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-	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	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	1.888E-08	0.0750
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	1.872E-08	0.0744
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	2.139E-07	0.8505
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	2.515E-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+00 years

Radio-	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total
Nuclide	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
Ac-227	2.428E-11	0.000E+00	0.000E+00	0.000E+00	1.395E-07	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.395E-07
Pa-231	1.543E-09	0.000E+00	0.000E+00	0.000E+00	8.866E-06	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	8.866E-06
Pb-210	1.064E-13	0.000E+00	0.000E+00	0.000E+00	6.110E-10	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	6.110E-10
Ra-226	1.034E-11	0.000E+00	0.000E+00	0.000E+00	5.942E-08	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	5.942E-08
Th-230	4.777E-08	0.000E+00	0.000E+00	0.000E+00	2.744E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.744E-04
U-234	5.301E-03	0.000E+00	0.000E+00	0.000E+00	3.045E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	3.045E+01
U-235	7.295E-05	0.000E+00	0.000E+00	0.000E+00	4.190E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	4.190E-01
U-238	3.769E-03	0.000E+00	0.000E+00	0.000E+00	2.165E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.165E+01

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

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	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	5.721E-06	5.583E-08	4.177E-11	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	5.721E-06	5.583E-08	4.177E-11	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

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

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 Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Ac-227	2.975E-13	0.0000	5.554E-16	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.786E-15	0.0000
Pa-231	3.960E-13	0.0000	2.798E-15	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.766E-14	0.0000
Pb-210	2.024E-17	0.0000	1.883E-18	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.211E-15	0.0000
Ra-226	7.677E-13	0.0000	3.313E-17	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.465E-15	0.0000
Th-230	7.355E-14	0.0000	3.881E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.803E-13	0.0000
U-234	6.297E-10	0.0025	8.780E-10	0.0035	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.732E-08	0.0690
U-235	1.843E-08	0.0734	1.087E-11	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.438E-10	0.0010
U-238	1.974E-07	0.7864	5.306E-10	0.0021	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.556E-08	0.0620
Total	2.164E-07	0.8623	1.419E-09	0.0057	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.313E-08	0.1320

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-	Water		Fish		Plant		Meat		Milk		All Pathways**	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.079E-13	0.0000
Pa-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.465E-13	0.0000
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.233E-15	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.712E-13	0.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.926E-13	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	0.0000	1.883E-08	0.0750
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	1.868E-08	0.0744
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	2.134E-07	0.8505
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	2.510E-07	1.0000

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

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	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	1.166E-15	2.339E-17	2.933E-20	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	1.166E-15	2.339E-17	2.933E-20	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

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

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 Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
U-234	6.306E-10	0.0025	8.780E-10	0.0035	1.190E-15	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.733E-08	0.0690
U-235	1.843E-08	0.0734	1.087E-11	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.438E-10	0.0010
U-238	1.974E-07	0.7864	5.306E-10	0.0021	4.199E-21	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.556E-08	0.0620
Total	2.164E-07	0.8623	1.419E-09	0.0057	1.190E-15	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.313E-08	0.1320

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-	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	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	1.883E-08	0.0750
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	1.868E-08	0.0744
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	2.134E-07	0.8505
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	2.510E-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= 3.000E+00 years

Radio-	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total
Nuclide	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
Ac-227	2.125E-10	0.000E+00	0.000E+00	0.000E+00	1.221E-06	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.221E-06
Pa-231	4.608E-09	0.000E+00	0.000E+00	0.000E+00	2.647E-05	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.647E-05
Pb-210	2.820E-12	0.000E+00	0.000E+00	0.000E+00	1.620E-08	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.620E-08
Ra-226	9.283E-11	0.000E+00	0.000E+00	0.000E+00	5.332E-07	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	5.332E-07
Th-230	1.430E-07	0.000E+00	0.000E+00	0.000E+00	8.213E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	8.213E-04
U-234	5.276E-03	0.000E+00	0.000E+00	0.000E+00	3.031E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	3.031E+01
U-235	7.260E-05	0.000E+00	0.000E+00	0.000E+00	4.170E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	4.170E-01
U-238	3.751E-03	0.000E+00	0.000E+00	0.000E+00	2.155E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.155E+01

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

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	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	5.133E-05	5.009E-07	3.748E-10	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	5.133E-05	5.009E-07	3.748E-10	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

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

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 Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Ac-227	5.970E-13	0.0000	1.114E-15	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.964E-14	0.0000
Pa-231	5.915E-13	0.0000	4.179E-15	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.120E-14	0.0000
Pb-210	5.384E-17	0.0000	5.008E-18	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.221E-15	0.0000
Ra-226	1.572E-12	0.0000	6.783E-17	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.095E-15	0.0000
Th-230	1.101E-13	0.0000	5.810E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.168E-12	0.0000
U-234	6.268E-10	0.0025	8.738E-10	0.0035	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.724E-08	0.0690
U-235	1.834E-08	0.0734	1.081E-11	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.426E-10	0.0010
U-238	1.964E-07	0.7864	5.281E-10	0.0021	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.548E-08	0.0620
Total	2.154E-07	0.8623	1.413E-09	0.0057	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.297E-08	0.1320

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-	Water		Fish		Plant		Meat		Milk		All Pathways**	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.178E-13	0.0000
Pa-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.669E-13	0.0000
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.279E-15	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.579E-12	0.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.336E-12	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	0.0000	1.874E-08	0.0750
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	1.859E-08	0.0744
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	2.124E-07	0.8505
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	2.498E-07	1.0000

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

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

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	2.387E-15	4.790E-17	6.005E-20	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	2.387E-15	4.790E-17	6.005E-20	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

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

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-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
U-234	6.284E-10	0.0025	8.739E-10	0.0035	2.435E-15	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.724E-08	0.0690
U-235	1.834E-08	0.0734	1.082E-11	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.427E-10	0.0010
U-238	1.964E-07	0.7864	5.281E-10	0.0021	1.130E-20	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.548E-08	0.0620
Total	2.154E-07	0.8623	1.413E-09	0.0057	2.435E-15	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.297E-08	0.1320

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-	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	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	1.875E-08	0.0751
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	1.859E-08	0.0744
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	2.124E-07	0.8505
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	2.498E-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+01 years

Radio-	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total
Nuclide	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
Ac-227	2.145E-09	0.000E+00	0.000E+00	0.000E+00	1.232E-05	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.232E-05
Pa-231	1.511E-08	0.000E+00	0.000E+00	0.000E+00	8.679E-05	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	8.679E-05
Pb-210	9.809E-11	0.000E+00	0.000E+00	0.000E+00	5.635E-07	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	5.635E-07
Ra-226	1.021E-09	0.000E+00	0.000E+00	0.000E+00	5.863E-06	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	5.863E-06
Th-230	4.727E-07	0.000E+00	0.000E+00	0.000E+00	2.715E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.715E-03
U-234	5.190E-03	0.000E+00	0.000E+00	0.000E+00	2.981E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.981E+01
U-235	7.142E-05	0.000E+00	0.000E+00	0.000E+00	4.102E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	4.102E-01
U-238	3.690E-03	0.000E+00	0.000E+00	0.000E+00	2.120E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.120E+01

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

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	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	5.641E-04	5.506E-06	4.119E-09	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	5.641E-04	5.506E-06	4.119E-09	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

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

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-	Ground		Inhalation		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Ac-227	2.412E-12	0.0000	4.502E-15	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.933E-14	0.0000
Pa-231	1.261E-12	0.0000	8.912E-15	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.518E-13	0.0000
Pb-210	4.361E-16	0.0000	4.057E-17	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.609E-14	0.0000
Ra-226	6.866E-12	0.0000	2.963E-16	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.099E-14	0.0000
Th-230	2.367E-13	0.0000	1.249E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.511E-12	0.0000
U-234	6.165E-10	0.0025	8.596E-10	0.0035	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.696E-08	0.0690
U-235	1.804E-08	0.0734	1.064E-11	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.387E-10	0.0010
U-238	1.932E-07	0.7864	5.195E-10	0.0021	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.523E-08	0.0620
Total	2.119E-07	0.8623	1.390E-09	0.0057	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.243E-08	0.1320

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-	Water		Fish		Plant		Meat		Milk		All Pathways**	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.496E-12	0.0000
Pa-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.422E-12	0.0000
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.656E-14	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.897E-12	0.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.872E-12	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	0.0000	1.844E-08	0.0750
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	1.829E-08	0.0744
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	2.090E-07	0.8505
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	2.457E-07	1.0000

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

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	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	1.042E-14	2.091E-16	2.621E-19	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	1.042E-14	2.091E-16	2.621E-19	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

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

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 Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
U-234	6.236E-10	0.0025	8.597E-10	0.0035	1.063E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.696E-08	0.0690
U-235	1.804E-08	0.0734	1.065E-11	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.389E-10	0.0010
U-238	1.932E-07	0.7864	5.195E-10	0.0021	9.579E-20	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.523E-08	0.0620
Total	2.119E-07	0.8623	1.390E-09	0.0057	1.063E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.243E-08	0.1320

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-	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	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	1.845E-08	0.0751
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	1.829E-08	0.0744
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	2.090E-07	0.8505
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	2.457E-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= 3.000E+01 years

Radio-	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total
Nuclide	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
Ac-227	1.494E-08	0.000E+00	0.000E+00	0.000E+00	8.582E-05	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	8.582E-05
Pa-231	4.324E-08	0.000E+00	0.000E+00	0.000E+00	2.484E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.484E-04
Pb-210	2.234E-09	0.000E+00	0.000E+00	0.000E+00	1.283E-05	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.283E-05
Ra-226	8.917E-09	0.000E+00	0.000E+00	0.000E+00	5.122E-05	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	5.122E-05
Th-230	1.385E-06	0.000E+00	0.000E+00	0.000E+00	7.957E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	7.957E-03
U-234	4.951E-03	0.000E+00	0.000E+00	0.000E+00	2.844E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.844E+01
U-235	6.814E-05	0.000E+00	0.000E+00	0.000E+00	3.914E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	3.914E-01
U-238	3.521E-03	0.000E+00	0.000E+00	0.000E+00	2.022E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.022E+01

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

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	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	4.921E-03	4.803E-05	3.594E-08	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	4.921E-03	4.803E-05	3.594E-08	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

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

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 Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Ac-227	1.194E-11	0.0001	2.228E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.926E-13	0.0000
Pa-231	3.056E-12	0.0000	2.159E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.678E-13	0.0000
Pb-210	5.792E-15	0.0000	5.388E-16	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.465E-13	0.0000
Ra-226	4.233E-11	0.0002	1.827E-15	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.910E-13	0.0000
Th-230	5.870E-13	0.0000	3.097E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.227E-12	0.0000
U-234	5.882E-10	0.0025	8.201E-10	0.0035	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.618E-08	0.0690
U-235	1.721E-08	0.0734	1.015E-11	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.277E-10	0.0010
U-238	1.843E-07	0.7862	4.957E-10	0.0021	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.453E-08	0.0620
Total	2.022E-07	0.8624	1.326E-09	0.0057	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.095E-08	0.1320

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-	Water		Fish		Plant		Meat		Milk		All Pathways**	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.235E-11	0.0001
Pa-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.445E-12	0.0000
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.528E-13	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.252E-11	0.0002
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.124E-12	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	0.0000	1.759E-08	0.0750
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	1.745E-08	0.0744
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	1.994E-07	0.8503
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	2.345E-07	1.0000

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

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

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	6.417E-14	1.287E-15	1.614E-18	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	6.417E-14	1.287E-15	1.614E-18	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

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

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-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
U-234	6.311E-10	0.0027	8.204E-10	0.0035	6.546E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.619E-08	0.0690
U-235	1.723E-08	0.0735	1.019E-11	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.285E-10	0.0010
U-238	1.844E-07	0.7862	4.957E-10	0.0021	1.449E-18	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.453E-08	0.0620
Total	2.022E-07	0.8624	1.326E-09	0.0057	6.546E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.095E-08	0.1320

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-	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	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	1.764E-08	0.0752
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	1.746E-08	0.0745
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	1.994E-07	0.8503
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	2.345E-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+02 years

Radio-	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total
Nuclide	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
Ac-227	7.986E-08	0.000E+00	0.000E+00	0.000E+00	4.587E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	4.587E-04
Pa-231	1.222E-07	0.000E+00	0.000E+00	0.000E+00	7.018E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	7.018E-04
Pb-210	4.977E-08	0.000E+00	0.000E+00	0.000E+00	2.859E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.859E-04
Ra-226	8.937E-08	0.000E+00	0.000E+00	0.000E+00	5.133E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	5.133E-04
Th-230	4.260E-06	0.000E+00	0.000E+00	0.000E+00	2.447E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.447E-02
U-234	4.200E-03	0.000E+00	0.000E+00	0.000E+00	2.413E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.413E+01
U-235	5.780E-05	0.000E+00	0.000E+00	0.000E+00	3.320E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	3.320E-01
U-238	2.987E-03	0.000E+00	0.000E+00	0.000E+00	1.716E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.716E+01

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

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	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	4.888E-02	4.771E-04	3.569E-07	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	4.888E-02	4.771E-04	3.569E-07	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

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

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 Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Ac-227	5.644E-11	0.0003	1.053E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.856E-12	0.0000
Pa-231	8.085E-12	0.0000	5.712E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.732E-13	0.0000
Pb-210	1.059E-13	0.0000	9.848E-15	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.333E-12	0.0000
Ra-226	3.711E-10	0.0019	1.602E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.675E-12	0.0000
Th-230	1.690E-12	0.0000	8.920E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.793E-11	0.0001
U-234	4.990E-10	0.0025	6.957E-10	0.0035	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.373E-08	0.0689
U-235	1.460E-08	0.0732	8.610E-12	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.932E-10	0.0010
U-238	1.564E-07	0.7846	4.205E-10	0.0021	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.233E-08	0.0618
Total	1.719E-07	0.8625	1.126E-09	0.0056	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.628E-08	0.1318

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-	Water		Fish		Plant		Meat		Milk		All Pathways**	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.840E-11	0.0003
Pa-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.116E-12	0.0000
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.449E-12	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.728E-10	0.0019
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.052E-11	0.0001
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	1.492E-08	0.0749
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	1.480E-08	0.0743
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	1.691E-07	0.8485
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	1.993E-07	1.0000

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

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	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	5.576E-13	1.119E-14	1.402E-17	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	5.576E-13	1.119E-14	1.402E-17	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

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

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 Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
U-234	8.718E-10	0.0044	6.964E-10	0.0035	5.688E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.375E-08	0.0690
U-235	1.466E-08	0.0736	8.773E-12	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.960E-10	0.0010
U-238	1.564E-07	0.7846	4.206E-10	0.0021	3.850E-17	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.233E-08	0.0619
Total	1.719E-07	0.8625	1.126E-09	0.0056	5.688E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.628E-08	0.1318

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-	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	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	1.532E-08	0.0769
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	1.487E-08	0.0746
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	1.691E-07	0.8485
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.993E-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= 3.000E+02 years

Radio-	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total
Nuclide	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
Ac-227	1.866E-07	0.000E+00	0.000E+00	0.000E+00	1.072E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.072E-03
Pa-231	2.286E-07	0.000E+00	0.000E+00	0.000E+00	1.313E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.313E-03
Pb-210	4.910E-07	0.000E+00	0.000E+00	0.000E+00	2.820E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.820E-03
Ra-226	6.036E-07	0.000E+00	0.000E+00	0.000E+00	3.467E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	3.467E-03
Th-230	1.028E-05	0.000E+00	0.000E+00	0.000E+00	5.903E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	5.903E-02
U-234	2.625E-03	0.000E+00	0.000E+00	0.000E+00	1.508E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.508E+01
U-235	3.613E-05	0.000E+00	0.000E+00	0.000E+00	2.075E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.075E-01
U-238	1.867E-03	0.000E+00	0.000E+00	0.000E+00	1.072E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.072E+01

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

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	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	3.237E-01	3.159E-03	2.364E-06	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	3.237E-01	3.159E-03	2.364E-06	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

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

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 Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Ac-227	1.282E-10	0.0010	2.393E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.216E-12	0.0000
Pa-231	1.483E-11	0.0001	1.048E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.786E-12	0.0000
Pb-210	9.914E-13	0.0000	9.223E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.931E-11	0.0005
Ra-226	2.410E-09	0.0190	1.040E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.088E-11	0.0001
Th-230	4.000E-12	0.0000	2.111E-12	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.243E-11	0.0003
U-234	3.118E-10	0.0025	4.347E-10	0.0034	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.578E-09	0.0676
U-235	9.125E-09	0.0719	5.381E-12	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.207E-10	0.0010
U-238	9.774E-08	0.7698	2.628E-10	0.0021	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.704E-09	0.0607
Total	1.097E-07	0.8643	7.055E-10	0.0056	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.652E-08	0.1301

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-	Water		Fish		Plant		Meat		Milk		All Pathways**	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.326E-10	0.0010
Pa-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.672E-11	0.0001
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.039E-11	0.0005
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.421E-09	0.0191
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.854E-11	0.0004
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	9.324E-09	0.0734
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	9.251E-09	0.0729
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	1.057E-07	0.8326
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	1.270E-07	1.0000

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

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	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	3.550E-12	7.122E-14	8.928E-17	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	3.550E-12	7.122E-14	8.928E-17	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

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

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 Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
U-234	2.727E-09	0.0215	4.367E-10	0.0034	3.621E-12	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.685E-09	0.0684
U-235	9.268E-09	0.0730	5.725E-12	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.267E-10	0.0010
U-238	9.774E-08	0.7698	2.631E-10	0.0021	6.881E-16	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.710E-09	0.0607
Total	1.097E-07	0.8643	7.055E-10	0.0056	3.621E-12	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.652E-08	0.1301

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-	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	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	1.185E-08	0.0933
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	9.400E-09	0.0740
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	1.057E-07	0.8326
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.270E-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-	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total
Nuclide	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
Ac-227	1.279E-07	0.000E+00	0.000E+00	0.000E+00	7.344E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	7.344E-04
Pa-231	1.460E-07	0.000E+00	0.000E+00	0.000E+00	8.384E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	8.384E-04
Pb-210	2.537E-06	0.000E+00	0.000E+00	0.000E+00	1.457E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.457E-02
Ra-226	2.704E-06	0.000E+00	0.000E+00	0.000E+00	1.553E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.553E-02
Th-230	1.827E-05	0.000E+00	0.000E+00	0.000E+00	1.049E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.049E-01
U-234	5.062E-04	0.000E+00	0.000E+00	0.000E+00	2.908E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.908E+00
U-235	6.972E-06	0.000E+00	0.000E+00	0.000E+00	4.005E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	4.005E-02
U-238	3.602E-04	0.000E+00	0.000E+00	0.000E+00	2.069E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.069E+00

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

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	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	1.193E+00	1.164E-02	8.710E-06	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	1.193E+00	1.164E-02	8.710E-06	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

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

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-	Ground		Inhalation		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Ac-227	8.713E-11	0.0025	1.626E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.866E-12	0.0001
Pa-231	9.407E-12	0.0003	6.646E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.132E-12	0.0000
Pb-210	5.046E-12	0.0001	4.694E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.019E-10	0.0086
Ra-226	1.066E-08	0.3029	4.598E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.809E-11	0.0014
Th-230	7.068E-12	0.0002	3.730E-12	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.498E-11	0.0021
U-234	6.014E-11	0.0017	8.384E-11	0.0024	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.654E-09	0.0470
U-235	1.761E-09	0.0501	1.038E-12	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.330E-11	0.0007
U-238	1.886E-08	0.5361	5.071E-11	0.0014	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.487E-09	0.0423
Total	3.145E-08	0.8939	1.405E-10	0.0040	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.593E-09	0.1021

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-	Water		Fish		Plant		Meat		Milk		All Pathways**	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.016E-11	0.0026
Pa-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.061E-11	0.0003
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.074E-10	0.0087
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.070E-08	0.3043
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.578E-11	0.0024
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	1.798E-09	0.0511
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	1.785E-09	0.0507
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	2.040E-08	0.5798
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	3.518E-08	1.0000

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

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

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	1.289E-11	2.587E-13	3.243E-16	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	1.289E-11	2.587E-13	3.243E-16	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

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

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 Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
U-234	1.072E-08	0.3047	8.833E-11	0.0025	1.315E-11	0.0004	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.076E-09	0.0590
U-235	1.858E-09	0.0528	1.268E-12	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.729E-11	0.0008
U-238	1.887E-08	0.5361	5.089E-11	0.0014	6.859E-15	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.490E-09	0.0423
Total	3.145E-08	0.8935	1.405E-10	0.0040	1.315E-11	0.0004	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.593E-09	0.1021

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-	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	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	1.290E-08	0.3665
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	1.886E-09	0.0536
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	2.041E-08	0.5799
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	3.519E-08	1.0000

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

Table of Contents

Part III: Intake Quantities and Health Risk Factors

Cancer Risk Slope Factors Summary Table
Risk Library: FGR 13 Morbidity

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	2.13E-07	1.49E-07	SLPF(1,2)
Sf-2	Pa-231	7.62E-08	7.62E-08	SLPF(2,2)
Sf-2	Pb-210+D	3.08E-08	1.58E-08	SLPF(3,2)
Sf-2	Ra-226+D	2.83E-08	2.82E-08	SLPF(4,2)
Sf-2	Th-230	3.40E-08	3.40E-08	SLPF(5,2)
Sf-2	U-234	2.78E-08	2.78E-08	SLPF(6,2)
Sf-2	U-235+D	2.50E-08	2.50E-08	SLPF(7,2)
Sf-2	U-238	2.36E-08	2.36E-08	SLPF(8,2)
Sf-2	U-238+D	2.36E-08	2.36E-08	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	2.66E-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	6.53E-10	2.45E-10	SLPF(1,5)
Sf-3	Pa-231	2.26E-10	2.26E-10	SLPF(2,5)
Sf-3	Pb-210+D	3.44E-09	1.18E-09	SLPF(3,5)
Sf-3	Ra-226+D	5.15E-10	5.14E-10	SLPF(4,5)
Sf-3	Th-230	1.19E-10	1.19E-10	SLPF(5,5)
Sf-3	U-234	9.55E-11	9.55E-11	SLPF(6,5)

RESRAD
ADULT COMMUTER

Uranium Soils Investigation
Baseline Human Health Risk Assessment
Saddle Road
October 2009

Cancer Risk Slope Factors Summary Table (continued)

Risk Library: FGR 13 Morbidity

Menu	Parameter	Current Value	Base Case*	Parameter Name
Sf-3	U-235+D	9.76E-11	9.44E-11	SLPF(7,5)
Sf-3	U-238	8.66E-11	8.66E-11	SLPF(8,5)
Sf-3	U-238+D	1.21E-10	8.66E-11	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.

Risk Slope and Environmental Transport Factors for the Ground Pathway

Nuclide (i)	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	9.567E-01	9.567E-01	9.567E-01	9.567E-01	9.567E-01	9.567E-01	9.567E-01	9.567E-01
At-218	3.570E-09	9.702E-01	9.702E-01	9.702E-01	9.702E-01	9.702E-01	9.702E-01	9.702E-01	9.702E-01
Bi-210	2.760E-09	9.450E-01	9.450E-01	9.450E-01	9.450E-01	9.450E-01	9.450E-01	9.450E-01	9.450E-01
Bi-211	1.880E-07	9.453E-01	9.453E-01	9.453E-01	9.453E-01	9.453E-01	9.453E-01	9.453E-01	9.453E-01
Bi-214	7.480E-06	9.401E-01	9.401E-01	9.401E-01	9.401E-01	9.401E-01	9.401E-01	9.401E-01	9.400E-01
Fr-223	1.400E-07	9.502E-01	9.502E-01	9.502E-01	9.502E-01	9.502E-01	9.502E-01	9.502E-01	9.502E-01
Pa-231	1.390E-07	9.456E-01	9.456E-01	9.456E-01	9.456E-01	9.456E-01	9.456E-01	9.456E-01	9.456E-01
Pa-234	8.710E-06	9.400E-01	9.400E-01	9.400E-01	9.400E-01	9.400E-01	9.400E-01	9.400E-01	9.400E-01
Pa-234m	6.870E-08	9.393E-01	9.393E-01	9.393E-01	9.393E-01	9.393E-01	9.393E-01	9.393E-01	9.393E-01
Pb-210	1.410E-09	9.813E-01	9.813E-01	9.813E-01	9.813E-01	9.813E-01	9.813E-01	9.813E-01	9.813E-01
Pb-211	2.290E-07	9.399E-01	9.399E-01	9.399E-01	9.399E-01	9.399E-01	9.399E-01	9.399E-01	9.399E-01
Pb-214	9.820E-07	9.456E-01	9.456E-01	9.456E-01	9.456E-01	9.456E-01	9.456E-01	9.456E-01	9.456E-01
Po-210	3.950E-11	9.390E-01	9.390E-01	9.390E-01	9.390E-01	9.390E-01	9.390E-01	9.390E-01	9.390E-01
Po-211	3.580E-08	9.360E-01	9.360E-01	9.360E-01	9.360E-01	9.360E-01	9.360E-01	9.360E-01	9.360E-01
Po-214	3.860E-10	9.360E-01	9.360E-01	9.360E-01	9.360E-01	9.360E-01	9.360E-01	9.360E-01	9.360E-01
Po-215	7.480E-10	9.410E-01	9.410E-01	9.410E-01	9.410E-01	9.410E-01	9.410E-01	9.410E-01	9.410E-01
Po-218	4.260E-11	9.390E-01	9.390E-01	9.390E-01	9.390E-01	9.390E-01	9.390E-01	9.390E-01	9.390E-01
Ra-223	4.340E-07	9.496E-01	9.496E-01	9.496E-01	9.496E-01	9.496E-01	9.496E-01	9.496E-01	9.496E-01
Ra-226	2.290E-08	9.524E-01	9.524E-01	9.524E-01	9.524E-01	9.524E-01	9.524E-01	9.524E-01	9.524E-01
Rn-219	2.250E-07	9.461E-01	9.461E-01	9.461E-01	9.461E-01	9.461E-01	9.461E-01	9.461E-01	9.461E-01
Rn-222	1.740E-09	9.370E-01	9.370E-01	9.370E-01	9.370E-01	9.370E-01	9.370E-01	9.370E-01	9.370E-01
Th-227	3.780E-07	9.508E-01	9.508E-01	9.508E-01	9.508E-01	9.508E-01	9.508E-01	9.508E-01	9.508E-01
Th-230	8.190E-10	9.588E-01	9.588E-01	9.588E-01	9.588E-01	9.588E-01	9.588E-01	9.588E-01	9.588E-01
Th-231	2.450E-08	9.599E-01	9.599E-01	9.599E-01	9.599E-01	9.599E-01	9.599E-01	9.599E-01	9.599E-01
Th-234	1.630E-08	9.610E-01	9.610E-01	9.610E-01	9.610E-01	9.610E-01	9.610E-01	9.610E-01	9.610E-01
Tl-207	1.520E-08	9.403E-01	9.403E-01	9.403E-01	9.403E-01	9.403E-01	9.403E-01	9.403E-01	9.403E-01
Tl-210	0.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
U-234	2.520E-10	9.643E-01	9.643E-01	9.643E-01	9.643E-01	9.643E-01	9.643E-01	9.643E-01	9.643E-01
U-235	5.180E-07	9.520E-01	9.520E-01	9.520E-01	9.520E-01	9.520E-01	9.520E-01	9.520E-01	9.520E-01
U-238	4.990E-11	9.912E-01	9.912E-01	9.912E-01	9.912E-01	9.912E-01	9.912E-01	9.912E-01	9.912E-01

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

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	1.063E-02	0.000E+00	0.000E+00	0.000E+00	1.526E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.526E+01
U-235	1.462E-04	0.000E+00	0.000E+00	0.000E+00	2.100E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.100E-01
U-238	7.556E-03	0.000E+00	0.000E+00	0.000E+00	1.085E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.085E+01

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

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	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

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 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	1.017E-11	0.0000	3.797E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.672E-13	0.0000
Pa-231	4.628E-12	0.0000	6.539E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.785E-13	0.0000
Pb-210	2.485E-15	0.0000	4.624E-16	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.434E-14	0.0000
Ra-226	3.045E-11	0.0000	2.628E-15	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.871E-14	0.0000
Th-230	8.710E-13	0.0000	9.192E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.620E-12	0.0000
U-234	2.472E-09	0.0027	6.894E-09	0.0074	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.401E-08	0.0367
U-235	7.234E-08	0.0781	8.532E-11	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.785E-10	0.0005
U-238	7.748E-07	0.8369	4.166E-09	0.0045	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.054E-08	0.0330
Total	8.497E-07	0.9177	1.115E-08	0.0120	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.503E-08	0.0702

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-	Water		Fish		Plant		Meat		Milk		All Pathways**	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.037E-11	0.0000
Pa-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.972E-12	0.0000
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.729E-14	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.052E-11	0.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.410E-12	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	0.0000	4.337E-08	0.0468
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	7.290E-08	0.0787
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	8.095E-07	0.8744
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	9.258E-07	1.0000

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

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

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	9.242E-14	1.854E-15	2.325E-18	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	9.242E-14	1.854E-15	2.325E-18	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

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

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-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
U-234	2.504E-09	0.0027	6.894E-09	0.0074	9.428E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.401E-08	0.0367
U-235	7.235E-08	0.0781	8.542E-11	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.789E-10	0.0005
U-238	7.748E-07	0.8369	4.167E-09	0.0045	1.133E-18	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.054E-08	0.0330
Total	8.497E-07	0.9177	1.115E-08	0.0120	9.428E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.503E-08	0.0702

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-	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	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	4.341E-08	0.0469
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	7.292E-08	0.0788
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	8.095E-07	0.8744
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	9.258E-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+00 years

Radio-	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total
Nuclide	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
Ac-227	4.856E-11	0.000E+00	0.000E+00	0.000E+00	6.974E-08	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	6.974E-08
Pa-231	3.087E-09	0.000E+00	0.000E+00	0.000E+00	4.433E-06	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	4.433E-06
Pb-210	2.127E-13	0.000E+00	0.000E+00	0.000E+00	3.055E-10	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	3.055E-10
Ra-226	2.069E-11	0.000E+00	0.000E+00	0.000E+00	2.971E-08	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.971E-08
Th-230	9.555E-08	0.000E+00	0.000E+00	0.000E+00	1.372E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.372E-04
U-234	1.060E-02	0.000E+00	0.000E+00	0.000E+00	1.522E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.522E+01
U-235	1.459E-04	0.000E+00	0.000E+00	0.000E+00	2.095E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.095E-01
U-238	7.538E-03	0.000E+00	0.000E+00	0.000E+00	1.082E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.082E+01

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

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	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	1.144E-05	1.117E-07	8.354E-11	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	1.144E-05	1.117E-07	8.354E-11	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

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

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 Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Ac-227	1.139E-11	0.0000	4.250E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.872E-13	0.0000
Pa-231	5.005E-12	0.0000	7.073E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.012E-13	0.0000
Pb-210	2.907E-15	0.0000	5.408E-16	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.694E-14	0.0000
Ra-226	3.438E-11	0.0000	2.967E-15	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.757E-14	0.0000
Th-230	9.429E-13	0.0000	9.950E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.001E-12	0.0000
U-234	2.466E-09	0.0027	6.877E-09	0.0074	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.393E-08	0.0367
U-235	7.217E-08	0.0781	8.512E-11	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.774E-10	0.0005
U-238	7.730E-07	0.8369	4.157E-09	0.0045	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.047E-08	0.0330
Total	8.477E-07	0.9177	1.112E-08	0.0120	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.488E-08	0.0702

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-	Water		Fish		Plant		Meat		Milk		All Pathways**	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.161E-11	0.0000
Pa-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.377E-12	0.0000
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.038E-14	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.446E-11	0.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.939E-12	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	0.0000	4.327E-08	0.0468
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	7.273E-08	0.0787
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	8.076E-07	0.8743
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	9.237E-07	1.0000

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

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	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	1.043E-13	2.093E-15	2.624E-18	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	1.043E-13	2.093E-15	2.624E-18	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

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

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 Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
U-234	2.502E-09	0.0027	6.878E-09	0.0074	1.064E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.393E-08	0.0367
U-235	7.218E-08	0.0781	8.523E-11	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.778E-10	0.0005
U-238	7.730E-07	0.8369	4.157E-09	0.0045	1.332E-18	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.047E-08	0.0330
Total	8.477E-07	0.9177	1.112E-08	0.0120	1.064E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.488E-08	0.0702

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-	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	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	4.331E-08	0.0469
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	7.275E-08	0.0788
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	8.076E-07	0.8744
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	9.237E-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= 3.000E+00 years

Radio-	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total
Nuclide	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
Ac-227	4.250E-10	0.000E+00	0.000E+00	0.000E+00	6.103E-07	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	6.103E-07
Pa-231	9.217E-09	0.000E+00	0.000E+00	0.000E+00	1.324E-05	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.324E-05
Pb-210	5.640E-12	0.000E+00	0.000E+00	0.000E+00	8.099E-09	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	8.099E-09
Ra-226	1.857E-10	0.000E+00	0.000E+00	0.000E+00	2.666E-07	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.666E-07
Th-230	2.860E-07	0.000E+00	0.000E+00	0.000E+00	4.107E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	4.107E-04
U-234	1.055E-02	0.000E+00	0.000E+00	0.000E+00	1.515E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.515E+01
U-235	1.452E-04	0.000E+00	0.000E+00	0.000E+00	2.085E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.085E-01
U-238	7.502E-03	0.000E+00	0.000E+00	0.000E+00	1.077E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.077E+01

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

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	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	1.027E-04	1.002E-06	7.496E-10	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	1.027E-04	1.002E-06	7.496E-10	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

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

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 Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Ac-227	1.405E-11	0.0000	5.245E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.311E-13	0.0000
Pa-231	5.755E-12	0.0000	8.132E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.463E-13	0.0000
Pb-210	3.901E-15	0.0000	7.258E-16	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.167E-13	0.0000
Ra-226	4.315E-11	0.0000	3.724E-15	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.737E-14	0.0000
Th-230	1.086E-12	0.0000	1.146E-12	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.760E-12	0.0000
U-234	2.455E-09	0.0027	6.845E-09	0.0074	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.377E-08	0.0367
U-235	7.183E-08	0.0781	8.472E-11	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.751E-10	0.0005
U-238	7.694E-07	0.8369	4.137E-09	0.0045	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.032E-08	0.0330
Total	8.437E-07	0.9177	1.107E-08	0.0120	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.457E-08	0.0702

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-	Water		Fish		Plant		Meat		Milk		All Pathways**	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.433E-11	0.0000
Pa-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.182E-12	0.0000
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.213E-13	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.325E-11	0.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.992E-12	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	0.0000	4.307E-08	0.0468
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	7.239E-08	0.0787
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	8.038E-07	0.8743
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	9.193E-07	1.0000

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

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

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	1.310E-13	2.627E-15	3.294E-18	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	1.310E-13	2.627E-15	3.294E-18	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

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

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-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
U-234	2.499E-09	0.0027	6.846E-09	0.0074	1.336E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.377E-08	0.0367
U-235	7.185E-08	0.0782	8.485E-11	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.757E-10	0.0005
U-238	7.694E-07	0.8369	4.137E-09	0.0045	1.807E-18	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.032E-08	0.0330
Total	8.437E-07	0.9177	1.107E-08	0.0120	1.336E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.457E-08	0.0702

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-	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	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	4.312E-08	0.0469
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	7.241E-08	0.0788
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	8.038E-07	0.8743
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	9.193E-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+01 years

Radio-	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total
Nuclide	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
Ac-227	4.291E-09	0.000E+00	0.000E+00	0.000E+00	6.161E-06	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	6.161E-06
Pa-231	3.022E-08	0.000E+00	0.000E+00	0.000E+00	4.340E-05	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	4.340E-05
Pb-210	1.962E-10	0.000E+00	0.000E+00	0.000E+00	2.817E-07	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.817E-07
Ra-226	2.041E-09	0.000E+00	0.000E+00	0.000E+00	2.932E-06	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.932E-06
Th-230	9.454E-07	0.000E+00	0.000E+00	0.000E+00	1.358E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.358E-03
U-234	1.038E-02	0.000E+00	0.000E+00	0.000E+00	1.491E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.491E+01
U-235	1.428E-04	0.000E+00	0.000E+00	0.000E+00	2.051E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.051E-01
U-238	7.380E-03	0.000E+00	0.000E+00	0.000E+00	1.060E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.060E+01

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

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	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	1.128E-03	1.101E-05	8.238E-09	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	1.128E-03	1.101E-05	8.238E-09	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

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

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-	Ground		Inhalation		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Ac-227	2.550E-11	0.0000	9.521E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.194E-13	0.0000
Pa-231	8.322E-12	0.0000	1.176E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.008E-13	0.0000
Pb-210	9.284E-15	0.0000	1.727E-15	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.777E-13	0.0000
Ra-226	8.338E-11	0.0001	7.196E-15	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.882E-13	0.0000
Th-230	1.582E-12	0.0000	1.669E-12	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.390E-12	0.0000
U-234	2.415E-09	0.0027	6.733E-09	0.0074	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.322E-08	0.0367
U-235	7.066E-08	0.0781	8.334E-11	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.674E-10	0.0005
U-238	7.568E-07	0.8368	4.070E-09	0.0045	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.983E-08	0.0330
Total	8.300E-07	0.9177	1.089E-08	0.0120	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.352E-08	0.0702

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-	Water		Fish		Plant		Meat		Milk		All Pathways**	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.602E-11	0.0000
Pa-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.941E-12	0.0000
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.887E-13	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.358E-11	0.0001
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.164E-11	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	0.0000	4.237E-08	0.0468
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	7.121E-08	0.0787
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	7.907E-07	0.8743
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	9.044E-07	1.0000

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

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	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	2.529E-13	5.074E-15	6.362E-18	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	2.529E-13	5.074E-15	6.362E-18	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

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

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 Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
U-234	2.500E-09	0.0028	6.735E-09	0.0074	2.580E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.322E-08	0.0367
U-235	7.069E-08	0.0782	8.355E-11	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.683E-10	0.0005
U-238	7.568E-07	0.8368	4.070E-09	0.0045	4.466E-18	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.983E-08	0.0330
Total	8.300E-07	0.9177	1.089E-08	0.0120	2.580E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.352E-08	0.0702

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-	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	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	4.246E-08	0.0469
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	7.124E-08	0.0788
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	7.907E-07	0.8743
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	9.044E-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= 3.000E+01 years

Radio-	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total
Nuclide	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
Ac-227	2.988E-08	0.000E+00	0.000E+00	0.000E+00	4.291E-05	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	4.291E-05
Pa-231	8.648E-08	0.000E+00	0.000E+00	0.000E+00	1.242E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.242E-04
Pb-210	4.468E-09	0.000E+00	0.000E+00	0.000E+00	6.416E-06	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	6.416E-06
Ra-226	1.783E-08	0.000E+00	0.000E+00	0.000E+00	2.561E-05	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.561E-05
Th-230	2.770E-06	0.000E+00	0.000E+00	0.000E+00	3.978E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	3.978E-03
U-234	9.903E-03	0.000E+00	0.000E+00	0.000E+00	1.422E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.422E+01
U-235	1.363E-04	0.000E+00	0.000E+00	0.000E+00	1.957E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.957E-01
U-238	7.041E-03	0.000E+00	0.000E+00	0.000E+00	1.011E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.011E+01

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

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	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	9.843E-03	9.606E-05	7.187E-08	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	9.843E-03	9.606E-05	7.187E-08	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

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

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 Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Ac-227	6.989E-11	0.0001	2.609E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.149E-12	0.0000
Pa-231	1.519E-11	0.0000	2.147E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.143E-13	0.0000
Pb-210	4.669E-14	0.0000	8.686E-15	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.396E-12	0.0000
Ra-226	2.764E-10	0.0003	2.386E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.238E-13	0.0000
Th-230	2.954E-12	0.0000	3.117E-12	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.567E-11	0.0000
U-234	2.304E-09	0.0027	6.424E-09	0.0074	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.169E-08	0.0367
U-235	6.741E-08	0.0781	7.951E-11	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.459E-10	0.0005
U-238	7.221E-07	0.8365	3.883E-09	0.0045	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.846E-08	0.0330
Total	7.921E-07	0.9177	1.039E-08	0.0120	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.062E-08	0.0702

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-	Water		Fish		Plant		Meat		Milk		All Pathways**	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.130E-11	0.0001
Pa-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.632E-11	0.0000
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.452E-12	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.771E-10	0.0003
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.174E-11	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	0.0000	4.042E-08	0.0468
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	6.794E-08	0.0787
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	7.544E-07	0.8740
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	8.631E-07	1.0000

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

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

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	8.370E-13	1.679E-14	2.105E-17	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	8.370E-13	1.679E-14	2.105E-17	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

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

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-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
U-234	2.583E-09	0.0030	6.427E-09	0.0074	8.538E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.171E-08	0.0367
U-235	6.750E-08	0.0782	7.999E-11	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.480E-10	0.0005
U-238	7.221E-07	0.8365	3.883E-09	0.0045	2.508E-17	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.846E-08	0.0330
Total	7.921E-07	0.9177	1.039E-08	0.0120	8.538E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.062E-08	0.0702

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-	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	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	4.072E-08	0.0472
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	6.803E-08	0.0788
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	7.544E-07	0.8740
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.631E-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+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	1.597E-07	0.000E+00	0.000E+00	0.000E+00	2.294E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.294E-04
Pa-231	2.443E-07	0.000E+00	0.000E+00	0.000E+00	3.509E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	3.509E-04
Pb-210	9.954E-08	0.000E+00	0.000E+00	0.000E+00	1.429E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.429E-04
Ra-226	1.787E-07	0.000E+00	0.000E+00	0.000E+00	2.567E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.567E-04
Th-230	8.520E-06	0.000E+00	0.000E+00	0.000E+00	1.223E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.223E-02
U-234	8.400E-03	0.000E+00	0.000E+00	0.000E+00	1.206E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.206E+01
U-235	1.156E-04	0.000E+00	0.000E+00	0.000E+00	1.660E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.660E-01
U-238	5.973E-03	0.000E+00	0.000E+00	0.000E+00	8.578E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	8.578E+00

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

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.	9.776E-02	9.541E-04	7.139E-07	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	9.776E-02	9.541E-04	7.139E-07	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

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

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 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	2.465E-10	0.0003	9.204E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.055E-12	0.0000
Pa-231	3.440E-11	0.0000	4.861E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.070E-12	0.0000
Pb-210	5.167E-13	0.0000	9.614E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.546E-11	0.0000
Ra-226	1.737E-09	0.0024	1.499E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.919E-12	0.0000
Th-230	7.275E-12	0.0000	7.678E-12	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.859E-11	0.0001
U-234	1.954E-09	0.0027	5.449E-09	0.0074	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.688E-08	0.0366
U-235	5.719E-08	0.0779	6.745E-11	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.783E-10	0.0005
U-238	6.125E-07	0.8345	3.294E-09	0.0045	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.414E-08	0.0329
Total	6.737E-07	0.9179	8.820E-09	0.0120	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.147E-08	0.0701

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-	Water		Fish		Plant		Meat		Milk		All Pathways**	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.515E-10	0.0003
Pa-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.696E-11	0.0001
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.607E-11	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.741E-09	0.0024
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.354E-11	0.0001
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	3.429E-08	0.0467
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	5.763E-08	0.0785
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	6.400E-07	0.8719
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	7.340E-07	1.0000

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

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	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	5.214E-12	1.046E-13	1.311E-16	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	5.214E-12	1.046E-13	1.311E-16	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

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

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 Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
U-234	3.698E-09	0.0050	5.456E-09	0.0074	5.318E-12	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.693E-08	0.0367
U-235	5.747E-08	0.0783	6.886E-11	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.844E-10	0.0005
U-238	6.125E-07	0.8345	3.295E-09	0.0045	3.931E-16	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.415E-08	0.0329
Total	6.737E-07	0.9179	8.820E-09	0.0120	5.319E-12	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.147E-08	0.0701

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-	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	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	3.609E-08	0.0492
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	5.792E-08	0.0789
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	6.400E-07	0.8719
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	7.340E-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= 3.000E+02 years

Radio-	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total
Nuclide	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
Ac-227	3.732E-07	0.000E+00	0.000E+00	0.000E+00	5.360E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	5.360E-04
Pa-231	4.572E-07	0.000E+00	0.000E+00	0.000E+00	6.565E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	6.565E-04
Pb-210	9.820E-07	0.000E+00	0.000E+00	0.000E+00	1.410E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.410E-03
Ra-226	1.207E-06	0.000E+00	0.000E+00	0.000E+00	1.734E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.734E-03
Th-230	2.055E-05	0.000E+00	0.000E+00	0.000E+00	2.951E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.951E-02
U-234	5.249E-03	0.000E+00	0.000E+00	0.000E+00	7.538E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	7.538E+00
U-235	7.225E-05	0.000E+00	0.000E+00	0.000E+00	1.038E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.038E-01
U-238	3.733E-03	0.000E+00	0.000E+00	0.000E+00	5.361E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	5.361E+00

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

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	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	6.474E-01	6.318E-03	4.727E-06	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	6.474E-01	6.318E-03	4.727E-06	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

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

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 Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Ac-227	5.183E-10	0.0011	1.935E-12	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.523E-12	0.0000
Pa-231	5.980E-11	0.0001	8.450E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.599E-12	0.0000
Pb-210	4.177E-12	0.0000	7.772E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.249E-10	0.0003
Ra-226	1.010E-08	0.0216	8.713E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.278E-11	0.0000
Th-230	1.632E-11	0.0000	1.722E-11	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.656E-11	0.0002
U-234	1.221E-09	0.0026	3.405E-09	0.0073	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.680E-08	0.0359
U-235	3.574E-08	0.0763	4.215E-11	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.364E-10	0.0005
U-238	3.828E-07	0.8173	2.059E-09	0.0044	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.509E-08	0.0322
Total	4.305E-07	0.9191	5.528E-09	0.0118	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.237E-08	0.0691

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-	Water		Fish		Plant		Meat		Milk		All Pathways**	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.287E-10	0.0011
Pa-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.425E-11	0.0001
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.299E-10	0.0003
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.012E-08	0.0216
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.201E-10	0.0003
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	2.142E-08	0.0457
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	3.602E-08	0.0769
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	4.000E-07	0.8539
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	4.684E-07	1.0000

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

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	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	2.970E-11	5.959E-13	7.471E-16	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	2.970E-11	5.959E-13	7.471E-16	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

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

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 Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
U-234	1.133E-08	0.0242	3.422E-09	0.0073	3.029E-11	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.702E-08	0.0363
U-235	3.632E-08	0.0775	4.493E-11	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.485E-10	0.0005
U-238	3.828E-07	0.8173	2.061E-09	0.0044	5.919E-15	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.510E-08	0.0322
Total	4.305E-07	0.9190	5.528E-09	0.0118	3.030E-11	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.237E-08	0.0691

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-	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	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	3.181E-08	0.0679
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	3.661E-08	0.0782
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	4.000E-07	0.8539
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.684E-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-	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total
Nuclide	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
Ac-227	2.557E-07	0.000E+00	0.000E+00	0.000E+00	3.672E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	3.672E-04
Pa-231	2.919E-07	0.000E+00	0.000E+00	0.000E+00	4.192E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	4.192E-04
Pb-210	5.074E-06	0.000E+00	0.000E+00	0.000E+00	7.287E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	7.287E-03
Ra-226	5.408E-06	0.000E+00	0.000E+00	0.000E+00	7.767E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	7.767E-03
Th-230	3.654E-05	0.000E+00	0.000E+00	0.000E+00	5.247E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	5.247E-02
U-234	1.012E-03	0.000E+00	0.000E+00	0.000E+00	1.454E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.454E+00
U-235	1.394E-05	0.000E+00	0.000E+00	0.000E+00	2.002E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.002E-02
U-238	7.204E-04	0.000E+00	0.000E+00	0.000E+00	1.035E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.035E+00

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

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	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	2.386E+00	2.328E-02	1.742E-05	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	2.386E+00	2.328E-02	1.742E-05	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

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

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-	Ground		Inhalation		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Ac-227	3.444E-10	0.0026	1.286E-12	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.663E-12	0.0000
Pa-231	3.717E-11	0.0003	5.252E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.237E-12	0.0000
Pb-210	2.034E-11	0.0002	3.784E-12	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.084E-10	0.0046
Ra-226	4.293E-08	0.3239	3.705E-12	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.688E-11	0.0007
Th-230	2.833E-11	0.0002	2.990E-11	0.0002	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.503E-10	0.0011
U-234	2.355E-10	0.0018	6.568E-10	0.0050	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.240E-09	0.0244
U-235	6.897E-09	0.0520	8.135E-12	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.562E-11	0.0003
U-238	7.388E-08	0.5574	3.973E-10	0.0030	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.912E-09	0.0220
Total	1.244E-07	0.9384	1.101E-09	0.0083	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.061E-09	0.0533

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-	Water		Fish		Plant		Meat		Milk		All Pathways**	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.513E-10	0.0027
Pa-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.993E-11	0.0003
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.325E-10	0.0048
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.303E-08	0.3247
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.085E-10	0.0016
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	4.132E-09	0.0312
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	6.951E-09	0.0524
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	7.719E-08	0.5824
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	1.325E-07	1.0000

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

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

Radon	Radionuclides							
Pathway	Rn-222	Po-218	Pb-214	Bi-214	Rn-220	Po-216	Pb-212	Bi-212
Water-ind.	1.034E-10	2.074E-12	2.600E-15	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	1.034E-10	2.074E-12	2.600E-15	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

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

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 Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
U-234	4.319E-08	0.3256	6.928E-10	0.0052	1.054E-10	0.0008	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.088E-09	0.0308
U-235	7.279E-09	0.0549	9.946E-12	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.352E-11	0.0004
U-238	7.390E-08	0.5572	3.986E-10	0.0030	5.535E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.919E-09	0.0220
Total	1.244E-07	0.9377	1.101E-09	0.0083	1.055E-10	0.0008	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.061E-09	0.0532

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-	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	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	4.808E-08	0.3625
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	7.342E-09	0.0554
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	7.722E-08	0.5822
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.326E-07	1.0000

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