Appendix E

Request for On-site Disposal of Unimportant Quantities of Source Material at Rare Earth Recovery Facility

REQUEST FOR ON-SITE DISPOSAL OF UNIMPORTANT QUANTITIES OF SOURCE MATERIAL AT RARE EARTH RECOVERY FACILITY

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LIST OF ACRONYMS AND ABBREVIATIONS

amsl	above mean sea level
bgs	below ground surface
CFR	U.S. Code of Federal Regulations
Ci	curie
DCs	dose coefficients
EPA	U.S. Environmental Protection Agency
EPPAD	Environmental Protection and Performance Assessment Directorate
ER	Environmental Report
ft	feet
g	gram
gpd/ft	gallons per day per foot
gpd/ft2	gallons per day per square foot
HDPE	high density polyethylene
Hydromet	hydrometallurgical
ICRP	International Commission on Radiation Protection
kg	kilogram
km	kilometer
LQD	Land Quality Division
MCLs	maximum contaminant levels
mrem	millirem
mrem/hr	millirem per hour
mrem/pCi	millirem per picocurie
mrem/yr	millirem per year
mg	milligram
mg/L	milligram per liter
mg/m^3	milligram per cubic meter
NIOSH	National Institute for Occupational Safety and Health
NORM	naturally occurring radioactive material
NRC	U.S. Nuclear Regulatory Commission
pCi	picocuries
pCi/g	picocuries per gram
pCi/L	picocuries per liter
PUG	physical upgrade
RER	Rare Element Resources, Inc.
REE	rare earth elements
REO	rare earth oxides
RESRAD	RESRAD Version 6.5
SDGS	South Dakota Geological Survey
STPD	standard ton per day
stpd	short ton per day
SI	International System of Units
TDS	total dissolved solids
TSF	Tailings Storage Facility
UBC	Uniform Building Code
UMW	Upton Monitoring Well
UNSCEAR	United Nations Scientific Committee on the Effects of Atomic Radiation
U.S.	United States
USGS	U.S. Geological Survey
WDEQ	Wyoming Department of Environmental Quality
WQD	Water Quality Division
WSGS	Wyoming State Geological Survey
Wt %	weight percent

1.0 INTRODUCTION

Rare Element Resources, Inc. (RER) proposes to build a rare earth element (REE) processing facility near Upton, in Weston County, Wyoming. The mine supplying the REE processing facility will be near Sundance, in Cook County, Wyoming. The proposed processing facility will consist of a hydrometallurgical (Hydromet) plant and Tailings Storage Facility (TSF). The tailing material contains source material but in concentrations less than 0.05 percent by weight.

The regulations in 10 CFR §40.13 exempt persons from the licensing requirements for certain materials containing uranium and thorium referred to as "unimportant quantities." One of these exemptions, § 40.13(a), is for "chemical mixtures, compounds, solutions, or alloys in which the source material is by weight less than 0.05 percent. Section 40.13(a) exempts any person from U.S. Nuclear Regulatory Commission (NRC) licensing requirements "to the extent that such person receives, possesses, uses, transfers, or delivers source material in any chemical mixture, compound, solution, or alloy in which source material is by weight less than one-twentieth of 1 percent (0.05 percent) of the mixture, compound, solution, or alloy." The 0.05 percent by weight limit was chosen on the basis of concentrations of source material that are necessary to be a useful source of fissionable material.

The word "storage" as used in the TSF naming convention does not imply a transient condition in which the tailings are subject to future relocation – this is a permanent tailings disposal facility that will be constructed in accordance with the definition of a "tailings disposal area" in Section 2 (h)(i) of Chapter 3 of the Non-coal Mining Rules and Regulations issued by the Wyoming Department of Environmental Quality-Land Quality Division (WDEQ-LQD).

The proposed disposal request would exempt the TSF from NRC licensing and would allow RER to dispose of materials that contain unimportant quantities of source material at the nearby TSF, which would be permitted by the WDEQ-LQD. Effectively, this request is to transfer unimportant quantities of source material as defined by 10 CFR §40.13 to a permitted facility for disposal.

The radiological dose assessment for the transfer of licensed source material to the Wyoming permitted disposal facility will ensure that doses are within the limits defined in Section 7.2.2 of Environmental Protection and Performance Assessment Directorate (EPPAD) Procedure 3.5, "Review, Approval, and Documentation of Low-Activity Waste Disposals in Accordance with 10 CFR §20.2002 and 10 CFR §40.13(a)." These dose criteria are also prescribed by the NRC in SRM-SECY-00-0201.

A description of the disposal site characteristics is contained in Section 2.0, including a description of important geological and hydrological characteristics. A description of the material to be disposed is included in Section 3.0. The description includes physical and chemical properties of the material important to risk evaluation and the proposed conditions of waste disposal. A description of the TSF design requirements is contained in Section 4.0. A conservative radiological dose assessment for the workers and members of the public is contained in Section 5.0 Section 6.0 is a summary section and Section 7.0 contains references.

2.0 TAILINGS STORAGE FACILITY SITE CHARACTERISTICS

The information provided in this section is largely summarized from the "*Tailings Storage Facility Preliminary Feasibility Design Report*" (Golder Associates, 2013) which is included as Stand Alone Report 2 in the Environmental Report (ER).

The proposed site for the TSF is along a broad slope that will require a side-hill type of embankment for containment of the tailings. Vegetation in and around the proposed TSF generally consist of native grasses and sagebrush. Carbonate deposits on the ground surface are present primarily in the northern portion of the site. Surface soils generally consist of clay likely derived from erosion and or in-place weathering of the exposed shale formations in the area.

The regions around Upton, including areas adjacent to the proposed TSF, have been mined for bentonite clay for a number of decades. Prior to the presence of the bentonite mining industry, the Upton area was a center for farming and ranching. There is no evidence of bentonite mining within the proposed TSF footprint or in areas west of the TSF (Golder Associates, 2013).

Utilities near the TSF include potable water, electrical power and natural gas. Northwest-southeast trending power and gas line easements traverse the proposed TSF site. The location of the utilities is provided in Stand Alone Report 2 in the ER.

2.1 GEOLOGY

2.1.1 REGIONAL GEOLOGIC SETTING OF THE UPTON PLANT SITE

The Upton Plant Site permit area is on the west side of the Black Hills uplift where rocks dip southwestward into the Powder River Basin.

2.1.2 SITE GEOLOGY

2.1.2.1 Surficial Geology

The Upton Plant Site and surrounding area were mapped by the U.S. Geological Survey (USGS) in the Upton 15-minute quadrangle (Mapel & Pillmore, 1964). Coyote Creek and Iron Creek occupy strike valleys in shale formations less resistant to erosion than an intervening sandstone formation (Turner Sandstone Member) that forms a low hogback ridge in the western portion of the Upton Plant Site permit area. The site is located in the Belle Fourche Shale, which is upturned to the west and returns to a gentle dip along the eastern flank of the monocline such that the shale is exposed in a wide band (i.e., large apparent thickness because of gentle dip) at the Upton Plant Site permit area.

2.1.2.2 Structural Geology

The Belle Fourche Shale is considered Upper Cretaceous in age and is about 650 feet thick in the site area. The un-eroded thickness of the Belle Fourche Shale at the site is not yet known. Older underlying Upper Cretaceous geological formations are the Mowry Shale (about 200 to 250 feet thick), underlain by the Newcastle Sandstone (20 to 50 feet thick). Further down in the section, Lower Cretaceous rock units are the Skull Creek Shale (185 to 210 feet thick) and the Inyan Kara Group, which is comprised of the Fall River Formation (130 feet thick) and the Lakota Formation (100 to 125 feet thick). Table 2.1-1 shows the general stratigraphic section of the Upton quadrangle (Mapel & Pillmore, 1964), and the following section is a detailed discussion of the stratigraphy.

Table 2.1-1
Generalized Stratigraphic Section of Rocks in the Upton Quadrangle

System	Series	Group, Formation, and Member		Thickness (feet)	Lithology
Cretaceous	Upper Cretaceous	Lance Formation		800+	Light-gray sandstone and dark-gray shale and sandy shale; nonmarine fossils.
		Fox Hills Sandstone		175	Light-gray and light yellowish-gray sandstone, dark-gray shale; marine fossils
		Pierre Shale	Upper part	300	Dark-gray shale, sandy and silty near top; septarian limestone concretions that weather medium gray; marine fossils.
			Kara Bentonitic Member	90	Dark-gray bentonitic shale; some barite concretions and a few limestone concretions that weather medium gray; marine fossils.
			Middle part	900	Dark-gray shale, silty in lower part; dark gray and grayish-red septarian limestone concretions; marine fossils.
			Mitten Black Shale Member	650	Upper part: grayish-black shale containing dark-gray and dark-red septarian limestone concretions. Lower part. dark-gray to brown hard platy shale; many bentonite beds in basal 30-40 ft in southeast part of quadrangle; marine fossils.
			Gammon Ferruginous Member	575-750	Medium- to dark-gray shale, thin sandstone and siltstone layers locally; many thin tabular dark-red siderite concretions; a few gray septarian limestone concretions in upper 50-100 ft; sparse marine fossils.
		Niobrara Formation		185-210	Marl and shale; weathers light gray and yellowish orange; several thin beds of bentonite: marine fossils.
Cretaceous	Upper Cretaceous	Carlile Shale	Sage Breaks Shale Member	290	Grayish-black shale; several beds of septarian limestone concretions that weather light gray; sparse marine fossils.
			Turner Sandy Member	185	Dark-gray shale and sandy shale; interlaminated and interbedded with light-gray siltstone and very fine grained sandstone; tan-weathering silty septarian limestone concretions; marine fossils
			Pool Creek Shale Member	40-50	Dark-gray shale; a few silty partings; thin bentonite bed in lower part; marine fossils.
		Greenhorn Formation		75-170	In southeast part of quadrangle, dark-gray to brownish-gray calcareous and noncalcereous shale that contains thin seams of light-gray limestone and a few beds of gray septarian limestone concretions in the upper part; grades northwestward to dark-gray non- calcareous shale containing large light-gray septarian limestone concretions; marine fossils.
		Belle Fourche Shale		650-750	Grayish-black shale; dark-red siderite concretions in lower part; light-gray, tan, and yellowish-gray septarian limestone concretions in upper part; several thick bentonite beds; marine fossils in upper part.
		Mowry Shale		200-215	Siliceous light-gray shale grading to dark-gray shale in basal 15-20 ft; many bentonite beds; marine fossils.
		Newcastle Sandstone		20-50	Light-gray sandstone, brown and gray carbonaceous shale, and bentonite; marine and nonmarine fossils.

System	Series	Group, Formation, and Member		Thick-ness (feet)	Lithology
Cretaceous	Lower Cretaceous	Skull Creek Shale		185-210	Grayish-black shale; local siltstone parting sparse marine fossils.
		Inyan Kara Group	Fall River Formation	130	Brown-weathering sandstone, light to dark- gray siltstone, and dark-gray shale; locally carbonaceous.
			Lakota Formation	100-125	Light-gray sandstone and conglomeratic sandstone; variegated sandy claystone; nonmarine fossils.
Jurassic	Upper Jurassic	Morrison Formation		80-100	Greenish-gray and grayish-red claystone and marl, some grayish-white sandstone; nonmarine fossils.
		Sundance Formation		370	Greenish-gray shale, light-gray and light yellowish-gray sandstone, pink and tan siltstone, and light-gray glauconitic limestone; divided from top to bottom into the Redwater Shale, Lak, Hulett Sandstone, Stockade Beaver Shale, and Canyon Springs Sandstone Members.
	Middle Jurassic	Gypsum Spring Formation		10±	Massive white gypsum and red claystone. May be absent locally.
Triassic		Spearfish Formation		550	Red siltstone, sandstone, and claystone; thick gypsum beds in the lower part.
Permian		Minnekahta Limestone		40	Light-gray limestone.
		Opeche Shale		100	Red siltstone.
Carbon-iferous: Pennsylv-anian		Minnelusa Formation		800-850	Light-gray and red sandstone, gray limestone and dolomite, red shale; gypsum and anhydrite locally.
Carbon-iferous: Mississip-pian	Lower Mississippian	Pahasapa Limestone		500	Light-gray locally dolomitic limestone.
		Englewood Limestone		50	Pinkish-gray limestone.
Ordovician	Upper Ordovician	Whitewood Dolomite		50±	Light-gray to tan dolomite. May be absent in southern part of the quadrangle.
	Middle Ordovician	Winnipeg Formation		50±	Light yellowish-gray to greenish-gray silt-stone and greenish-gray shale. May be absent in southern part of the quadrangle
Cambrian	Upper Cambrian and Lower Ordovician	Deadwood Formation		300±	Mostly brown sandstone; some greenish-gray siltstone and shale, and gray limestone.
Precambrian					Metamorphic and igneous rocks.
Source: Mapel and Pillmore, 1964.					

2.1.2.3 Stratigraphy

In 1964 the USGS prepared a geology report of the Upton Quadrangle in Crook and Weston counties. The Upton 15-minute quadrangle includes approximately 215 square miles of the western slopes of the Black Hills and summarizes the different formations found within the area. Figure 3.4-3 of the ER (RER, 2015) depicts the geologic map for the project area including a geological cross section.

Stratigraphic units occur in a westward-facing monocline composed of Late Cretaceous marine sediments which include the Belle Fourche Formation overlain by Greenhorn and Carlisle formations. Bedding dips 15-20 degrees to the west-southwest. The Upton Site is located on a substrate of Belle Fourche Formation shale in a low lying area overlain by 15 to +50 feet of overburden. The overburden consists largely of swelling clays. The project area is also within the boundaries of Quaternary alluvium deposited by Coyote Creek.

Four deep monitor wells were drilled within the project area. Figure 2.1-1 illustrates the lithology obtained from the monitor wells and the formations found within the site. Figure 2.1-1 also exhibits two geologic cross sections that are used to illustrate the subsurface stratigraphy of the project area. Based on the USGS, the stratigraphic sequence includes the Belle Fourche Shale, Mowry Shale, Newcastle Sandstone, Skull Creek Shale, and the Inyan Kara Group.

As shown on the geologic cross sections, the lithology of the Upton Plant Site primarily includes shales with interbedded clays and sand layers. Monitor well UMW-03 was drill specifically to target the Newcastle Sandstone Formation which runs in a north-southeast direction.

2.1.2.4 Historic Exploration and Mine Development Activities at the Upton Plant Site Area

Bentonite mining has been important to the economy of Weston County since the early twentieth century. The vicinity of Upton was extensively mined for bentonite. Reclaimed bentonite pits exist within the Upton Plant Site permit area, providing evidence that bentonite exploration and mining occurred there in the past. American Colloid's permit number 621 included some of the eastern portion of RER's Upton Plant Site permit area. Additionally, oil and gas exploration has been, and is, common in Weston County. However, a search of the Wyoming Oil and Gas Commission's records does not show any wells having been drilled within the permit area.

2.2 SEISMOLOGY OF THE UPTON PLANT SITE PERMIT AREA

The seismic hazard review for the Upton Plant Site was based on analysis of available literature and historical seismicity for the permit area. There are no capable faults (i.e. active faults) with surface expression mapped within or near the permit area, according to the USGS. The closest capable fault to the site is the Stagner Creek fault system located in central Wyoming approximately 185 miles (298 km) to the west-southwest. The faults at Yellowstone National Park are located approximately 275 miles (443 km) to the west-northwest (USGS, 2010).

2.2.1 SEISMICITY

Earthquakes are common in Wyoming and have occurred in every county in the State over the past 120 years. Most of these have occurred in the northwestern part of the State (Case and Green, 2000). Twenty recorded earthquakes with a magnitude greater than 2.5 (Richter Magnitude Scale) or intensity greater than III (Modified Mercalli Intensity Scale) have been recorded within a 60-mile radius of the Upton Plant Site (Wyoming State Geological Survey – WSGS, 2013; USGS, 2013; South Dakota Geological Survey - SDGS, 2013).

Natural earthquakes in Wyoming occur because of movements on existing or newly created faults or movements of (or in) the magma chamber beneath Yellowstone National Park. As

discussed in the preceding section, no faults have been mapped within 185 miles of the Upton Plant Site permit area (USGS, 2010).

Earthquakes generally do not result in ground surface rupture unless the magnitude of the event is greater than 6.5. Because of this, areas of the state that do not have active faults exposed at the surface, such as the Upton Plant Site permit area, are generally thought to be incapable of having earthquakes with magnitudes over 6.5. Earthquakes with magnitudes less than 6.5 would cause little damage in specially built structures, but could cause considerable damage to ordinary buildings and severe damage to poorly built structures. Some walls could collapse. Underground pipes would generally not be broken, and ground cracking would not occur or would be minor (Case and Green, 2000).

2.2.2 HISTORIC SEISMICITY NEAR PERMIT AREA

Aforementioned, twenty recorded earthquakes of magnitude greater than 2.5 or intensity greater than III have occurred within a 60-mile radius of the Upton Plant Site (WSGS, 2013; USGS, 2013; SDGS, 2013). Only two recorded earthquake of greater than magnitude 2.5 has occurred in Weston County. The earliest recorded occurred near Osage on May 1, 1926 approximately 14 miles southeast of Upton, and was intensity IV. There were reports of dishes shifting and objects moving (Case et al., 2002). The second was a magnitude 2.7 earthquake that occurred on May 2, 2006 approximately 18 miles southwest of the Upton Plant Site permit area. The intensity IV-V earthquake of 1897 southwest of Sundance, the magnitude 3.7 earthquake of 2004 near Moorcroft, the magnitude 4.3 earthquake of 1972 approximately 28 miles northwest of Upton, and the magnitude 3.8 earthquake of 2012 near Gillette were within 60 miles of the Upton Plant Site (WSGS, 2013). Several other earthquakes have occurred in Campbell County within 60 miles of the Upton Plant Site. On February 6, 1996, a magnitude 3.7, intensity V earthquake was recorded near Hill City, South Dakota. Wyoming residents living 22 miles north of Newcastle reported dishes being shaken off shelves (Case et al., 2002). Five other earthquakes of magnitude 2.5 or greater have occurred in South Dakota within a 60-mile radius (SDGS, 2013).

2.2.3 SEISMIC RISK

Weston County is in Uniform Building Code (UBC) Seismic Zone 0 and Zone 1. Upton and the Upton Plant Site are located in Zone 0 which suggests that there is a 90% probability that an earthquake with an acceleration of 5%g would not occur within any 50-year period. An average peak acceleration of 5%g could be applied to non-critical facilities, but is significantly less than values suggested by newer building codes (Case et al., 2002).

When considering earthquakes occurring within a tectonic province, or “floating earthquakes,” a magnitude 6.25 earthquake placed within 15 km of any structure within Weston County would produce horizontal accelerations of 15%g at the site. This would provide a fairly conservative estimate for design ground accelerations (Case et al., 2002).

2.3 TOPOGRAPHY

The proposed TSF site is located along the western flank of a broad flat-lying valley that slopes in a southeasterly direction. Stand Alone Report 2 in the ER provides topographical maps of the area. A modest northwest-southeast trending ridgeline with a maximum elevation of approximately 4,450 feet defines the west side of the valley. The slopes extending from the ridge down into the valley are slightly rough with an average grade of 45 to 50 percent towards the valley. The slopes are cut with incised drainage channels created by groundwater springs and erosion due to surface water runoff that initiate primarily in the upper third of the ridgeline slopes based on site observations. The channels appear less defined below their transition into

the shallow sloping valley. An irrigation dam remains intact on one channel. The existing grade within the TSF footprint slopes gently to the east-southeast with slopes of approximately 0.5 to 1.0 percent. Within the TSF footprint, existing ground surface elevations vary from approximately 4,230 to 4,285 feet above mean sea level (amsl).

2.4 SURFACE AND GROUND WATER

The follow subsection provide summaries of regional and site specific ground water and surface water hydrology of the Upton Plant Site area.

2.4.1 REGIONAL GEOHYDROLOGY

The Upton Plant Site is located in the northern portion of Weston County, Wyoming, west of the Black Hills Uplift. Sedimentary rocks exposed in the Upton quadrangle are approximately 5,900 feet thick including strata of Late Jurassic and Cretaceous age. These rocks overlie as much as 2,800 feet of unexposed sedimentary rocks of Cambrian to Jurassic age (Mapel and Pillmore, 1964).

Within Weston County groundwater has been utilized from rocks ranging in age from the Mississippian (Madison Formation) to the Quaternary. Adequate supplies for domestic or stock use can be developed from wells generally less than a 1,000 feet deep, except in those areas underlain by the thick sequence of marine shale that extend from the southeastern to northwestern corners of Weston County. Wells completed in the shale sequence generally yield small quantities of highly mineralized waters, generally unsuitable for most uses.

The seven geohydrologic units within Weston County include the (1) igneous and metamorphic rocks, (2) marine carbonate and sandstone sequence (Deadwood to Minnelusa Formations), (3) red-bed and gypsum sequence (Opeche Shale to Gypsum Spring Formation), (4) marine, marginal marine, and continental sandstone and shale sequence (Sundance through Inyan Kara), (5) marine shale sequence (Skull Creek to Pierre Shale), (6) continental sandstone and shale sequence (Fox Hills to Fort Union Formation), and (7) Quaternary-age alluvium deposits.

Water-bearing properties of the igneous and metamorphic rocks is relatively unknown and no wells are noted to be developed in this unit within Weston County. The red-bed and gypsum sequence of the Opeche to Gypsum Spring Formation consists almost entirely of fine-grained clastics and evaporites with little permeability and waters are commonly highly mineralized. The marine shale sequence of the Skull Creek to Pierre Shale have the lowest yields noted in Weston County and sandstones that occur are silty, fine-grained, and discontinuous, and waters are commonly highly mineralized. This marine shale sequence includes Belle Fourche Shale which is the surficial geologic unit at the Upton Plant Site. These three geohydrologic units are very minor water-bearing zones in the region, and no further discussion of these units is provided. Further discussion is restricted to the primary aquifers in the region that includes the Deadwood to Minnelusa Formations, the Sundance to Inyan Kara, the Fox Hills to Fort Union, and Quaternary deposits.

The Deadwood to Minnelusa unit includes the Late Cambrian and Early Ordovician-age Deadwood Formation, the Ordovician-age Winnipeg Formation and Whitewood Dolomite, the Devonian and Early Mississippian age Pahasapa Limestone (Madison equivalent), and the Pennsylvanian and Early Permian-age Minnelusa Formation. The largest yields are generally from the Pahasapa Limestone, reported at more than 1,000 gallons per minute (gpm). The second major water-bearing formation is the Minnelusa Formation, with the largest yields of 300 gpm reported in Weston County (Lowry et al., 1984).

The Sundance, Morrison, and the Lakota and Fall River formations of the Inyan Kara Group are approximately 650 feet thick in Weston County. Sandstones and conglomerates in the Inyan

Kara Group can yield as much as 146 gpm to wells. The Lakota is generally a more productive aquifer than the Fall River, as more wells are drilled deeper to the Lakota to obtain adequate supply, and the Lakota generally supplies higher quality water. Most Lakota wells are flowing at the surface, generally yielding less than 30 gpm, which could be increased by pumping. Yields in the Sundance are similar to the Lakota, though most Sundance wells are shallow and drilled near outcrop (Lowry et al., 1984).

The Fox Hills to Fort Union sequence is composed of the marginal marine Fox Hills Sandstone, overlain by the continental deposits of the Late Cretaceous Lance Formation and Paleocene-age Fort Union Formation. Wells are completed in the sandstone intervals of these formations at depths of less than 600 feet. Yields are suitable in quantity and quality for domestic and stock usage (Lowry et al., 1984).

Quaternary-age alluvium deposits consist of primarily silt, clay, and fine-grained sand in the alluvial valleys of Weston County. Most stream valleys are less than a ¼-mile wide, and alluvial deposits are less than 100 feet thick, commonly less than 50 feet thick. Due to the fine-grained sediments, permeability is generally low and yields are small. Reported yields are generally less than 10 gpm, with some higher yields above 60 gpm reported in Beaver Creek and Stockade Beaver Creek. The largest yields are reported along the Cheyenne River, where yields from 200 to 900 gpm are reported (Lowry et al., 1984).

2.4.2 UPTON SITE GROUNDWATER

Shallow groundwater at the Upton site is limited to shallow (less than 20 feet) groundwater that accumulates in perched and isolated zones within the shallow accumulations of alluvial valley fill and weathered upper portion of the surficial geologic formation, the Belle Fourche Shale.

Deeper groundwater at the Upton Plant Site is found several hundred feet below the uppermost Belle Fourche Shale and Mowry Shale, in the Newcastle Sandstone and the Inyan Kara Group. Regionally, the Fall River and Lakota formations of the Inyan Kara Group are referred to as the Dakota Aquifer System. Below the Newcastle is the underlying the Skull Creek Shale.

Groundwater encountered at the Upton Plant Site permit area is grouped for further discussion into the shallow waters encountered in the valley fill and weathered shale, and into the deeper waters of the Newcastle Sandstone and Dakota Aquifer (Inyan Kara Group, specifically Fall River Formation).

The shallow groundwater unit composed of the valley fill and the weathered shale is considered a single hydrostratigraphic unit within the Upton Plant Site permit area. The unit is not considered an aquifer, as well yields in the fine-grained alluvium and weathered shale are low (based on groundwater sampling) and the waters are highly mineralized and not suitable for any use (RER, 2014). Groundwater in the valley fill and weathered shale units exceeds multiple standards for Class, I, Class II, and Class III groundwaters of the state. Based on the degree of fine-grained sediments, the hydraulic conductivities of this unit are expected to be very low. The depth of this unit ranges from 8.5 to 19 feet below ground surface (bgs).

The deeper waters of the Newcastle Sandstone and Dakota Aquifer are well below the TSF (approximately 800 feet). Based on the geophysical log, the thickness of the porous interval of the Newcastle is approximately 10 to 20 feet thick at this well location. Regional information related to permeability in this aquifer indicates that the Newcastle Sandstone is exploited near outcrop only. Regional oil field data indicates a porosity between 5% to 27%, with permeabilities of less than 11 gallons per day per square foot (gpd/ft^2), and transmissivities from 0 to 140 gallons per day per foot (gpd/ft) (HKM Engineering, 2002). Wells completed in the Newcastle Sandstone and Dakota Aquifer within the Upton Plant Site permit area are either sodium bicarbonate type or sodium sulfate type. Average total dissolved solids (TDS) concentrations in the Dakota Aquifer wells range between 621 to 826 milligrams per liter (mg/L). The average

TDS concentration in a well completed in the shallower Newcastle Sandstone is significantly higher at over 7,000 mg/L.

The following summarizes exceedances of U.S. Environmental Protection Agency (EPA) Maximum Contaminant Levels (MCLs) or EPA Secondary Drinking Water Standards for the deep Upton groundwater wells:

- Gross Alpha (MCL of 15 picocuries per liter - pCi/L): Exceeded in Upton Monitoring Well (UMW-04).
- Benzene (MCL of 0.005 mg/L): Exceeded in well UMW-03.
- TDS (Secondary standard of 500 mg/L): Exceeded in all wells.
- Chloride (Secondary standard of 250 mg/L): Exceeded in well UMW-04.
- Sulfate (Secondary standard of 250 mg/L): Exceeded in UMW-02, UMW-03, and UMW-04.
- Fluoride (Secondary standard of 2.0 mg/L): Exceeded in well UMW-04.
- Aluminum (Secondary standard of 0.05 – 0.2 mg/L): Exceeded in wells UMW-01, UMW-03, and UMW-04.
- pH (Secondary standard of 6.5 – 8.5): Exceeded in all wells.
- Manganese (Secondary standard of 0.05 mg/L): Exceeded in well UMW-04.
- Iron (Secondary standard of 0.3 mg/L): Exceeded in well UMW-04.

2.4.3 REGIONAL HYDROLOGY

The Upton Plant Site near Upton, Wyoming is located in the northern plains of the Cheyenne River Basin (Hydrologic Unit Code 101201). The Cheyenne River originates in northeastern Wyoming, and flows easterly to the Wyoming-South Dakota State line into southwestern South Dakota and then flows northeasterly until it empties into the Missouri River at Lake Oahe. Its drainage area is approximately 24,300 square miles and the total stream length is approximately 295 miles (USGS, 2009). Map 3.5-1 in the ER (RER, 2015) depicts the Cheyenne River drainage basin. The Upton Plant Site permit area constitutes approximately 0.005 percent of the greater Cheyenne River drainage basin.

This area is in the semi-arid West where evaporation exceeds annual precipitation. The streams in the immediate area of the Upton Plant Site are ephemeral. The Upton Plant Site is located near the headwaters of Coyote Creek, a tributary to Iron Creek. Coyote Creek flows approximately 5 stream channel-miles to Iron Creek. Iron Creek is a tributary to Beaver Creek. It flows approximately 11.6 stream channel-miles to Beaver Creek. Beaver Creek flows approximately 117 stream channel-miles to where it empties into the Cheyenne River near the Wyoming-South Dakota State line.

There are no USGS gaging stations on Coyote Creek, Iron Creek, or Beaver Creek. Seven USGS gaging stations are located on the Cheyenne River downstream of the Beaver Creek–Cheyenne River confluence and before the point at which the Cheyenne River empties into Lake Oahe. The highest annual flows have occurred between February and November. The timing of these peak flows indicates that spring runoff, in particular, and snow melt result in the highest flows of the Cheyenne River drainage basin.

2.4.4 UPTON SITE HYDROLOGY

At the Upton Plant Site, surface water hydrology adjacent to and within the project area is dominated by southeastward flowing Coyote Creek and its associated tributaries. The majority of the Coyote Creek drainage area is composed of minor, ephemeral stream channels. The total drainage area of Coyote Creek at the point that it leaves the project area is approximately 4.48 square miles. After leaving the project area, Coyote Creek continues southeastward until it empties into Iron Creek.

The Coyote Creek drainage basin within the project area is composed of rolling plains and rangeland. A hogback ridge runs along the western side of the permit area. Maximum basin relief is approximately 200 feet. Stream channels generally slope at less than 1 percent to 2 percent.

The Upton Plant Site surface waters were also categorized use using the Wyoming Department of Environmental Quality–Water Quality Division (WDEQ-WQD) Classification Standards. Coyote Creek is classified a 3B stream. The stream Coyote Creek empties into, Iron Creek, is also classified a 3B stream (WDEQ-WQD, 2001). The 3B streams are intermittent or ephemeral streams incapable of supporting fish populations or drinking water supplies (WDEQ-WQD, 2001).

3.0 DESCRIPTION OF THE TAILINGS

Two waste streams will be discharged from the Hydromet plant and combined for deposition into the TSF. They include the solids from initial acid leaching and precipitated metal carbonates from the acid recovery process. Blending and neutralization of these two waste streams will occur at the Hydromet Plant prior to the final waste being transported to the TSF.

The source material content of these waste streams are summarized in Table 3.0-1.

Table 3.0-1
Thorium and Uranium Mass and Activity Concentrations for Tailing Material

Material	Thorium Content (wt %)	Uranium Content (wt %)	Natural Thorium Concentration (pCi/g)[a]	Natural Uranium Concentration (pCi/g)[a]
Leach Solids	0.02	0.003	44	21
Precipitated Metal Carbonates[b]	0.00	0.024	0.0	170
Final Tailing	0.02	0.003	44	21

[a]Mass units were converted to activity units using specific activity of 2.2×10^{-7} and 7.1 x 10-7 Ci/g for thorium-232 and uranium-238, respectively. Natural uranium and thorium means naturally occurring isotopes present in naturally occurring activity ratios.

[b]The mass of the metal carbonates is very small compared to the leach solids and does not change the radionuclide concentration of the leach solids once mixed.

Based on current production estimates, the Hydromet Plant will have a 45 year operating life, and will operate at pre-concentrate feed rates of approximately 500 short tons per day (stpd) for the first 9 years and approximately 600 stpd for an additional 36 years. The Hydromet Plant will generate tailing material at average rates of approximately 815 stpd for the first 9 years and approximately 1,000 stpd for the remaining 36 years. The increase in waste over the feed rate is a function of the precipitation of additional waste solids from the additives used in the Hydromet Plant and the use of neutralizing agents for the tailing material.

4.0 TAILING STORAGE FACILITY DESIGN

Design guidelines and criteria for the TSF are in accordance with the WDEQ-LQD Noncoal Mine Rules and Regulations. The general environmental protection performance standards for tailing storage area facilities include (WDEQ-LQD, 2006):

- Tailings disposal areas shall be designed, constructed, and operated in accordance with established engineering principles using best technology currently available to ensure long term stability and to prevent contamination of surface or groundwater.
- Appropriate leak detection and groundwater monitoring systems shall be installed to detect any movement of contaminated fluids from the facility. Any leakage or movement of contaminated fluids shall be promptly controlled and remediated using the best technology currently available.
- Reclamation of tailings disposal areas shall be accomplished by removal and storage of all topsoil present within the affected lands. After termination of operations, the facility shall be reclaimed in accordance with the approved plan using best technology currently available to ensure long term stability, prevent contamination of surface or groundwater and facilitate the approved post-mining land uses.

The TSF design and operational features intended to meet the above requirements include:

- Designed to be operated as a dry-stack waste facility
- Maximum height of 130 feet above existing grade
- Operational side slopes of 3.5H:1V
- Underdrain system to manage and convey groundwater seeps and springs
- Composite liner system consisting of (from top to bottom)
    - 12 inch thick low permeability soil liner
    - 80 mil high density polyethylene (HDPE) smooth geomembrane
- Seepage collection and contact water management system
    - Toe drain system at the northern end of the TSF
    - Collection and evaporation ponds with ability to reclaim excess water for use as make-up water at the Hydromet Plant
- Active tailings deposition operations will be limited to 35 acres at any given time to limit fugitive dust releases and or erosion from runoff
- 6 inches of interim soil cover for areas dormant for more than 60 days
- Tailing material will be placed in lifts about 4 to 7 feet thick

Reclamation of the TSF includes the following features:

- A geotextile installed directly over the TSF surface to provide stability for the heavy equipment placing backfill and cover material
- 30 inches of random fill placed over the geotextile
- 24 inches of rock fill place over the random fill
- 10 inches of subsoil over the rock fill
- 12 inches of topsoil over the subsoil
- The TSF surface and embankment slope will be re-vegetated

The WDEQ-LQD will provide the regulatory oversight of the TSF to ensure the general environmental protection performance standards are met.

5.0 PUBLIC DOSE EVALUATION

A dose assessment for a worker (a member of the public during TSF operations) and members of the public following TSF closure is provided below.

5.1 WORKER DOSE ASSESSMENT

The workers at TSF will be exposed to the small amounts of radioactive material in the tailing material. The magnitude of the potential exposures will depend on the concentrations of radionuclides in the tailings. The average uranium and thorium concentrations in the tailing material is shown in Table 3.0-1 above.

The thorium and uranium series decay products were also assumed to be in radioactive equilibrium.

5.1.1 DOSE COEFFICIENTS

Dose coefficients (DCs) of 1.2 x 10^{-3} and 1.5 x 10^{-3} millirem per hour (mrem/hr) per pCi/g for uranium-238 and thorium-232, respectively, were used to estimate external doses from large sources of naturally occurring radioactive material (NORM) that would be indicative of TSF (United Nations Scientific Committee on the Effects of Atomic Radiation - UNSCEAR, 2000). These DCs assume that decay series radionuclides are in equilibrium and are similar to DCs developed using Federal Guidance 12 (EPA, 1993).

Internationally accepted DCs of the International Commission on Radiation Protection - ICRP (1994) were used to estimate internal doses from inhalation and ingestion of NORM in dust. Table 5.1-1 lists the DCs. This evaluation omits the small contributions to dose from the uranium-235 decay series. The DCs for each radionuclide in the thorium and uranium decay series were summed, resulting in two DCs as shown in Table 5.1-1; one each for the thorium and uranium decay series. As in the external dose estimate, radionuclides in each decay series were assumed to be in equilibrium.

Table 5.1-1
Worker Radiation Dose Coefficients for Inhalation and Ingestion Pathways

Decay Series	Radionuclide	Worker Radiation Dose Coefficients (mrem/pCi)[a]	
		[T]Inhalation	Ingestion
Uranium	Uranium-238	$2.1x10^{-2}$	$1.6 x10^{-4}$
	Uranium-234	$2.5 x10^{-2}$	$1.8 x10^{-4}$
	Thorium-230	$2.7 x10^{-2}$	$7.8 x10^{-4}$
	Radium-226	$8.1 x10^{-3}$	$1.0 x10^{-3}$
	Lead-210	$4.1 x10^{-3}$	$2.5 x10^{-3}$
	Polonium-210	$8.1 x10^{-3}$	$8.9 x10^{-4}$
	Sum of all uranium-238 decay series radionuclides except radon-222	**$9.3 x10^{-2}$**	**$5.6 x10^{-3}$**
Thorium	Thorium-232	$4.4 x10^{-2}$	$8.1 x10^{-4}$
	Radium-228	$6.3 x10^{-3}$	$2.5 x10^{-3}$
	Actinium-228	$4.4 x10^{-5}$	$1.6 x 10^{-6}$
	Thorium-228	$1.2 x10^{-1}$	$1.3 x10^{-4}$
	Radium-224	$8.9 x10^{-3}$	$2.4 x10^{-4}$
	Lead-212	$1.2 x10^{-4}$	$2.2 x10^{-5}$
	Bismuth-212	$1.4 x10^{-4}$	$9.6 x10^{-7}$
	Sum of all thorium-232 decay series radionuclides except radon-220	**$1.8 x10^{-1}$**	**$3.7 x10^{-3}$**

[a]Worker radiation DCs from ICRP 68 (ICRP, 1994) except for revised radium-226 inhalation coefficients from ICRP 72 (ICRP, 1996). All are for least soluble form. Inhalation dose coefficients are for 5 micron particle size.

5.1.2 ESTIMATED WORKER DOSES

Table 5.1-2 lists the input parameters used to estimate doses to workers. Table 5.1-2 also defines the variables used in the following equations. The estimate is evaluated for a heavy equipment operator leveling tailings material on the TSF. Although the tails contain an unimportant quantity of source material, this worker is expected to receive the highest occupational does from the due to the period of time managing the tailings material. There is no off-site transport of the tailing material; therefore, no dose assessment is performed as suggested in NRC guidelines (NRC, 2009). The NRC acknowledges that past reviews have indicated that worker dose at the receiving facility tends to bound the doses from other scenarios (NRC, 2009). The heavy equipment operator leveling tailings would be equivalent to the worker at a waste disposal receiving facility.

Table 5.1-2
Input Parameters Used to Estimate Worker Radiation Dose

Parameter Name	Variable ID	Value	Units	Source
Worker Inhalation Rate	W_{inh}	1.2	m^3/hr	ICRP, 1994
Worker dust ingestion rate	W_{ing}	0.05	g/day	EPA, 1991
Worker exposure time to ore and dust in a year	t	2000	hr/yr	Based on 8 hours a day for 250 days
Fraction of time spent on tailings pile	f_{tp}	0.38	Unit less	Based on tailing production rate of 1,500 stpd (approximately 1,000 cubic yards per day) and D6 production rate of 300 cubic yards per hour (Caterpillar Handbook Edition 29)
Heavy equipment shielding factor	f_{sh}	0.7	Unit less	Shielding from heavy equipment (NRC, 2001) NUREG 1717
Working days per year	t_d	250	D	Based on 5 day per week for 50 weeks
Mass-based dust concentration	C_d	0.001 and 0.01	g/m^3	Section 5.1.2
In-Cab Air Reduction Factor	f_{CA}	0.7	Unit less	National Institute for Occupational Safety and Health - NIOSH, 2008
Tailing U-238 concentration	U_T	10	pCi/g	Table 3.0-1
Tailing Th-232 concentration	Th_T	22	pCi/g	Table 3.0-1
External Radiation Dose Coefficient U-238	DCU_{ext}	1.2×10^{-3}	mrem/hr/pCi/g	Section 5.1.1
Inhalation Radiation Dose Coefficient for uranium series	DCU_{inh}	9.3×10^{-2}	mrem/pCi	Table 5.1-1
Ingestion Radiation Dose Coefficient for uranium series	DCU_{ing}	5.6×10^{-3}	mrem/pCi	Table 5.1-1
External Radiation Dose Coefficient Th-232	DCT_{ext}	1.5×10^{-3}	mrem/hr/pCi/g	Section 5.1.1
Inhalation Radiation Dose Coefficient for thorium series	DCT_{inh}	1.8×10^{-1}	mrem/pCi	Table 5.1-1
Ingestion Radiation Dose Coefficient for thorium series	DCT_{ing}	3.7×10^{-3}	mrem/pCi	Table 5.1-1

Equation 1 was used to estimate external doses.

$$D_{ext} = [(U_T \times DCU_{ext}) + (Th_T \times DCT_{ext})]x\ t\ x\ f_{sh}\ x\ f_{tp} \qquad \text{(Equation 1)}$$

Equation 2 was used to estimate internal doses from inhalation of radioactive material in dust. A nuisance dust level of 1 milligram per cubic meter (mg/m^3) was used in this assessment, which is a reasonable estimate of typical dust levels at mine and processing facilities, in particular the TSF because the tailing material will be placed as a stackable paste with a high moisture content. This will likely reduce levels of nuisance dust below the level assumed herein.

$$D_{inh} = [(U_T \times DCU_{inh}) + (Th_T\ \times\ DCT_{inh})]C_d \times W_{inh} \times t\ \times f_{CA}\ x\ f_{tp} \qquad \text{(Equation 2)}$$

Equation 3 was used to estimate internal doses from ingestion of NORM in dust.

$$D_{ing} = \left[\left(U_T \times DCU_{ing}\right) + (Th_T DCT_{ing})\right]W_{ing} \times t_d\ x\ f_{tp} \qquad \text{(Equation 3)}$$

Table 5.1-3 lists the estimated external and internal doses. Worker exposure to radon was not addressed in this assessment. The ambient diffusion of radon from open areas and the low concentrations of radionuclides in the tailing material are expected to control radon and its decay products to levels that would not add significantly to worker dose.

The dose estimates in Table 5.1-3 demonstrate two key points. First, a dose estimate of 27 millirem per year (mrem/yr) -- using conservative assumptions-- is far below the regulatory limit for occupational radiation doses contained in 10 CFR §20 for licensed radioactive material. In fact, the radiation monitoring requirement for individuals described in 10 CFR §20.1502 would not apply because the annual dose less than 10 percent of the 5,000 mrem/yr limit for occupational workers. Secondly, a conservative dose estimate of 27 mrem/yr is near radiological criteria for unrestricted use of 25 mrem/yr contained in10 CFR §20.1402 and is within the 25 to 100 mrem/yr dose range the NRC would typically consider for approval in 10 CFR §40.13(a) exemption requests for off-site disposal (NRC, 2009).

Table 5.1-3
Radiation Dose Estimates for Bull Dozer Operator at the TSF (mrem/yr)

Pathway	Thorium Series	Uranium Series	Total
External	17.3	6.3	23.6
Inhalation	2.5	0.6	3.1
Ingestion	0.4	0.3	0.7
Total	**20.2**	**7.2**	**27.4**

5.2 POST-CLOSURE DOSE EVALUATION

NRC guidance (NRC, 2009) recommends dose evaluations for disposal facilities following closure. The TSF meets the scenarios described in NRC guidance for transfer of unimportant quantities of source material to a permitted facility for disposal. The TSF would be permitted by the WDEQ-LQD. This evaluation will follow the guidance for off-site disposal for 10 CFR §40.13(a) exemption requests. For off-site disposal requests, NRC guidance (NRC, 2009) recommends following NUREG-1757 Volume 2, Appendices I and J for post closure dose modeling.

NUREG-1757 Volume 2, Appendix J provides the assessment strategy for buried material but not necessarily a designed containment structure such as the TSF. The TSF will be monitored following closure to ensure stability and the resources such as groundwater and surface water are not impacted. The design of the TSF cover is for long term stability and protection of the environment. The most likely future land use scenario for the TSF is an industrial or commercial use because the site is currently adjacent to an industrial park and the soil quality near the site is generally poor. A commercial land use scenario will be used for compliance with NRC dose guidelines. A resident farmer scenario will be used to evaluate the upper bounds of dose from the TSF. A resident farmer is not a reasonable foreseeable land use in light of the poor quality of soil at the site and the industrial nature of the surrounding area. Both scenarios following closure include a pathway analysis to preclude evaluation of unimportant or incomplete pathways.

5.3 INDUSTRIAL WORKER AND RESIDENT FARMER PATHWAY ANALYSIS

At closure, the TSF will contain a cover of nearly 7 feet thick as described in Section 4.0. The cover is stabilized with a sustainable vegetative cover.

The industrial scenario will include an industrial building on the TSF. Minimal disturbance of the cover is assumed due to the thickness and cover type. The livestock, crops, and the fish pathways are incomplete in the industrial scenario and are not evaluated. Due to the thickness of the cover (approximately 7 feet), unsuitability of baseline groundwater in the area for domestic uses (Section 2.4.2), and design of the TSF, the following pathways are excluded in the industrial use pathway:

- External exposure from soil
- Inhalation from suspended soil
- Ingestion from soil
- Ingestion from drinking water

For reasons indicated above, the exposure pathway for the industrial scenario is limited to radon. Worker exposure was assumed to occur indoors to be conservative in the radon dose estimate.

The resident farmer scenario as described in NUREG 1757, Volume 2, Appendix I consists of an intruder coming onto the TSF and building a home on top of the TSF. It assumes that material from the TSF (i.e. the tailings material) is displaced from its location and brought to the surface where the resident farmer is exposed. With a cover of nearly 7 feet, it is unreasonable to expect a significant amount of tailings material to be brought to the surface during construction of a home and if material is brought to the surface, it would be mixed with the overlying cover material to a concentration much lower than the tailing material itself. Table 5.3-1 presents the pathways suggested in NUREG 1757 for the residential farmer scenario and provides site specific reasons why each pathway is or is not included in this analysis.

Table 5.3-1
Resident Farmer Pathway Analysis for Post-Closure Dose Assessment of the TSF

Parameter Name	Pathway Include (Y/N)	Justification for Decision
External exposure from soil	N	There are high energy gamma emitters in the thorium and uranium decay series. The cover is approximately 7 feet thick so very little external dose will be received by a resident farmer. Some tailings material could be brought to the surface by activities such as well installation or septic system construction but this material would be mixed with the overlying cover material and the resulting volume and radionuclide concentrations would be insignificant.
Inhalation from suspended soil	N	The TSF cover is approximately 7 feet thick and is protected from erosion by a vegetative cover and an underlying rocky material layer. Some tailings material could be brought to the surface by activities such as well installation or septic system construction but this material would be mixed with the overlying cover material and the resulting volume and radionuclide concentrations would be insignificant.
Ingestion from soil	N	
Ingestion from drinking water	N	The TSF is designed to preclude groundwater contamination during operations. The low permeability earthen liner will continue to protect groundwater following closure. Additionally, the vegetative cover and the low annual rain fall at the site will likely mitigate infiltration of water through the cover and into the tailings material. Finally, baseline groundwater quality in the area is unsuitable for domestic uses (Section 2.4.2).
Ingestion of plant products grown in contaminated soil and using aquifer to supply irrigation needs	N	The TSF cover is approximately 7 feet thick and is protected from erosion by a vegetative cover and an underlying rocky material layer. Some tailings material could be brought to the surface by activities such as well installation or septic system construction but this material would be mixed with the overlying cover material and the resulting volume and radionuclide concentrations would be insignificant.
Ingestion of animal products grown onsite (using feed and water derived from potentially contaminated sources	N	
Ingestion of fish	N	There are no perennial streams near the TSF.
Inhalation of radon	Y	Radon-222 could diffuse through the cover material and into the home of the resident farmer.

RESRAD Version 6.5 (RESRAD) was used to estimate the total effective dose for both scenarios. Radionuclide concentrations in Table 3.0-1 in equilibrium with progeny was assumed. The site specific parameters used in the analysis are presented in Table 5.3-2. All other parameters were default values used in RESRAD which are typically conservative.

Based on this evaluation, the highest dose to the industrial work worker, the compliance case, was 0.6 mrem/yr occurring during the first year. This dose slowly decreased over time to around 0.35 mrem/yr at year 1,000. The dose to the residential farmer in the bounding case is estimated to be 33 mrem/yr in the first year and slowly decreasing to 10 mrem/yr in year 1,000. The RESRAD output results are contained in Attachment A.

The dose estimates for the industrial scenario, the compliance case, demonstrates two important points. First, a post-closure public dose estimate of 0.6 mrem/yr - using conservative assumptions - is far below the 100 mrem/yr regulatory limit for public radiation doses contained in 10 CFR §20 for licensed radioactive material during site operations. Secondly, a conservative dose estimate of 0.6 mrem/yr, due to radon-222 is far below the radiological criteria for unrestricted use of 25 mrem/yr contained in 10 CFR §20.1402 which the NRC would typically consider for approval in 10 CFR §40.13(a) exemption requests (NRC, 2009).

Table 5.3-2
Site Specific Parameters Used for Residential Farmer and Industrial Worker Dose Analysis

Parameter Name	Industrial	Residential	Default Value	Unit	Justification for Value Used
Cover thickness	2.1 m	2.1 m	0	m	Preliminary design of the TSF includes a composite cover approximately 2.1 meters thick.
Cover Erosion Rate	0	0	0.001	m/yr	The TSF will have a sustainable vegetative cover as required by WDEQ-LQD regulations for non-coal mines.
Building Foundation	0.2	0.2	0.15	m	An 8 inch (0.2 meter) concrete slab foundation was assumed for a residence. The same thickness was assumed for the industrial scenario which is likely conservatively thin.
Building air exchange rate	5	0.7	0.5	per hour	(EPA, 1995) mean of west region for residential use, average industrial use from http://www.engineeringtoolbox.com/air-change-rate-room-d_867.html.
Building room height	3.7	2.7	2.5		Assumed 9 foot ceilings for new construction of residences, 12 foot ceilings for industrial use.
Foundation depth below ground surface.	0.2	0.2	1.0		Assumed an eight inch slab foundation of grade, typical of west construction.
Annual Exposure time	2,000	8,760	8,760	hour	2,000 hours per year is standard work year.

The dose estimates for the residential farmer scenario, the upper bounding case, demonstrates two important points. First, a post-closure dose estimate of 33 mrem/yr - using conservative assumptions - is well below the 100 mrem/yr regulatory limit for public radiation doses contained in 10 CFR §20 for licensed radioactive material during site operations. Secondly, a conservative dose estimate of 33 mrem/yr, due to radon-222 is near radiological criteria for unrestricted use of 25 mrem/yr contained in 10 CFR §20.1402, and is also at the low end of the 25 to 100 mrem/yr range that NRC would typically consider for approval in 10 CFR §40.13(a) exemption requests (NRC, 2009). The long term dose to the residential farmer would be approximately 10 mrem/yr in year 1,000, which is below the dose criteria in 10 CFR §20.1402.

6.0 SUMMARY

The following items provide justification to exclude the TSF from the licensing of source material at the site.

1. The TSF will consist of tailing material that qualifies as an unimportant quantity of source material as defined in 10 CFR §40.13(a).
2. The TSF will be permitted by the WDEQ-LQD and the design is required to meet the general environmental protection performance standards for tailing disposal area facilities.
3. The TSF will contain design features to protect ground and surface water from impacts resulting from storage of the tailings.
4. The radiation dose to workers on the TSF during operations is well below occupational standards and is within the 25 to 100 mrem/yr dose range the NRC would typically consider for approval in 10 CFR § 40.13(a) exemption requests (NRC, 2009).
5. The radiation dose to an industrial worker, the compliance case assessment, following closure of the TSF is well below public dose standards for licensed material is also below the 25 mrem/yr dose the NRC would typically consider for approval in 10 CFR §40.13(a) exemption requests (NRC, 2009).
6. The dose estimate in the bounding residential farmer is far below the regulatory limit for public radiation doses contained in 10 CFR §20 for licensed radioactive material.

Secondly, a conservative dose estimate of 33 mrem/yr, due to radon-222 is near radiological criteria for unrestricted use of 25 mrem/yr contained in 10 CFR §20.1402. The long term dose to the residential farmer would be approximately 10 mrem/yr in year 1,000, which is below the dose criteria in 10 CFR §20.1402.

7.0 REFERENCES

Case, J. C., and J.A. Green. 2000. *Earthquakes in Wyoming: Information Pamphlet 6.* Wyoming State Geological Society: Hazards. Accessed online: http://www.wsgs.uwyo.edu/Research/hazards/docs/earthquakes.pdf.

Case, J. C., Toner, R. N., and R. Kirkwood. 2002. *Basic Seismological Characterization for Crook County, Wyoming.* Seismological Characterizations of Wyoming Counties: Accessed online: http://www.wrds.uwyo.edu/wrds/wsgs/hazards/quakes/seischar/seischar.html. April 2013.

Golder Associates. 2013. *Tailings Storage Facility Preliminary Feasibility Design Report Bear Lodge Project*. December.

International Commission on Radiation Protection (ICRP). 1994. *Dose Coefficients for Intakes of Radionuclides by Workers*, ICRP Publication 68, Annals of the ICRP 24(4).

International Commission on Radiation Protection. 1996. *Age-dependent Doses to Members of the Public from Intake of Radionuclides: Part 5, Compilation of Ingestion and Inhalation Dose Coefficients*, ICRP Publication 72, Annals of the ICRP 26(1).

HKM Engineering. 2002. *Northeast Wyoming River Basins Plan*, Final Report. Prepared for Wyoming Water Development Commission, Basin Planning Program. February.

Lowry, M.E., Head, W.J., Rankl, J.G., and Busby, J.F. 1984. *Water Resources of Weston County, Wyoming*. USGS Water Resources Investigations Report 84-4079.

Mapel, W. J., and C.L. Pillmore. 1964. *Geology of the Upton Quadrangle, Crook and Weston Counties, Wyoming.* Contributions to General Geology: Geological Survey Bulletin 1181-J. Accessed online: http://pubs.usgs.gov/bul/1181j/report.pdf. April 2013.

National Institute for Occupational Safety and Health (NIOSH). 2008. *Key Design Factors of Enclosed Cab Dust Filtration Systems*. Report of Investigations 9677. November.

Rare Element Resources, Inc. (RER). 2014. *Bear Lodge Project: Plan of Operations for Mining Activities on National Forest System Lands*. Lakewood, Colorado.

Rare Element Resources, Inc. 2015. *Environmental Report in Support of the Radioactive Materials License Application for the Upton Plant Site*. May.

South Dakota Geological Survey (SDGS). 2013. *Earthquakes in South Dakota (1872-2013)*. South Dakota Department of Environment and Natural Resources: Protecting South Dakota's tomorrow...today! Accessed online: http://www.sdgs.usd.edu/publications/maps/earthquakes/earthquakes.htm.

United Nations Scientific Committee and the Effects of Atomic Radiation (UNSCEAR). 2000. *Sources and Effects of Ionizing Radiation – Volume 1: Sources*. Report to the General Assembly, with Scientific Annexes, United Nations, New York.

U.S. Environmental Protection Agency (EPA). 1991. *Risk Assessment Guidance for Superfund: Volume 1 - Human Health Evaluation Manual* (Part B, Development of Risk-based Preliminary Remediation Goals - Interim), EPA/540/R-92/003. December.

U.S. Environmental Protection Agency. 1993. Federal Guidance Report No. 12. *External Exposure to Radionuclides in Air, Water and Soil*. EPA-402-R-93-081. September.

U.S. Environmental Protection Agency. 1995. GEOMET Report Number IE-2603. Estimation of Distributions for Residential Air Exchange Rates. March.

U.S. Geological Survey (USGS). 2009. Hydrologic Unit Map (Based on Data from USGS Water Supply Paper 2294). Accessed online: http//water.usgs.gov/GIS/regions.html. Accessed June 15, 2012.

U.S. Geological Survey. 2010. *Quaternary Fault and Fold Database of the United States*. Earthquakes Hazards Program. Accessed online: http://earthquake.usgs.gov/hazards/qfaults/. November 3.

U.S. Geological Survey. 2013. *Global Earthquake Search (Beta)*. Earthquake Hazards Program. Accessed online: http://earthquake.usgs.gov/earthquakes/eqarchives/epic/. June.

U.S. Nuclear Regulatory Commision (NRC). 2001. *Systematic Radiological Assessment of Exemptions for Source and Byproduct Materials*, NUREG-1717.

U.S. Nuclear Regulatory Commission. 2009. Review, Approval, and Documentation of Low-Activity Waste Disposals in Accordance with 10 CFR 20.2002 and 10 CFR 40.13(a). EPPAD 3.5. August.

Wyoming State Geological Survey (WSGS). 2013. *Earthquakes: Search*. Wyoming Earthquakes Database IMS. Accessed online: http://ims.wsgs.uwyo.edu/earthquakes/. June.

Wyoming Department of Environmental Quality-Land Quality Division (WDEQ-LQD). 2006. Noncoal Environmental Protection Performance Standards, Rules and Regulations, Chapter 3, State of Woming, Cheyenne.

Wyoming Department of Environmental Quality-Water Quality Division (WDEQ-WQD). 2001. Wyoming Surface Water Classification List. Accessed online: http://deq.state.wy.us/wqd/watershed/surfacestandards/Downloads/Standards/2-3648-doc.pdf.

Attachment A

RESRAD Output-Results

RESRAD Output – Industrial

Summary : RESRAD Default Parameters
File : X:\PROJECT_DATA\RARE ELEMENTS BEAR LODGE\LICENSE APPLICATION\TSF INDUSTRIAL.RAD

Table of Contents

Part I: Mixture Sums and Single Radionuclide Guidelines

Summary : RESRAD Default Parameters
File : X:\PROJECT_DATA\RARE ELEMENTS BEAR LODGE\LICENSE APPLICATION\TSF INDUSTRIAL.RAD

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

0 Menu	Parameter	Current Value#	Base Case*	Parameter Name
A-1	DCF's for external ground radiation, (mrem/yr)/(pCi/g)			
A-1	Ac-228 (Source: FGR 12)	5.978E+00	5.978E+00	DCF1(1)
A-1	At-218 (Source: FGR 12)	5.847E-03	5.847E-03	DCF1(2)
A-1	Bi-210 (Source: FGR 12)	3.606E-03	3.606E-03	DCF1(3)
A-1	Bi-212 (Source: FGR 12)	1.171E+00	1.171E+00	DCF1(4)
A-1	Bi-214 (Source: FGR 12)	9.808E+00	9.808E+00	DCF1(5)
A-1	Pa-234 (Source: FGR 12)	1.155E+01	1.155E+01	DCF1(6)
A-1	Pa-234m (Source: FGR 12)	8.967E-02	8.967E-02	DCF1(7)
A-1	Pb-210 (Source: FGR 12)	2.447E-03	2.447E-03	DCF1(8)
A-1	Pb-212 (Source: FGR 12)	7.043E-01	7.043E-01	DCF1(9)
A-1	Pb-214 (Source: FGR 12)	1.341E+00	1.341E+00	DCF1(10)
A-1	Po-210 (Source: FGR 12)	5.231E-05	5.231E-05	DCF1(11)
A-1	Po-212 (Source: FGR 12)	0.000E+00	0.000E+00	DCF1(12)
A-1	Po-214 (Source: FGR 12)	5.138E-04	5.138E-04	DCF1(13)
A-1	Po-216 (Source: FGR 12)	1.042E-04	1.042E-04	DCF1(14)
A-1	Po-218 (Source: FGR 12)	5.642E-05	5.642E-05	DCF1(15)
A-1	Ra-224 (Source: FGR 12)	5.119E-02	5.119E-02	DCF1(16)
A-1	Ra-226 (Source: FGR 12)	3.176E-02	3.176E-02	DCF1(17)
A-1	Ra-228 (Source: FGR 12)	0.000E+00	0.000E+00	DCF1(18)
A-1	Rn-220 (Source: FGR 12)	2.298E-03	2.298E-03	DCF1(19)
A-1	Rn-222 (Source: FGR 12)	2.354E-03	2.354E-03	DCF1(20)
A-1	Th-228 (Source: FGR 12)	7.940E-03	7.940E-03	DCF1(21)
A-1	Th-230 (Source: FGR 12)	1.209E-03	1.209E-03	DCF1(22)
A-1	Th-232 (Source: FGR 12)	5.212E-04	5.212E-04	DCF1(23)
A-1	Th-234 (Source: FGR 12)	2.410E-02	2.410E-02	DCF1(24)
A-1	Tl-208 (Source: FGR 12)	2.298E+01	2.298E+01	DCF1(25)
A-1	Tl-210 (Source: no data)	0.000E+00	-2.000E+00	DCF1(26)
A-1	U-234 (Source: FGR 12)	4.017E-04	4.017E-04	DCF1(27)
A-1	U-238 (Source: FGR 12)	1.031E-04	1.031E-04	DCF1(28)
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	Pb-210+D	2.320E-02	1.360E-02	DCF2(1)
B-1	Ra-226+D	8.594E-03	8.580E-03	DCF2(2)
B-1	Ra-228+D	5.078E-03	4.770E-03	DCF2(3)
B-1	Th-228+D	3.454E-01	3.420E-01	DCF2(4)
B-1	Th-230	3.260E-01	3.260E-01	DCF2(5)
B-1	Th-232	1.640E+00	1.640E+00	DCF2(6)
B-1	U-234	1.320E-01	1.320E-01	DCF2(7)
B-1	U-238	1.180E-01	1.180E-01	DCF2(8)
B-1	U-238+D	1.180E-01	1.180E-01	DCF2(9)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	Pb-210+D	7.276E-03	5.370E-03	DCF3(1)
D-1	Ra-226+D	1.321E-03	1.320E-03	DCF3(2)
D-1	Ra-228+D	1.442E-03	1.440E-03	DCF3(3)
D-1	Th-228+D	8.086E-04	3.960E-04	DCF3(4)
D-1	Th-230	5.480E-04	5.480E-04	DCF3(5)
D-1	Th-232	2.730E-03	2.730E-03	DCF3(6)
D-1	U-234	2.830E-04	2.830E-04	DCF3(7)
D-1	U-238	2.550E-04	2.550E-04	DCF3(8)

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

0 Menu	Parameter	Current Value#	Base Case*	Parameter Name
D-1	U-238+D	2.687E-04	2.550E-04	DCF3(9)
D-34	Food transfer factors:			
D-34	Pb-210+D , plant/soil concentration ratio, dimensionless	1.000E-02	1.000E-02	RTF(1,1)
D-34	Pb-210+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	8.000E-04	8.000E-04	RTF(1,2)
D-34	Pb-210+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	3.000E-04	3.000E-04	RTF(1,3)
D-34				
D-34	Ra-226+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(2,1)
D-34	Ra-226+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(2,2)
D-34	Ra-226+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-03	1.000E-03	RTF(2,3)
D-34				
D-34	Ra-228+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(3,1)
D-34	Ra-228+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(3,2)
D-34	Ra-228+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-03	1.000E-03	RTF(3,3)
D-34				
D-34	Th-228+D , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(4,1)
D-34	Th-228+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(4,2)
D-34	Th-228+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(4,3)
D-34				
D-34	Th-230 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(5,1)
D-34	Th-230 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(5,2)
D-34	Th-230 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(5,3)
D-34				
D-34	Th-232 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(6,1)
D-34	Th-232 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(6,2)
D-34	Th-232 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(6,3)
D-34				
D-34	U-234 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(7,1)
D-34	U-234 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(7,2)
D-34	U-234 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(7,3)
D-34				
D-34	U-238 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(8,1)
D-34	U-238 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(8,2)
D-34	U-238 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(8,3)
D-34				
D-34	U-238+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(9,1)
D-34	U-238+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(9,2)
D-34	U-238+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(9,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	Pb-210+D , fish	3.000E+02	3.000E+02	BIOFAC(1,1)
D-5	Pb-210+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(1,2)
D-5				
D-5	Ra-226+D , fish	5.000E+01	5.000E+01	BIOFAC(2,1)
D-5	Ra-226+D , crustacea and mollusks	2.500E+02	2.500E+02	BIOFAC(2,2)
D-5				
D-5	Ra-228+D , fish	5.000E+01	5.000E+01	BIOFAC(3,1)
D-5	Ra-228+D , crustacea and mollusks	2.500E+02	2.500E+02	BIOFAC(3,2)
D-5				

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

0 Menu	Parameter	Current Value#	Base Case*	Parameter Name
D-5	Th-228+D , fish	1.000E+02	1.000E+02	BIOFAC(4,1)
D-5	Th-228+D , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(4,2)
D-5				
D-5	Th-230 , fish	1.000E+02	1.000E+02	BIOFAC(5,1)
D-5	Th-230 , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(5,2)
D-5				
D-5	Th-232 , fish	1.000E+02	1.000E+02	BIOFAC(6,1)
D-5	Th-232 , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(6,2)
D-5				
D-5	U-234 , fish	1.000E+01	1.000E+01	BIOFAC(7,1)
D-5	U-234 , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(7,2)
D-5				
D-5	U-238 , fish	1.000E+01	1.000E+01	BIOFAC(8,1)
D-5	U-238 , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(8,2)
D-5				
D-5	U-238+D , fish	1.000E+01	1.000E+01	BIOFAC(9,1)
D-5	U-238+D , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(9,2)

#For DCF1(xxx) only, factors are for infinite depth & area. See ETFG table in Ground Pathway of Detailed Report.
*Base Case means Default.Lib w/o Associate Nuclide contributions.

Summary : RESRAD Default Parameters
File : X:\PROJECT_DATA\RARE ELEMENTS BEAR LODGE\LICENSE APPLICATION\TSF INDUSTRIAL.RAD

Site-Specific Parameter Summary

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R011	Area of contaminated zone (m**2)	1.000E+04	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	2.000E+00	2.000E+00	---	THICK0
R011	Fraction of contamination that is submerged	0.000E+00	0.000E+00	---	SUBMFRACT
R011	Length parallel to aquifer flow (m)	1.000E+02	1.000E+02	---	LCZPAQ
R011	Basic radiation dose limit (mrem/yr)	2.500E+01	3.000E+01	---	BRDL
R011	Time since placement of material (yr)	0.000E+00	0.000E+00	---	TI
R011	Times for calculations (yr)	1.000E+00	1.000E+00	---	T(2)
R011	Times for calculations (yr)	3.000E+00	3.000E+00	---	T(3)
R011	Times for calculations (yr)	1.000E+01	1.000E+01	---	T(4)
R011	Times for calculations (yr)	3.000E+01	3.000E+01	---	T(5)
R011	Times for calculations (yr)	1.000E+02	1.000E+02	---	T(6)
R011	Times for calculations (yr)	3.000E+02	3.000E+02	---	T(7)
R011	Times for calculations (yr)	1.000E+03	1.000E+03	---	T(8)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(9)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(10)
R012	Initial principal radionuclide (pCi/g): Pb-210	1.000E+01	0.000E+00	---	S1(1)
R012	Initial principal radionuclide (pCi/g): Ra-226	1.000E+01	0.000E+00	---	S1(2)
R012	Initial principal radionuclide (pCi/g): Ra-228	2.200E+01	0.000E+00	---	S1(3)
R012	Initial principal radionuclide (pCi/g): Th-228	2.200E+01	0.000E+00	---	S1(4)
R012	Initial principal radionuclide (pCi/g): Th-230	1.000E+01	0.000E+00	---	S1(5)
R012	Initial principal radionuclide (pCi/g): Th-232	2.200E+01	0.000E+00	---	S1(6)
R012	Initial principal radionuclide (pCi/g): U-234	1.000E+01	0.000E+00	---	S1(7)
R012	Initial principal radionuclide (pCi/g): U-238	1.000E+01	0.000E+00	---	S1(8)
R012	Concentration in groundwater (pCi/L): Pb-210	not used	0.000E+00	---	W1(1)
R012	Concentration in groundwater (pCi/L): Ra-226	not used	0.000E+00	---	W1(2)
R012	Concentration in groundwater (pCi/L): Ra-228	not used	0.000E+00	---	W1(3)
R012	Concentration in groundwater (pCi/L): Th-228	not used	0.000E+00	---	W1(4)
R012	Concentration in groundwater (pCi/L): Th-230	not used	0.000E+00	---	W1(5)
R012	Concentration in groundwater (pCi/L): Th-232	not used	0.000E+00	---	W1(6)
R012	Concentration in groundwater (pCi/L): U-234	not used	0.000E+00	---	W1(7)
R012	Concentration in groundwater (pCi/L): U-238	not used	0.000E+00	---	W1(8)
R013	Cover depth (m)	2.100E+00	0.000E+00	---	COVER0
R013	Density of cover material (g/cm**3)	1.500E+00	1.500E+00	---	DENSCV
R013	Cover depth erosion rate (m/yr)	0.000E+00	1.000E-03	---	VCV
R013	Density of contaminated zone (g/cm**3)	1.500E+00	1.500E+00	---	DENSCZ
R013	Contaminated zone erosion rate (m/yr)	0.000E+00	1.000E-03	---	VCZ
R013	Contaminated zone total porosity	4.000E-01	4.000E-01	---	TPCZ
R013	Contaminated zone field capacity	2.000E-01	2.000E-01	---	FCCZ
R013	Contaminated zone hydraulic conductivity (m/yr)	1.000E+01	1.000E+01	---	HCCZ
R013	Contaminated zone b parameter	5.300E+00	5.300E+00	---	BCZ
R013	Average annual wind speed (m/sec)	2.000E+00	2.000E+00	---	WIND
R013	Humidity in air (g/m**3)	not used	8.000E+00	---	HUMID
R013	Evapotranspiration coefficient	5.000E-01	5.000E-01	---	EVAPTR
R013	Precipitation (m/yr)	1.500E-01	1.000E+00	---	PRECIP
R013	Irrigation (m/yr)	2.000E-01	2.000E-01	---	RI
R013	Irrigation mode	overhead	overhead	---	IDITCH
R013	Runoff coefficient	2.000E-01	2.000E-01	---	RUNOFF
R013	Watershed area for nearby stream or pond (m**2)	1.000E+06	1.000E+06	---	WAREA

Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R013	Accuracy for water/soil computations	1.000E-03	1.000E-03	---	EPS
R014	Density of saturated zone (g/cm**3)	1.500E+00	1.500E+00	---	DENSAQ
R014	Saturated zone total porosity	4.000E-01	4.000E-01	---	TPSZ
R014	Saturated zone effective porosity	2.000E-01	2.000E-01	---	EPSZ
R014	Saturated zone field capacity	2.000E-01	2.000E-01	---	FCSZ
R014	Saturated zone hydraulic conductivity (m/yr)	1.000E+02	1.000E+02	---	HCSZ
R014	Saturated zone hydraulic gradient	2.000E-02	2.000E-02	---	HGWT
R014	Saturated zone b parameter	5.300E+00	5.300E+00	---	BSZ
R014	Water table drop rate (m/yr)	1.000E-03	1.000E-03	---	VWT
R014	Well pump intake depth (m below water table)	1.000E+01	1.000E+01	---	DWIBWT
R014	Model: Nondispersion (ND) or Mass-Balance (MB)	ND	ND	---	MODEL
R014	Well pumping rate (m**3/yr)	2.500E+02	2.500E+02	---	UW
R015	Number of unsaturated zone strata	not used	1	---	NS
R015	Unsat. zone 1, thickness (m)	4.000E+00	4.000E+00	---	H(1)
R015	Unsat. zone 1, soil density (g/cm**3)	1.500E+00	1.500E+00	---	DENSUZ(1)
R015	Unsat. zone 1, total porosity	4.000E-01	4.000E-01	---	TPUZ(1)
R015	Unsat. zone 1, effective porosity	2.000E-01	2.000E-01	---	EPUZ(1)
R015	Unsat. zone 1, field capacity	2.000E-01	2.000E-01	---	FCUZ(1)
R015	Unsat. zone 1, soil-specific b parameter	5.300E+00	5.300E+00	---	BUZ(1)
R015	Unsat. zone 1, hydraulic conductivity (m/yr)	1.000E+01	1.000E+01	---	HCUZ(1)
R016	Distribution coefficients for Pb-210				
R016	Contaminated zone (cm**3/g)	1.000E+02	1.000E+02	---	DCNUCC(1)
R016	Unsaturated zone 1 (cm**3/g)	1.000E+02	1.000E+02	---	DCNUCU(1,1)
R016	Saturated zone (cm**3/g)	1.000E+02	1.000E+02	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	5.323E-04	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
R016	Distribution coefficients for Ra-226				
R016	Contaminated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCC(2)
R016	Unsaturated zone 1 (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCU(2,1)
R016	Saturated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCS(2)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	7.598E-04	ALEACH(2)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(2)
R016	Distribution coefficients for Ra-228				
R016	Contaminated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCC(3)
R016	Unsaturated zone 1 (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCU(3,1)
R016	Saturated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCS(3)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	7.598E-04	ALEACH(3)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(3)
R016	Distribution coefficients for Th-228				
R016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCC(4)
R016	Unsaturated zone 1 (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCU(4,1)
R016	Saturated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCS(4)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	8.889E-07	ALEACH(4)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(4)

Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R016	Distribution coefficients for Th-230				
R016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCC(5)
R016	Unsaturated zone 1 (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCU(5,1)
R016	Saturated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCS(5)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	8.889E-07	ALEACH(5)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(5)
R016	Distribution coefficients for Th-232				
R016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCC(6)
R016	Unsaturated zone 1 (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCU(6,1)
R016	Saturated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCS(6)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	8.889E-07	ALEACH(6)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(6)
R016	Distribution coefficients for U-234				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(7)
R016	Unsaturated zone 1 (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCU(7,1)
R016	Saturated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCS(7)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.062E-03	ALEACH(7)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(7)
R016	Distribution coefficients for U-238				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(8)
R016	Unsaturated zone 1 (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCU(8,1)
R016	Saturated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCS(8)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.062E-03	ALEACH(8)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(8)
R017	Inhalation rate (m**3/yr)	not used	8.400E+03	---	INHALR
R017	Mass loading for inhalation (g/m**3)	not used	1.000E-04	---	MLINH
R017	Exposure duration	3.000E+01	3.000E+01	---	ED
R017	Shielding factor, inhalation	not used	4.000E-01	---	SHF3
R017	Shielding factor, external gamma	not used	7.000E-01	---	SHF1
R017	Fraction of time spent indoors	2.200E-01	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	0.000E+00	2.500E-01	---	FOTD
R017	Shape factor flag, external gamma	not used	1.000E+00	>0 shows circular AREA.	FS
R017	Radii of shape factor array (used if FS = -1):				
R017	Outer annular radius (m), ring 1:	not used	5.000E+01	---	RAD_SHAPE(1)
R017	Outer annular radius (m), ring 2:	not used	7.071E+01	---	RAD_SHAPE(2)
R017	Outer annular radius (m), ring 3:	not used	0.000E+00	---	RAD_SHAPE(3)
R017	Outer annular radius (m), ring 4:	not used	0.000E+00	---	RAD_SHAPE(4)
R017	Outer annular radius (m), ring 5:	not used	0.000E+00	---	RAD_SHAPE(5)
R017	Outer annular radius (m), ring 6:	not used	0.000E+00	---	RAD_SHAPE(6)
R017	Outer annular radius (m), ring 7:	not used	0.000E+00	---	RAD_SHAPE(7)
R017	Outer annular radius (m), ring 8:	not used	0.000E+00	---	RAD_SHAPE(8)
R017	Outer annular radius (m), ring 9:	not used	0.000E+00	---	RAD_SHAPE(9)
R017	Outer annular radius (m), ring 10:	not used	0.000E+00	---	RAD_SHAPE(10)
R017	Outer annular radius (m), ring 11:	not used	0.000E+00	---	RAD_SHAPE(11)
R017	Outer annular radius (m), ring 12:	not used	0.000E+00	---	RAD_SHAPE(12)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R017	Fractions of annular areas within AREA:				
R017	Ring 1	not used	1.000E+00	---	FRACA(1)
R017	Ring 2	not used	2.732E-01	---	FRACA(2)
R017	Ring 3	not used	0.000E+00	---	FRACA(3)
R017	Ring 4	not used	0.000E+00	---	FRACA(4)
R017	Ring 5	not used	0.000E+00	---	FRACA(5)
R017	Ring 6	not used	0.000E+00	---	FRACA(6)
R017	Ring 7	not used	0.000E+00	---	FRACA(7)
R017	Ring 8	not used	0.000E+00	---	FRACA(8)
R017	Ring 9	not used	0.000E+00	---	FRACA(9)
R017	Ring 10	not used	0.000E+00	---	FRACA(10)
R017	Ring 11	not used	0.000E+00	---	FRACA(11)
R017	Ring 12	not used	0.000E+00	---	FRACA(12)
R018	Fruits, vegetables and grain consumption (kg/yr)	not used	1.600E+02	---	DIET(1)
R018	Leafy vegetable consumption (kg/yr)	not used	1.400E+01	---	DIET(2)
R018	Milk consumption (L/yr)	not used	9.200E+01	---	DIET(3)
R018	Meat and poultry consumption (kg/yr)	not used	6.300E+01	---	DIET(4)
R018	Fish consumption (kg/yr)	not used	5.400E+00	---	DIET(5)
R018	Other seafood consumption (kg/yr)	not used	9.000E-01	---	DIET(6)
R018	Soil ingestion rate (g/yr)	not used	3.650E+01	---	SOIL
R018	Drinking water intake (L/yr)	not used	5.100E+02	---	DWI
R018	Contamination fraction of drinking water	not used	1.000E+00	---	FDW
R018	Contamination fraction of household water	1.000E+00	1.000E+00	---	FHHW
R018	Contamination fraction of livestock water	not used	1.000E+00	---	FLW
R018	Contamination fraction of irrigation water	not used	1.000E+00	---	FIRW
R018	Contamination fraction of aquatic food	not used	5.000E-01	---	FR9
R018	Contamination fraction of plant food	not used	-1	---	FPLANT
R018	Contamination fraction of meat	not used	-1	---	FMEAT
R018	Contamination fraction of milk	not used	-1	---	FMILK
R019	Livestock fodder intake for meat (kg/day)	not used	6.800E+01	---	LFI5
R019	Livestock fodder intake for milk (kg/day)	not used	5.500E+01	---	LFI6
R019	Livestock water intake for meat (L/day)	not used	5.000E+01	---	LWI5
R019	Livestock water intake for milk (L/day)	not used	1.600E+02	---	LWI6
R019	Livestock soil intake (kg/day)	not used	5.000E-01	---	LSI
R019	Mass loading for foliar deposition (g/m**3)	not used	1.000E-04	---	MLFD
R019	Depth of soil mixing layer (m)	not used	1.500E-01	---	DM
R019	Depth of roots (m)	not used	9.000E-01	---	DROOT
R019	Drinking water fraction from ground water	not used	1.000E+00	---	FGWDW
R019	Household water fraction from ground water	1.000E+00	1.000E+00	---	FGWHH
R019	Livestock water fraction from ground water	not used	1.000E+00	---	FGWLW
R019	Irrigation fraction from ground water	not used	1.000E+00	---	FGWIR
R19B	Wet weight crop yield for Non-Leafy (kg/m**2)	not used	7.000E-01	---	YV(1)
R19B	Wet weight crop yield for Leafy (kg/m**2)	not used	1.500E+00	---	YV(2)
R19B	Wet weight crop yield for Fodder (kg/m**2)	not used	1.100E+00	---	YV(3)
R19B	Growing Season for Non-Leafy (years)	not used	1.700E-01	---	TE(1)
R19B	Growing Season for Leafy (years)	not used	2.500E-01	---	TE(2)
R19B	Growing Season for Fodder (years)	not used	8.000E-02	---	TE(3)

Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R19B	Translocation Factor for Non-Leafy	not used	1.000E-01	---	TIV(1)
R19B	Translocation Factor for Leafy	not used	1.000E+00	---	TIV(2)
R19B	Translocation Factor for Fodder	not used	1.000E+00	---	TIV(3)
R19B	Dry Foliar Interception Fraction for Non-Leafy	not used	2.500E-01	---	RDRY(1)
R19B	Dry Foliar Interception Fraction for Leafy	not used	2.500E-01	---	RDRY(2)
R19B	Dry Foliar Interception Fraction for Fodder	not used	2.500E-01	---	RDRY(3)
R19B	Wet Foliar Interception Fraction for Non-Leafy	not used	2.500E-01	---	RWET(1)
R19B	Wet Foliar Interception Fraction for Leafy	not used	2.500E-01	---	RWET(2)
R19B	Wet Foliar Interception Fraction for Fodder	not used	2.500E-01	---	RWET(3)
R19B	Weathering Removal Constant for Vegetation	not used	2.000E+01	---	WLAM
C14	C-12 concentration in water (g/cm**3)	not used	2.000E-05	---	C12WTR
C14	C-12 concentration in contaminated soil (g/g)	not used	3.000E-02	---	C12CZ
C14	Fraction of vegetation carbon from soil	not used	2.000E-02	---	CSOIL
C14	Fraction of vegetation carbon from air	not used	9.800E-01	---	CAIR
C14	C-14 evasion layer thickness in soil (m)	not used	3.000E-01	---	DMC
C14	C-14 evasion flux rate from soil (1/sec)	not used	7.000E-07	---	EVSN
C14	C-12 evasion flux rate from soil (1/sec)	not used	1.000E-10	---	REVSN
C14	Fraction of grain in beef cattle feed	not used	8.000E-01	---	AVFG4
C14	Fraction of grain in milk cow feed	not used	2.000E-01	---	AVFG5
STOR	Storage times of contaminated foodstuffs (days):				
STOR	Fruits, non-leafy vegetables, and grain	1.400E+01	1.400E+01	---	STOR_T(1)
STOR	Leafy vegetables	1.000E+00	1.000E+00	---	STOR_T(2)
STOR	Milk	1.000E+00	1.000E+00	---	STOR_T(3)
STOR	Meat and poultry	2.000E+01	2.000E+01	---	STOR_T(4)
STOR	Fish	7.000E+00	7.000E+00	---	STOR_T(5)
STOR	Crustacea and mollusks	7.000E+00	7.000E+00	---	STOR_T(6)
STOR	Well water	1.000E+00	1.000E+00	---	STOR_T(7)
STOR	Surface water	1.000E+00	1.000E+00	---	STOR_T(8)
STOR	Livestock fodder	4.500E+01	4.500E+01	---	STOR_T(9)
R021	Thickness of building foundation (m)	2.000E-01	1.500E-01	---	FLOOR1
R021	Bulk density of building foundation (g/cm**3)	2.400E+00	2.400E+00	---	DENSFL
R021	Total porosity of the cover material	4.000E-01	4.000E-01	---	TPCV
R021	Total porosity of the building foundation	1.000E-01	1.000E-01	---	TPFL
R021	Volumetric water content of the cover material	5.000E-02	5.000E-02	---	PH2OCV
R021	Volumetric water content of the foundation	3.000E-02	3.000E-02	---	PH2OFL
R021	Diffusion coefficient for radon gas (m/sec):				
R021	in cover material	2.000E-06	2.000E-06	---	DIFCV
R021	in foundation material	3.000E-07	3.000E-07	---	DIFFL
R021	in contaminated zone soil	2.000E-06	2.000E-06	---	DIFCZ
R021	Radon vertical dimension of mixing (m)	2.000E+00	2.000E+00	---	HMIX
R021	Average building air exchange rate (1/hr)	5.000E+00	5.000E-01	---	REXG
R021	Height of the building (room) (m)	3.700E+00	2.500E+00	---	HRM
R021	Building interior area factor	0.000E+00	0.000E+00	code computed (time dependent)	FAI
R021	Building depth below ground surface (m)	2.000E-01	-1.000E+00	---	DMFL
R021	Emanating power of Rn-222 gas	2.500E-01	2.500E-01	---	EMANA(1)
R021	Emanating power of Rn-220 gas	1.500E-01	1.500E-01	---	EMANA(2)
TITL	Number of graphical time points	32	---	---	NPTS

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
TITL	Maximum number of integration points for dose	17	---	---	LYMAX
TITL	Maximum number of integration points for risk	1	---	---	KYMAX

Summary of Pathway Selections

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

Summary : RESRAD Default Parameters
File : X:\PROJECT_DATA\RARE ELEMENTS BEAR LODGE\LICENSE APPLICATION\TSF INDUSTRIAL.RAD

Contaminated Zone Dimensions		Initial Soil Concentrations, pCi/g	
Area:	10000.00 square meters	Pb-210	1.000E+01
Thickness:	2.00 meters	Ra-226	1.000E+01
Cover Depth:	2.10 meters	Ra-228	2.200E+01
		Th-228	2.200E+01
		Th-230	1.000E+01
		Th-232	2.200E+01
		U-234	1.000E+01
		U-238	1.000E+01

0

Total Dose TDOSE(t), mrem/yr
Basic Radiation Dose Limit = 2.500E+01 mrem/yr
Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

t (years):	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
TDOSE(t):	6.483E-01	6.478E-01	6.468E-01	6.434E-01	6.338E-01	6.019E-01	5.241E-01	3.604E-01
M(t):	2.593E-02	2.591E-02	2.587E-02	2.574E-02	2.535E-02	2.408E-02	2.096E-02	1.441E-02

0Maximum TDOSE(t): 6.483E-01 mrem/yr at t = 0.000E+00 years

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

Radio-Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
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	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	6.482E-01	0.9998	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	1.404E-04	0.0002	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	4.213E-10	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	2.985E-16	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	6.483E-01	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

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

Radio-Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
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	0.000E+00	0.0000	0.000E+00	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	0.000E+00	0.0000	6.482E-01	0.9998
Ra-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	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	0.000E+00	0.0000	1.404E-04	0.0002
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	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	0.000E+00	0.0000	4.213E-10	0.0000
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	2.985E-16	0.0000
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	6.483E-01	1.0000

*Sum of all water independent and dependent pathways.

Summary : RESRAD Default Parameters
File : X:\PROJECT_DATA\RARE ELEMENTS BEAR LODGE\LICENSE APPLICATION\TSF INDUSTRIAL.RAD

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

Radio-Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
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	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	6.474E-01	0.9994	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	4.211E-04	0.0006	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	2.947E-09	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	4.475E-15	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	6.478E-01	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

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

Radio-Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
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	0.000E+00	0.0000	0.000E+00	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	0.000E+00	0.0000	6.474E-01	0.9994
Ra-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	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	0.000E+00	0.0000	4.211E-04	0.0006
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	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	0.000E+00	0.0000	2.947E-09	0.0000
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	4.475E-15	0.0000
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	6.478E-01	1.0000

*Sum of all water independent and dependent pathways.

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

Radio-Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
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	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	6.459E-01	0.9985	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	9.813E-04	0.0015	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	1.556E-08	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	5.213E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	6.468E-01	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

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

Radio-Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
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	0.000E+00	0.0000	0.000E+00	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	0.000E+00	0.0000	6.459E-01	0.9985
Ra-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	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	0.000E+00	0.0000	9.813E-04	0.0015
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	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	0.000E+00	0.0000	1.556E-08	0.0000
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	5.213E-14	0.0000
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	6.468E-01	1.0000

*Sum of all water independent and dependent pathways.

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

Radio-Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
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	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	6.405E-01	0.9954	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	2.932E-03	0.0046	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	1.384E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	1.374E-12	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	6.434E-01	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

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

Radio-Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
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	0.000E+00	0.0000	0.000E+00	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	0.000E+00	0.0000	6.405E-01	0.9954
Ra-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	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	0.000E+00	0.0000	2.932E-03	0.0046
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	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	0.000E+00	0.0000	1.384E-07	0.0000
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	1.374E-12	0.0000
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	6.434E-01	1.0000

*Sum of all water independent and dependent pathways.

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

Radio-Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
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	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	6.254E-01	0.9867	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	8.414E-03	0.0133	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	1.150E-06	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	3.306E-11	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	6.338E-01	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

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

Radio-Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
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	0.000E+00	0.0000	0.000E+00	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	0.000E+00	0.0000	6.254E-01	0.9867
Ra-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	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	0.000E+00	0.0000	8.414E-03	0.0133
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	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	0.000E+00	0.0000	1.150E-06	0.0000
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	3.306E-11	0.0000
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	6.338E-01	1.0000

*Sum of all water independent and dependent pathways.

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

Radio-Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
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	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	5.753E-01	0.9558	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	2.660E-02	0.0442	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	1.184E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	1.116E-09	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	6.019E-01	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

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

Radio-Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
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	0.000E+00	0.0000	0.000E+00	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	0.000E+00	0.0000	5.753E-01	0.9558
Ra-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	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	0.000E+00	0.0000	2.660E-02	0.0442
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	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	0.000E+00	0.0000	1.184E-05	0.0000
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	1.116E-09	0.0000
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	6.019E-01	1.0000

*Sum of all water independent and dependent pathways.

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

Radio-Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
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	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	4.532E-01	0.8647	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	7.084E-02	0.1352	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	9.128E-05	0.0002	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	2.530E-08	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	5.241E-01	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

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

Radio-Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
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	0.000E+00	0.0000	0.000E+00	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	0.000E+00	0.0000	4.532E-01	0.8647
Ra-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	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	0.000E+00	0.0000	7.084E-02	0.1352
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	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	0.000E+00	0.0000	9.128E-05	0.0002
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	2.530E-08	0.0000
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	5.241E-01	1.0000

*Sum of all water independent and dependent pathways.

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

Radio-Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
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	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	1.966E-01	0.5455	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	1.632E-01	0.4527	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	6.163E-04	0.0017	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	5.330E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	3.604E-01	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

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

Radio-Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
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	0.000E+00	0.0000	0.000E+00	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	0.000E+00	0.0000	1.966E-01	0.5455
Ra-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	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	0.000E+00	0.0000	1.632E-01	0.4527
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	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	0.000E+00	0.0000	6.163E-04	0.0017
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	5.330E-07	0.0000
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	3.604E-01	1.0000

*Sum of all water independent and dependent pathways.

Summary : RESRAD Default Parameters
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Dose/Source Ratios Summed Over All Pathways
Parent and Progeny Principal Radionuclide Contributions Indicated

0 Parent (i)	Product (j)	Thread Fraction	DSR(j,t) At Time in Years (mrem/yr)/(pCi/g) 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Pb-210+D	Pb-210+D	1.000E+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
0Ra-226+D	Ra-226+D	1.000E+00	6.482E-02	6.474E-02	6.459E-02	6.405E-02	6.254E-02	5.753E-02	4.532E-02	1.966E-02
Ra-226+D	Pb-210+D	1.000E+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+D	ΣDSR(j)		6.482E-02	6.474E-02	6.459E-02	6.405E-02	6.254E-02	5.753E-02	4.532E-02	1.966E-02
0Ra-228+D	Ra-228+D	1.000E+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-228+D	Th-228+D	1.000E+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-228+D	ΣDSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0Th-228+D	Th-228+D	1.000E+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
0Th-230	Th-230	1.000E+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	Ra-226+D	1.000E+00	1.404E-05	4.211E-05	9.813E-05	2.932E-04	8.414E-04	2.660E-03	7.084E-03	1.632E-02
Th-230	Pb-210+D	1.000E+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	ΣDSR(j)		1.404E-05	4.211E-05	9.813E-05	2.932E-04	8.414E-04	2.660E-03	7.084E-03	1.632E-02
0Th-232	Th-232	1.000E+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-232	Ra-228+D	1.000E+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-232	Th-228+D	1.000E+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-232	ΣDSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0U-234	U-234	1.000E+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	Th-230	1.000E+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	Ra-226+D	1.000E+00	4.213E-11	2.947E-10	1.556E-09	1.384E-08	1.150E-07	1.184E-06	9.128E-06	6.163E-05
U-234	Pb-210+D	1.000E+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	ΣDSR(j)		4.213E-11	2.947E-10	1.556E-09	1.384E-08	1.150E-07	1.184E-06	9.128E-06	6.163E-05
0U-238	U-238	5.400E-05	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0U-238+D	U-238+D	9.999E-01	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-238+D	U-234	9.999E-01	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-238+D	Th-230	9.999E-01	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-238+D	Ra-226+D	9.999E-01	2.985E-17	4.475E-16	5.213E-15	1.374E-13	3.306E-12	1.116E-10	2.530E-09	5.330E-08
U-238+D	Pb-210+D	9.999E-01	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-238+D	ΣDSR(j)		2.985E-17	4.475E-16	5.213E-15	1.374E-13	3.306E-12	1.116E-10	2.530E-09	5.330E-08

The DSR includes contributions from associated (half-life ≤ 180 days) daughters.

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

0Nuclide

(i)	t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Pb-210	*7.634E+13	*7.634E+13	*7.634E+13	*7.634E+13	*7.634E+13	*7.634E+13	*7.634E+13	*7.634E+13
Ra-226	3.857E+02	3.862E+02	3.871E+02	3.903E+02	3.998E+02	4.346E+02	5.517E+02	1.272E+03
Ra-228	*2.726E+14	*2.726E+14	*2.726E+14	*2.726E+14	*2.726E+14	*2.726E+14	*2.726E+14	*2.726E+14
Th-228	*8.195E+14	*8.195E+14	*8.195E+14	*8.195E+14	*8.195E+14	*8.195E+14	*8.195E+14	*8.195E+14
Th-230	1.780E+06	5.937E+05	2.548E+05	8.528E+04	2.971E+04	9.400E+03	3.529E+03	1.532E+03
Th-232	*1.097E+05	*1.097E+05	*1.097E+05	*1.097E+05	*1.097E+05	*1.097E+05	*1.097E+05	*1.097E+05
U-234	*6.247E+09	*6.247E+09	*6.247E+09	1.806E+09	2.174E+08	2.111E+07	2.739E+06	4.056E+05
U-238	*3.361E+05	*3.361E+05	*3.361E+05	*3.361E+05	*3.361E+05	*3.361E+05	*3.361E+05	*3.361E+05

*At specific activity limit

0
Summed Dose/Source Ratios DSR(i,t) in (mrem/yr)/(pCi/g)
and Single Radionuclide Soil Guidelines G(i,t) in pCi/g
at tmin = time of minimum single radionuclide soil guideline
and at tmax = time of maximum total dose = 0.000E+00 years

0Nuclide

(i)	Initial (pCi/g)	tmin (years)	DSR(i,tmin)	G(i,tmin) (pCi/g)	DSR(i,tmax)	G(i,tmax) (pCi/g)
Pb-210	1.000E+01	0.000E+00	0.000E+00	*7.634E+13	0.000E+00	*7.634E+13
Ra-226	1.000E+01	0.000E+00	6.482E-02	3.857E+02	6.482E-02	3.857E+02
Ra-228	2.200E+01	0.000E+00	0.000E+00	*2.726E+14	0.000E+00	*2.726E+14
Th-228	2.200E+01	0.000E+00	0.000E+00	*8.195E+14	0.000E+00	*8.195E+14
Th-230	1.000E+01	1.000E+03	1.632E-02	1.532E+03	1.404E-05	1.780E+06
Th-232	2.200E+01	0.000E+00	0.000E+00	*1.097E+05	0.000E+00	*1.097E+05
U-234	1.000E+01	1.000E+03	6.163E-05	4.056E+05	4.213E-11	*6.247E+09
U-238	1.000E+01	1.000E+03	5.330E-08	*3.361E+05	2.985E-17	*3.361E+05

*At specific activity limit

Summary : RESRAD Default Parameters
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Individual Nuclide Dose Summed Over All Pathways
Parent Nuclide and Branch Fraction Indicated

0Nuclide (j)	Parent (i)	THF(i)	DOSE(j,t), mrem/yr							
		t=	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Pb-210	Pb-210	1.000E+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	Ra-226	1.000E+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	Th-230	1.000E+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	U-234	1.000E+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	U-238	9.999E-01	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	ΣDOSE(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0Ra-226	Ra-226	1.000E+00	6.482E-01	6.474E-01	6.459E-01	6.405E-01	6.254E-01	5.753E-01	4.532E-01	1.966E-01
Ra-226	Th-230	1.000E+00	1.404E-04	4.211E-04	9.813E-04	2.932E-03	8.414E-03	2.660E-02	7.084E-02	1.632E-01
Ra-226	U-234	1.000E+00	4.213E-10	2.947E-09	1.556E-08	1.384E-07	1.150E-06	1.184E-05	9.128E-05	6.163E-04
Ra-226	U-238	9.999E-01	2.985E-16	4.475E-15	5.213E-14	1.374E-12	3.306E-11	1.116E-09	2.530E-08	5.330E-07
Ra-226	ΣDOSE(j)		6.483E-01	6.478E-01	6.468E-01	6.434E-01	6.338E-01	6.019E-01	5.241E-01	3.604E-01
0Ra-228	Ra-228	1.000E+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-228	Th-232	1.000E+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-228	ΣDOSE(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0Th-228	Ra-228	1.000E+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-228	Th-228	1.000E+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-228	Th-232	1.000E+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-228	ΣDOSE(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0Th-230	Th-230	1.000E+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	U-234	1.000E+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	U-238	9.999E-01	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	ΣDOSE(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0Th-232	Th-232	1.000E+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
0U-234	U-234	1.000E+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	U-238	9.999E-01	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	ΣDOSE(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0U-238	U-238	5.400E-05	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-238	U-238	9.999E-01	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-238	ΣDOSE(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

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

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Individual Nuclide Soil Concentration
Parent Nuclide and Branch Fraction Indicated

0Nuclide (j)	Parent (i)	THF(i)	S(j,t), pCi/g t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Pb-210	Pb-210	1.000E+00	1.000E+01	9.689E+00	9.095E+00	7.289E+00	3.873E+00	4.236E-01	7.602E-04	1.861E-13
Pb-210	Ra-226	1.000E+00	0.000E+00	3.058E-01	8.880E-01	2.648E+00	5.900E+00	8.635E+00	7.143E+00	3.099E+00
Pb-210	Th-230	1.000E+00	0.000E+00	6.660E-05	5.865E-04	6.051E-03	4.466E-02	2.831E-01	9.749E-01	2.431E+00
Pb-210	U-234	1.000E+00	0.000E+00	2.003E-10	5.319E-09	1.859E-07	4.296E-06	1.006E-04	1.140E-03	8.946E-03
Pb-210	U-238	9.999E-01	0.000E+00	1.422E-16	1.136E-14	1.337E-12	9.506E-11	7.917E-09	2.892E-07	7.521E-06
Pb-210	ΣS(j):		1.000E+01	9.995E+00	9.984E+00	9.944E+00	9.819E+00	9.342E+00	8.119E+00	5.539E+00
0Ra-226	Ra-226	1.000E+00	1.000E+01	9.988E+00	9.964E+00	9.881E+00	9.648E+00	8.875E+00	6.991E+00	3.033E+00
Ra-226	Th-230	1.000E+00	0.000E+00	4.330E-03	1.297E-02	4.306E-02	1.276E-01	4.082E-01	1.091E+00	2.515E+00
Ra-226	U-234	1.000E+00	0.000E+00	1.948E-08	1.751E-07	1.935E-06	1.716E-05	1.809E-04	1.403E-03	9.497E-03
Ra-226	U-238	9.999E-01	0.000E+00	1.841E-14	4.962E-13	1.827E-11	4.852E-10	1.696E-08	3.883E-07	8.209E-06
Ra-226	ΣS(j):		1.000E+01	9.992E+00	9.977E+00	9.924E+00	9.776E+00	9.284E+00	8.084E+00	5.558E+00
0Ra-228	Ra-228	1.000E+00	2.200E+01	1.949E+01	1.529E+01	6.540E+00	5.780E-01	1.186E-04	3.448E-15	0.000E+00
Ra-228	Th-232	1.000E+00	0.000E+00	2.497E+00	6.669E+00	1.536E+01	2.129E+01	2.186E+01	2.186E+01	2.184E+01
Ra-228	ΣS(j):		2.200E+01	2.198E+01	2.196E+01	2.190E+01	2.187E+01	2.186E+01	2.186E+01	2.184E+01
0Th-228	Ra-228	1.000E+00	0.000E+00	6.274E+00	1.183E+01	8.949E+00	8.683E-01	1.783E-04	5.183E-15	0.000E+00
Th-228	Th-228	1.000E+00	2.200E+01	1.531E+01	7.419E+00	5.874E-01	4.187E-04	4.048E-15	0.000E+00	0.000E+00
Th-228	Th-232	1.000E+00	0.000E+00	4.101E-01	2.733E+00	1.239E+01	2.100E+01	2.186E+01	2.186E+01	2.184E+01
Th-228	ΣS(j):		2.200E+01	2.200E+01	2.198E+01	2.192E+01	2.187E+01	2.186E+01	2.186E+01	2.184E+01
0Th-230	Th-230	1.000E+00	1.000E+01	1.000E+01	1.000E+01	9.999E+00	9.997E+00	9.990E+00	9.970E+00	9.902E+00
Th-230	U-234	1.000E+00	0.000E+00	8.997E-05	2.696E-04	8.954E-04	2.657E-03	8.535E-03	2.308E-02	5.506E-02
Th-230	U-238	9.999E-01	0.000E+00	1.275E-10	1.146E-09	1.267E-08	1.124E-07	1.189E-06	9.299E-06	6.462E-05
Th-230	ΣS(j):		1.000E+01	1.000E+01	1.000E+01	1.000E+01	1.000E+01	9.999E+00	9.993E+00	9.957E+00
0Th-232	Th-232	1.000E+00	2.200E+01	2.200E+01	2.200E+01	2.200E+01	2.200E+01	2.200E+01	2.199E+01	2.198E+01
0U-234	U-234	1.000E+00	1.000E+01	9.989E+00	9.968E+00	9.894E+00	9.685E+00	8.989E+00	7.264E+00	3.446E+00
U-234	U-238	9.999E-01	0.000E+00	2.832E-05	8.477E-05	2.805E-04	8.237E-04	2.549E-03	6.181E-03	9.783E-03
U-234	ΣS(j):		1.000E+01	9.989E+00	9.968E+00	9.894E+00	9.686E+00	8.992E+00	7.271E+00	3.456E+00
0U-238	U-238	5.400E-05	5.400E-04	5.394E-04	5.383E-04	5.343E-04	5.231E-04	4.856E-04	3.926E-04	1.866E-04
U-238	U-238	9.999E-01	9.999E+00	9.989E+00	9.968E+00	9.894E+00	9.686E+00	8.992E+00	7.270E+00	3.456E+00
U-238	ΣS(j):		1.000E+01	9.989E+00	9.968E+00	9.894E+00	9.686E+00	8.992E+00	7.271E+00	3.456E+00

THF(i) is the thread fraction of the parent nuclide.
0RESCALC.EXE execution time = 1.30 seconds

RESRAD Output – Resident Farmer

Summary : RESRAD Default Parameters
File : X:\PROJECT_DATA\RARE ELEMENTS BEAR LODGE\LICENSE APPLICATION\TSF.RAD

Table of Contents

Part I: Mixture Sums and Single Radionuclide Guidelines

Summary : RESRAD Default Parameters
File : X:\PROJECT_DATA\RARE ELEMENTS BEAR LODGE\LICENSE APPLICATION\TSF.RAD

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

0 Menu	Parameter	Current Value#	Base Case*	Parameter Name
A-1	DCF's for external ground radiation, (mrem/yr)/(pCi/g)			
A-1	Ac-228 (Source: FGR 12)	5.978E+00	5.978E+00	DCF1(1)
A-1	At-218 (Source: FGR 12)	5.847E-03	5.847E-03	DCF1(2)
A-1	Bi-210 (Source: FGR 12)	3.606E-03	3.606E-03	DCF1(3)
A-1	Bi-212 (Source: FGR 12)	1.171E+00	1.171E+00	DCF1(4)
A-1	Bi-214 (Source: FGR 12)	9.808E+00	9.808E+00	DCF1(5)
A-1	Pa-234 (Source: FGR 12)	1.155E+01	1.155E+01	DCF1(6)
A-1	Pa-234m (Source: FGR 12)	8.967E-02	8.967E-02	DCF1(7)
A-1	Pb-210 (Source: FGR 12)	2.447E-03	2.447E-03	DCF1(8)
A-1	Pb-212 (Source: FGR 12)	7.043E-01	7.043E-01	DCF1(9)
A-1	Pb-214 (Source: FGR 12)	1.341E+00	1.341E+00	DCF1(10)
A-1	Po-210 (Source: FGR 12)	5.231E-05	5.231E-05	DCF1(11)
A-1	Po-212 (Source: FGR 12)	0.000E+00	0.000E+00	DCF1(12)
A-1	Po-214 (Source: FGR 12)	5.138E-04	5.138E-04	DCF1(13)
A-1	Po-216 (Source: FGR 12)	1.042E-04	1.042E-04	DCF1(14)
A-1	Po-218 (Source: FGR 12)	5.642E-05	5.642E-05	DCF1(15)
A-1	Ra-224 (Source: FGR 12)	5.119E-02	5.119E-02	DCF1(16)
A-1	Ra-226 (Source: FGR 12)	3.176E-02	3.176E-02	DCF1(17)
A-1	Ra-228 (Source: FGR 12)	0.000E+00	0.000E+00	DCF1(18)
A-1	Rn-220 (Source: FGR 12)	2.298E-03	2.298E-03	DCF1(19)
A-1	Rn-222 (Source: FGR 12)	2.354E-03	2.354E-03	DCF1(20)
A-1	Th-228 (Source: FGR 12)	7.940E-03	7.940E-03	DCF1(21)
A-1	Th-230 (Source: FGR 12)	1.209E-03	1.209E-03	DCF1(22)
A-1	Th-232 (Source: FGR 12)	5.212E-04	5.212E-04	DCF1(23)
A-1	Th-234 (Source: FGR 12)	2.410E-02	2.410E-02	DCF1(24)
A-1	Tl-208 (Source: FGR 12)	2.298E+01	2.298E+01	DCF1(25)
A-1	Tl-210 (Source: no data)	0.000E+00	-2.000E+00	DCF1(26)
A-1	U-234 (Source: FGR 12)	4.017E-04	4.017E-04	DCF1(27)
A-1	U-238 (Source: FGR 12)	1.031E-04	1.031E-04	DCF1(28)
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	Pb-210+D	2.320E-02	1.360E-02	DCF2(1)
B-1	Ra-226+D	8.594E-03	8.580E-03	DCF2(2)
B-1	Ra-228+D	5.078E-03	4.770E-03	DCF2(3)
B-1	Th-228+D	3.454E-01	3.420E-01	DCF2(4)
B-1	Th-230	3.260E-01	3.260E-01	DCF2(5)
B-1	Th-232	1.640E+00	1.640E+00	DCF2(6)
B-1	U-234	1.320E-01	1.320E-01	DCF2(7)
B-1	U-238	1.180E-01	1.180E-01	DCF2(8)
B-1	U-238+D	1.180E-01	1.180E-01	DCF2(9)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	Pb-210+D	7.276E-03	5.370E-03	DCF3(1)
D-1	Ra-226+D	1.321E-03	1.320E-03	DCF3(2)
D-1	Ra-228+D	1.442E-03	1.440E-03	DCF3(3)
D-1	Th-228+D	8.086E-04	3.960E-04	DCF3(4)
D-1	Th-230	5.480E-04	5.480E-04	DCF3(5)
D-1	Th-232	2.730E-03	2.730E-03	DCF3(6)
D-1	U-234	2.830E-04	2.830E-04	DCF3(7)
D-1	U-238	2.550E-04	2.550E-04	DCF3(8)

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

0 Menu	Parameter	Current Value#	Base Case*	Parameter Name
D-1	U-238+D	2.687E-04	2.550E-04	DCF3(9)
D-34	Food transfer factors:			
D-34	Pb-210+D , plant/soil concentration ratio, dimensionless	1.000E-02	1.000E-02	RTF(1,1)
D-34	Pb-210+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	8.000E-04	8.000E-04	RTF(1,2)
D-34	Pb-210+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	3.000E-04	3.000E-04	RTF(1,3)
D-34				
D-34	Ra-226+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(2,1)
D-34	Ra-226+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(2,2)
D-34	Ra-226+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-03	1.000E-03	RTF(2,3)
D-34				
D-34	Ra-228+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(3,1)
D-34	Ra-228+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(3,2)
D-34	Ra-228+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-03	1.000E-03	RTF(3,3)
D-34				
D-34	Th-228+D , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(4,1)
D-34	Th-228+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(4,2)
D-34	Th-228+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(4,3)
D-34				
D-34	Th-230 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(5,1)
D-34	Th-230 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(5,2)
D-34	Th-230 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(5,3)
D-34				
D-34	Th-232 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(6,1)
D-34	Th-232 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(6,2)
D-34	Th-232 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(6,3)
D-34				
D-34	U-234 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(7,1)
D-34	U-234 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(7,2)
D-34	U-234 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(7,3)
D-34				
D-34	U-238 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(8,1)
D-34	U-238 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(8,2)
D-34	U-238 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(8,3)
D-34				
D-34	U-238+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(9,1)
D-34	U-238+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(9,2)
D-34	U-238+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(9,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	Pb-210+D , fish	3.000E+02	3.000E+02	BIOFAC(1,1)
D-5	Pb-210+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(1,2)
D-5				
D-5	Ra-226+D , fish	5.000E+01	5.000E+01	BIOFAC(2,1)
D-5	Ra-226+D , crustacea and mollusks	2.500E+02	2.500E+02	BIOFAC(2,2)
D-5				
D-5	Ra-228+D , fish	5.000E+01	5.000E+01	BIOFAC(3,1)
D-5	Ra-228+D , crustacea and mollusks	2.500E+02	2.500E+02	BIOFAC(3,2)
D-5				

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

0 Menu	Parameter	Current Value#	Base Case*	Parameter Name
D-5	Th-228+D , fish	1.000E+02	1.000E+02	BIOFAC(4,1)
D-5	Th-228+D , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(4,2)
D-5				
D-5	Th-230 , fish	1.000E+02	1.000E+02	BIOFAC(5,1)
D-5	Th-230 , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(5,2)
D-5				
D-5	Th-232 , fish	1.000E+02	1.000E+02	BIOFAC(6,1)
D-5	Th-232 , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(6,2)
D-5				
D-5	U-234 , fish	1.000E+01	1.000E+01	BIOFAC(7,1)
D-5	U-234 , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(7,2)
D-5				
D-5	U-238 , fish	1.000E+01	1.000E+01	BIOFAC(8,1)
D-5	U-238 , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(8,2)
D-5				
D-5	U-238+D , fish	1.000E+01	1.000E+01	BIOFAC(9,1)
D-5	U-238+D , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(9,2)

#For DCF1(xxx) only, factors are for infinite depth & area. See ETFG table in Ground Pathway of Detailed Report.
*Base Case means Default.Lib w/o Associate Nuclide contributions.

Summary : RESRAD Default Parameters
File : X:\PROJECT_DATA\RARE ELEMENTS BEAR LODGE\LICENSE APPLICATION\TSF.RAD

Site-Specific Parameter Summary

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R011	Area of contaminated zone (m**2)	1.000E+04	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	2.000E+00	2.000E+00	---	THICK0
R011	Fraction of contamination that is submerged	0.000E+00	0.000E+00	---	SUBMFRACT
R011	Length parallel to aquifer flow (m)	1.000E+02	1.000E+02	---	LCZPAQ
R011	Basic radiation dose limit (mrem/yr)	2.500E+01	3.000E+01	---	BRDL
R011	Time since placement of material (yr)	0.000E+00	0.000E+00	---	TI
R011	Times for calculations (yr)	1.000E+00	1.000E+00	---	T(2)
R011	Times for calculations (yr)	3.000E+00	3.000E+00	---	T(3)
R011	Times for calculations (yr)	1.000E+01	1.000E+01	---	T(4)
R011	Times for calculations (yr)	3.000E+01	3.000E+01	---	T(5)
R011	Times for calculations (yr)	1.000E+02	1.000E+02	---	T(6)
R011	Times for calculations (yr)	3.000E+02	3.000E+02	---	T(7)
R011	Times for calculations (yr)	1.000E+03	1.000E+03	---	T(8)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(9)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(10)
R012	Initial principal radionuclide (pCi/g): Pb-210	1.000E+01	0.000E+00	---	S1(1)
R012	Initial principal radionuclide (pCi/g): Ra-226	1.000E+01	0.000E+00	---	S1(2)
R012	Initial principal radionuclide (pCi/g): Ra-228	2.200E+01	0.000E+00	---	S1(3)
R012	Initial principal radionuclide (pCi/g): Th-228	2.200E+01	0.000E+00	---	S1(4)
R012	Initial principal radionuclide (pCi/g): Th-230	1.000E+01	0.000E+00	---	S1(5)
R012	Initial principal radionuclide (pCi/g): Th-232	2.200E+01	0.000E+00	---	S1(6)
R012	Initial principal radionuclide (pCi/g): U-234	1.000E+01	0.000E+00	---	S1(7)
R012	Initial principal radionuclide (pCi/g): U-238	1.000E+01	0.000E+00	---	S1(8)
R012	Concentration in groundwater (pCi/L): Pb-210	not used	0.000E+00	---	W1(1)
R012	Concentration in groundwater (pCi/L): Ra-226	not used	0.000E+00	---	W1(2)
R012	Concentration in groundwater (pCi/L): Ra-228	not used	0.000E+00	---	W1(3)
R012	Concentration in groundwater (pCi/L): Th-228	not used	0.000E+00	---	W1(4)
R012	Concentration in groundwater (pCi/L): Th-230	not used	0.000E+00	---	W1(5)
R012	Concentration in groundwater (pCi/L): Th-232	not used	0.000E+00	---	W1(6)
R012	Concentration in groundwater (pCi/L): U-234	not used	0.000E+00	---	W1(7)
R012	Concentration in groundwater (pCi/L): U-238	not used	0.000E+00	---	W1(8)
R013	Cover depth (m)	2.100E+00	0.000E+00	---	COVER0
R013	Density of cover material (g/cm**3)	1.500E+00	1.500E+00	---	DENSCV
R013	Cover depth erosion rate (m/yr)	0.000E+00	1.000E-03	---	VCV
R013	Density of contaminated zone (g/cm**3)	1.500E+00	1.500E+00	---	DENSCZ
R013	Contaminated zone erosion rate (m/yr)	0.000E+00	1.000E-03	---	VCZ
R013	Contaminated zone total porosity	4.000E-01	4.000E-01	---	TPCZ
R013	Contaminated zone field capacity	2.000E-01	2.000E-01	---	FCCZ
R013	Contaminated zone hydraulic conductivity (m/yr)	1.000E+01	1.000E+01	---	HCCZ
R013	Contaminated zone b parameter	5.300E+00	5.300E+00	---	BCZ
R013	Average annual wind speed (m/sec)	2.000E+00	2.000E+00	---	WIND
R013	Humidity in air (g/m**3)	not used	8.000E+00	---	HUMID
R013	Evapotranspiration coefficient	5.000E-01	5.000E-01	---	EVAPTR
R013	Precipitation (m/yr)	1.000E+00	1.000E+00	---	PRECIP
R013	Irrigation (m/yr)	2.000E-01	2.000E-01	---	RI
R013	Irrigation mode	overhead	overhead	---	IDITCH
R013	Runoff coefficient	2.000E-01	2.000E-01	---	RUNOFF
R013	Watershed area for nearby stream or pond (m**2)	1.000E+06	1.000E+06	---	WAREA

Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R013	Accuracy for water/soil computations	1.000E-03	1.000E-03	---	EPS
R014	Density of saturated zone (g/cm**3)	1.500E+00	1.500E+00	---	DENSAQ
R014	Saturated zone total porosity	4.000E-01	4.000E-01	---	TPSZ
R014	Saturated zone effective porosity	2.000E-01	2.000E-01	---	EPSZ
R014	Saturated zone field capacity	2.000E-01	2.000E-01	---	FCSZ
R014	Saturated zone hydraulic conductivity (m/yr)	1.000E+02	1.000E+02	---	HCSZ
R014	Saturated zone hydraulic gradient	2.000E-02	2.000E-02	---	HGWT
R014	Saturated zone b parameter	5.300E+00	5.300E+00	---	BSZ
R014	Water table drop rate (m/yr)	1.000E-03	1.000E-03	---	VWT
R014	Well pump intake depth (m below water table)	1.000E+01	1.000E+01	---	DWIBWT
R014	Model: Nondispersion (ND) or Mass-Balance (MB)	ND	ND	---	MODEL
R014	Well pumping rate (m**3/yr)	2.500E+02	2.500E+02	---	UW
R015	Number of unsaturated zone strata	not used	1	---	NS
R015	Unsat. zone 1, thickness (m)	4.000E+00	4.000E+00	---	H(1)
R015	Unsat. zone 1, soil density (g/cm**3)	1.500E+00	1.500E+00	---	DENSUZ(1)
R015	Unsat. zone 1, total porosity	4.000E-01	4.000E-01	---	TPUZ(1)
R015	Unsat. zone 1, effective porosity	2.000E-01	2.000E-01	---	EPUZ(1)
R015	Unsat. zone 1, field capacity	2.000E-01	2.000E-01	---	FCUZ(1)
R015	Unsat. zone 1, soil-specific b parameter	5.300E+00	5.300E+00	---	BUZ(1)
R015	Unsat. zone 1, hydraulic conductivity (m/yr)	1.000E+01	1.000E+01	---	HCUZ(1)
R016	Distribution coefficients for Pb-210				
R016	Contaminated zone (cm**3/g)	1.000E+02	1.000E+02	---	DCNUCC(1)
R016	Unsaturated zone 1 (cm**3/g)	1.000E+02	1.000E+02	---	DCNUCU(1,1)
R016	Saturated zone (cm**3/g)	1.000E+02	1.000E+02	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.663E-03	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
R016	Distribution coefficients for Ra-226				
R016	Contaminated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCC(2)
R016	Unsaturated zone 1 (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCU(2,1)
R016	Saturated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCS(2)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.374E-03	ALEACH(2)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(2)
R016	Distribution coefficients for Ra-228				
R016	Contaminated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCC(3)
R016	Unsaturated zone 1 (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCU(3,1)
R016	Saturated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCS(3)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.374E-03	ALEACH(3)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(3)
R016	Distribution coefficients for Th-228				
R016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCC(4)
R016	Unsaturated zone 1 (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCU(4,1)
R016	Saturated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCS(4)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.778E-06	ALEACH(4)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(4)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R016	Distribution coefficients for Th-230				
R016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCC(5)
R016	Unsaturated zone 1 (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCU(5,1)
R016	Saturated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCS(5)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.778E-06	ALEACH(5)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(5)
R016	Distribution coefficients for Th-232				
R016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCC(6)
R016	Unsaturated zone 1 (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCU(6,1)
R016	Saturated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCS(6)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.778E-06	ALEACH(6)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(6)
R016	Distribution coefficients for U-234				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(7)
R016	Unsaturated zone 1 (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCU(7,1)
R016	Saturated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCS(7)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.319E-03	ALEACH(7)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(7)
R016	Distribution coefficients for U-238				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(8)
R016	Unsaturated zone 1 (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCU(8,1)
R016	Saturated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCS(8)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.319E-03	ALEACH(8)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(8)
R017	Inhalation rate (m**3/yr)	not used	8.400E+03	---	INHALR
R017	Mass loading for inhalation (g/m**3)	not used	1.000E-04	---	MLINH
R017	Exposure duration	3.000E+01	3.000E+01	---	ED
R017	Shielding factor, inhalation	not used	4.000E-01	---	SHF3
R017	Shielding factor, external gamma	not used	7.000E-01	---	SHF1
R017	Fraction of time spent indoors	5.000E-01	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	2.500E-01	2.500E-01	---	FOTD
R017	Shape factor flag, external gamma	not used	1.000E+00	>0 shows circular AREA.	FS
R017	Radii of shape factor array (used if FS = -1):				
R017	Outer annular radius (m), ring 1:	not used	5.000E+01	---	RAD_SHAPE(1)
R017	Outer annular radius (m), ring 2:	not used	7.071E+01	---	RAD_SHAPE(2)
R017	Outer annular radius (m), ring 3:	not used	0.000E+00	---	RAD_SHAPE(3)
R017	Outer annular radius (m), ring 4:	not used	0.000E+00	---	RAD_SHAPE(4)
R017	Outer annular radius (m), ring 5:	not used	0.000E+00	---	RAD_SHAPE(5)
R017	Outer annular radius (m), ring 6:	not used	0.000E+00	---	RAD_SHAPE(6)
R017	Outer annular radius (m), ring 7:	not used	0.000E+00	---	RAD_SHAPE(7)
R017	Outer annular radius (m), ring 8:	not used	0.000E+00	---	RAD_SHAPE(8)
R017	Outer annular radius (m), ring 9:	not used	0.000E+00	---	RAD_SHAPE(9)
R017	Outer annular radius (m), ring 10:	not used	0.000E+00	---	RAD_SHAPE(10)
R017	Outer annular radius (m), ring 11:	not used	0.000E+00	---	RAD_SHAPE(11)
R017	Outer annular radius (m), ring 12:	not used	0.000E+00	---	RAD_SHAPE(12)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R017	Fractions of annular areas within AREA:				
R017	Ring 1	not used	1.000E+00	---	FRACA(1)
R017	Ring 2	not used	2.732E-01	---	FRACA(2)
R017	Ring 3	not used	0.000E+00	---	FRACA(3)
R017	Ring 4	not used	0.000E+00	---	FRACA(4)
R017	Ring 5	not used	0.000E+00	---	FRACA(5)
R017	Ring 6	not used	0.000E+00	---	FRACA(6)
R017	Ring 7	not used	0.000E+00	---	FRACA(7)
R017	Ring 8	not used	0.000E+00	---	FRACA(8)
R017	Ring 9	not used	0.000E+00	---	FRACA(9)
R017	Ring 10	not used	0.000E+00	---	FRACA(10)
R017	Ring 11	not used	0.000E+00	---	FRACA(11)
R017	Ring 12	not used	0.000E+00	---	FRACA(12)
R018	Fruits, vegetables and grain consumption (kg/yr)	not used	1.600E+02	---	DIET(1)
R018	Leafy vegetable consumption (kg/yr)	not used	1.400E+01	---	DIET(2)
R018	Milk consumption (L/yr)	not used	9.200E+01	---	DIET(3)
R018	Meat and poultry consumption (kg/yr)	not used	6.300E+01	---	DIET(4)
R018	Fish consumption (kg/yr)	not used	5.400E+00	---	DIET(5)
R018	Other seafood consumption (kg/yr)	not used	9.000E-01	---	DIET(6)
R018	Soil ingestion rate (g/yr)	not used	3.650E+01	---	SOIL
R018	Drinking water intake (L/yr)	not used	5.100E+02	---	DWI
R018	Contamination fraction of drinking water	not used	1.000E+00	---	FDW
R018	Contamination fraction of household water	1.000E+00	1.000E+00	---	FHHW
R018	Contamination fraction of livestock water	not used	1.000E+00	---	FLW
R018	Contamination fraction of irrigation water	not used	1.000E+00	---	FIRW
R018	Contamination fraction of aquatic food	not used	5.000E-01	---	FR9
R018	Contamination fraction of plant food	not used	-1	---	FPLANT
R018	Contamination fraction of meat	not used	-1	---	FMEAT
R018	Contamination fraction of milk	not used	-1	---	FMILK
R019	Livestock fodder intake for meat (kg/day)	not used	6.800E+01	---	LFI5
R019	Livestock fodder intake for milk (kg/day)	not used	5.500E+01	---	LFI6
R019	Livestock water intake for meat (L/day)	not used	5.000E+01	---	LWI5
R019	Livestock water intake for milk (L/day)	not used	1.600E+02	---	LWI6
R019	Livestock soil intake (kg/day)	not used	5.000E-01	---	LSI
R019	Mass loading for foliar deposition (g/m**3)	not used	1.000E-04	---	MLFD
R019	Depth of soil mixing layer (m)	not used	1.500E-01	---	DM
R019	Depth of roots (m)	not used	9.000E-01	---	DROOT
R019	Drinking water fraction from ground water	not used	1.000E+00	---	FGWDW
R019	Household water fraction from ground water	1.000E+00	1.000E+00	---	FGWHH
R019	Livestock water fraction from ground water	not used	1.000E+00	---	FGWLW
R019	Irrigation fraction from ground water	not used	1.000E+00	---	FGWIR
R19B	Wet weight crop yield for Non-Leafy (kg/m**2)	not used	7.000E-01	---	YV(1)
R19B	Wet weight crop yield for Leafy (kg/m**2)	not used	1.500E+00	---	YV(2)
R19B	Wet weight crop yield for Fodder (kg/m**2)	not used	1.100E+00	---	YV(3)
R19B	Growing Season for Non-Leafy (years)	not used	1.700E-01	---	TE(1)
R19B	Growing Season for Leafy (years)	not used	2.500E-01	---	TE(2)
R19B	Growing Season for Fodder (years)	not used	8.000E-02	---	TE(3)

Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R19B	Translocation Factor for Non-Leafy	not used	1.000E-01	---	TIV(1)
R19B	Translocation Factor for Leafy	not used	1.000E+00	---	TIV(2)
R19B	Translocation Factor for Fodder	not used	1.000E+00	---	TIV(3)
R19B	Dry Foliar Interception Fraction for Non-Leafy	not used	2.500E-01	---	RDRY(1)
R19B	Dry Foliar Interception Fraction for Leafy	not used	2.500E-01	---	RDRY(2)
R19B	Dry Foliar Interception Fraction for Fodder	not used	2.500E-01	---	RDRY(3)
R19B	Wet Foliar Interception Fraction for Non-Leafy	not used	2.500E-01	---	RWET(1)
R19B	Wet Foliar Interception Fraction for Leafy	not used	2.500E-01	---	RWET(2)
R19B	Wet Foliar Interception Fraction for Fodder	not used	2.500E-01	---	RWET(3)
R19B	Weathering Removal Constant for Vegetation	not used	2.000E+01	---	WLAM
C14	C-12 concentration in water (g/cm**3)	not used	2.000E-05	---	C12WTR
C14	C-12 concentration in contaminated soil (g/g)	not used	3.000E-02	---	C12CZ
C14	Fraction of vegetation carbon from soil	not used	2.000E-02	---	CSOIL
C14	Fraction of vegetation carbon from air	not used	9.800E-01	---	CAIR
C14	C-14 evasion layer thickness in soil (m)	not used	3.000E-01	---	DMC
C14	C-14 evasion flux rate from soil (1/sec)	not used	7.000E-07	---	EVSN
C14	C-12 evasion flux rate from soil (1/sec)	not used	1.000E-10	---	REVSN
C14	Fraction of grain in beef cattle feed	not used	8.000E-01	---	AVFG4
C14	Fraction of grain in milk cow feed	not used	2.000E-01	---	AVFG5
STOR	Storage times of contaminated foodstuffs (days):				
STOR	Fruits, non-leafy vegetables, and grain	1.400E+01	1.400E+01	---	STOR_T(1)
STOR	Leafy vegetables	1.000E+00	1.000E+00	---	STOR_T(2)
STOR	Milk	1.000E+00	1.000E+00	---	STOR_T(3)
STOR	Meat and poultry	2.000E+01	2.000E+01	---	STOR_T(4)
STOR	Fish	7.000E+00	7.000E+00	---	STOR_T(5)
STOR	Crustacea and mollusks	7.000E+00	7.000E+00	---	STOR_T(6)
STOR	Well water	1.000E+00	1.000E+00	---	STOR_T(7)
STOR	Surface water	1.000E+00	1.000E+00	---	STOR_T(8)
STOR	Livestock fodder	4.500E+01	4.500E+01	---	STOR_T(9)
R021	Thickness of building foundation (m)	2.000E-01	1.500E-01	---	FLOOR1
R021	Bulk density of building foundation (g/cm**3)	2.400E+00	2.400E+00	---	DENSFL
R021	Total porosity of the cover material	4.000E-01	4.000E-01	---	TPCV
R021	Total porosity of the building foundation	1.000E-01	1.000E-01	---	TPFL
R021	Volumetric water content of the cover material	5.000E-02	5.000E-02	---	PH2OCV
R021	Volumetric water content of the foundation	3.000E-02	3.000E-02	---	PH2OFL
R021	Diffusion coefficient for radon gas (m/sec):				
R021	in cover material	2.000E-06	2.000E-06	---	DIFCV
R021	in foundation material	3.000E-07	3.000E-07	---	DIFFL
R021	in contaminated zone soil	2.000E-06	2.000E-06	---	DIFCZ
R021	Radon vertical dimension of mixing (m)	2.000E+00	2.000E+00	---	HMIX
R021	Average building air exchange rate (1/hr)	7.000E-01	5.000E-01	---	REXG
R021	Height of the building (room) (m)	3.000E+00	2.500E+00	---	HRM
R021	Building interior area factor	0.000E+00	0.000E+00	code computed (time dependent)	FAI
R021	Building depth below ground surface (m)	2.000E-01	-1.000E+00	---	DMFL
R021	Emanating power of Rn-222 gas	2.500E-01	2.500E-01	---	EMANA(1)
R021	Emanating power of Rn-220 gas	1.500E-01	1.500E-01	---	EMANA(2)
TITL	Number of graphical time points	32	---	---	NPTS

Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
TITL	Maximum number of integration points for dose	17	---	---	LYMAX
TITL	Maximum number of integration points for risk	1	---	---	KYMAX

Summary of Pathway Selections

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

Summary : RESRAD Default Parameters
File : X:\PROJECT_DATA\RARE ELEMENTS BEAR LODGE\LICENSE APPLICATION\TSF.RAD

Contaminated Zone Dimensions		Initial Soil Concentrations, pCi/g	
Area:	10000.00 square meters	Pb-210	1.000E+01
Thickness:	2.00 meters	Ra-226	1.000E+01
Cover Depth:	2.10 meters	Ra-228	2.200E+01
		Th-228	2.200E+01
		Th-230	1.000E+01
		Th-232	2.200E+01
		U-234	1.000E+01
		U-238	1.000E+01

0

Total Dose TDOSE(t), mrem/yr
Basic Radiation Dose Limit = 2.500E+01 mrem/yr
Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

t (years):	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
TDOSE(t):	3.298E+01	3.291E+01	3.275E+01	3.221E+01	3.073E+01	2.616E+01	1.711E+01	1.010E+01
M(t):	1.319E+00	1.316E+00	1.310E+00	1.289E+00	1.229E+00	1.046E+00	6.843E-01	4.040E-01

0Maximum TDOSE(t): 3.298E+01 mrem/yr at t = 0.000E+00 years

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

Radio-Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
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	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	3.298E+01	0.9998	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	7.146E-03	0.0002	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	2.143E-08	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	1.518E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	3.298E+01	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

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

Radio-Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
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	0.000E+00	0.0000	0.000E+00	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	0.000E+00	0.0000	3.298E+01	0.9998
Ra-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	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	0.000E+00	0.0000	7.146E-03	0.0002
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	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	0.000E+00	0.0000	2.143E-08	0.0000
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	1.518E-14	0.0000
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	3.298E+01	1.0000

*Sum of all water independent and dependent pathways.

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

Radio-Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
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	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	3.288E+01	0.9993	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	2.141E-02	0.0007	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	1.498E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	2.273E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	3.291E+01	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

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

Radio-Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
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	0.000E+00	0.0000	0.000E+00	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	0.000E+00	0.0000	3.288E+01	0.9993
Ra-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	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	0.000E+00	0.0000	2.141E-02	0.0007
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	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	0.000E+00	0.0000	1.498E-07	0.0000
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	2.273E-13	0.0000
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	3.291E+01	1.0000

*Sum of all water independent and dependent pathways.

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

Radio-Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
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	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	3.270E+01	0.9985	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	4.982E-02	0.0015	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	7.884E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	2.640E-12	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	3.275E+01	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

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

Radio-Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
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	0.000E+00	0.0000	0.000E+00	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	0.000E+00	0.0000	3.270E+01	0.9985
Ra-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	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	0.000E+00	0.0000	4.982E-02	0.0015
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	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	0.000E+00	0.0000	7.884E-07	0.0000
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	2.640E-12	0.0000
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	3.275E+01	1.0000

*Sum of all water independent and dependent pathways.

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

Radio-Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
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	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	3.206E+01	0.9954	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	1.480E-01	0.0046	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	6.954E-06	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	6.886E-11	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	3.221E+01	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

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

Radio-Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
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	0.000E+00	0.0000	0.000E+00	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	0.000E+00	0.0000	3.206E+01	0.9954
Ra-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	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	0.000E+00	0.0000	1.480E-01	0.0046
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	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	0.000E+00	0.0000	6.954E-06	0.0000
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	6.886E-11	0.0000
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	3.221E+01	1.0000

*Sum of all water independent and dependent pathways.

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

Radio-Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
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	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	3.031E+01	0.9864	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	4.181E-01	0.0136	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	5.629E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	1.607E-09	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	3.073E+01	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

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

Radio-Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
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	0.000E+00	0.0000	0.000E+00	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	0.000E+00	0.0000	3.031E+01	0.9864
Ra-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	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	0.000E+00	0.0000	4.181E-01	0.0136
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	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	0.000E+00	0.0000	5.629E-05	0.0000
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	1.607E-09	0.0000
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	3.073E+01	1.0000

*Sum of all water independent and dependent pathways.

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

Radio-Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
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	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	2.491E+01	0.9521	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	1.252E+00	0.0479	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	5.309E-04	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	4.879E-08	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	2.616E+01	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

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

Radio-Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
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	0.000E+00	0.0000	0.000E+00	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	0.000E+00	0.0000	2.491E+01	0.9521
Ra-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	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	0.000E+00	0.0000	1.252E+00	0.0479
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	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	0.000E+00	0.0000	5.309E-04	0.0000
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	4.879E-08	0.0000
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	2.616E+01	1.0000

*Sum of all water independent and dependent pathways.

Summary : RESRAD Default Parameters
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Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years
Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
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	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	1.421E+01	0.8304	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	2.898E+00	0.1694	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	3.222E-03	0.0002	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	8.259E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	1.711E+01	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

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

Radio-Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
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	0.000E+00	0.0000	0.000E+00	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	0.000E+00	0.0000	1.421E+01	0.8304
Ra-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	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	0.000E+00	0.0000	2.898E+00	0.1694
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	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	0.000E+00	0.0000	3.222E-03	0.0002
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	8.259E-07	0.0000
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	1.711E+01	1.0000

*Sum of all water independent and dependent pathways.

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

Radio-Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
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	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	1.992E+00	0.1972	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	4.750E+00	0.4702	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	1.108E-02	0.0011	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	7.116E-06	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	6.752E+00	0.6685	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

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

Radio-Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
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	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	2.957E+00	0.2927	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.948E+00	0.4899
Ra-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	3.873E-01	0.0383	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.137E+00	0.5086
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	4.948E-03	0.0005	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.603E-02	0.0016
U-238	0.000E+00	0.0000	0.000E+00	0.0000	6.461E-06	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.358E-05	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	3.349E+00	0.3315	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.010E+01	1.0000

*Sum of all water independent and dependent pathways.

Summary : RESRAD Default Parameters
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Dose/Source Ratios Summed Over All Pathways
Parent and Progeny Principal Radionuclide Contributions Indicated

0 Parent (i)	Product (j)	Thread Fraction	DSR(j,t) At Time in Years (mrem/yr)/(pCi/g) 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Pb-210+D	Pb-210+D	1.000E+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
0Ra-226+D	Ra-226+D	1.000E+00	3.298E+00	3.288E+00	3.270E+00	3.206E+00	3.031E+00	2.491E+00	1.421E+00	4.948E-01
Ra-226+D	Pb-210+D	1.000E+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+D	ΣDSR(j)		3.298E+00	3.288E+00	3.270E+00	3.206E+00	3.031E+00	2.491E+00	1.421E+00	4.948E-01
0Ra-228+D	Ra-228+D	1.000E+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-228+D	Th-228+D	1.000E+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-228+D	ΣDSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0Th-228+D	Th-228+D	1.000E+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
0Th-230	Th-230	1.000E+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	Ra-226+D	1.000E+00	7.146E-04	2.141E-03	4.982E-03	1.480E-02	4.181E-02	1.252E-01	2.898E-01	5.137E-01
Th-230	Pb-210+D	1.000E+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	ΣDSR(j)		7.146E-04	2.141E-03	4.982E-03	1.480E-02	4.181E-02	1.252E-01	2.898E-01	5.137E-01
0Th-232	Th-232	1.000E+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-232	Ra-228+D	1.000E+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-232	Th-228+D	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.562E-36
Th-232	ΣDSR(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.562E-36
0U-234	U-234	1.000E+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	Th-230	1.000E+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	Ra-226+D	1.000E+00	2.143E-09	1.498E-08	7.884E-08	6.954E-07	5.629E-06	5.309E-05	3.222E-04	1.603E-03
U-234	Pb-210+D	1.000E+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	ΣDSR(j)		2.143E-09	1.498E-08	7.884E-08	6.954E-07	5.629E-06	5.309E-05	3.222E-04	1.603E-03
0U-238	U-238	5.400E-05	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0U-238+D	U-238+D	9.999E-01	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-238+D	U-234	9.999E-01	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-238+D	Th-230	9.999E-01	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-238+D	Ra-226+D	9.999E-01	1.518E-15	2.273E-14	2.640E-13	6.886E-12	1.607E-10	4.879E-09	8.259E-08	1.358E-06
U-238+D	Pb-210+D	9.999E-01	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-238+D	ΣDSR(j)		1.518E-15	2.273E-14	2.640E-13	6.886E-12	1.607E-10	4.879E-09	8.259E-08	1.358E-06

The DSR includes contributions from associated (half-life ≤ 180 days) daughters.

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

0Nuclide

(i)	t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Pb-210	*7.634E+13	*7.634E+13	*7.634E+13	*7.634E+13	*7.634E+13	*7.634E+13	*7.634E+13	*7.634E+13
Ra-226	7.581E+00	7.602E+00	7.645E+00	7.797E+00	8.247E+00	1.004E+01	1.760E+01	5.052E+01
Ra-228	*2.726E+14	*2.726E+14	*2.726E+14	*2.726E+14	*2.726E+14	*2.726E+14	*2.726E+14	*2.726E+14
Th-228	*8.195E+14	*8.195E+14	*8.195E+14	*8.195E+14	*8.195E+14	*8.195E+14	*8.195E+14	*8.195E+14
Th-230	3.498E+04	1.168E+04	5.018E+03	1.689E+03	5.979E+02	1.997E+02	8.626E+01	4.867E+01
Th-232	*1.097E+05	*1.097E+05	*1.097E+05	*1.097E+05	*1.097E+05	*1.097E+05	*1.097E+05	*1.097E+05
U-234	*6.356E+09	1.669E+09	3.171E+08	3.595E+07	4.441E+06	4.709E+05	7.759E+04	1.560E+04
U-238	*3.361E+05	*3.361E+05	*3.361E+05	*3.361E+05	*3.361E+05	*3.361E+05	*3.361E+05	*3.361E+05

*At specific activity limit

0

Summed Dose/Source Ratios DSR(i,t) in (mrem/yr)/(pCi/g)
and Single Radionuclide Soil Guidelines G(i,t) in pCi/g
at tmin = time of minimum single radionuclide soil guideline
and at tmax = time of maximum total dose = 0.000E+00 years

0Nuclide

(i)	Initial (pCi/g)	tmin (years)	DSR(i,tmin)	G(i,tmin) (pCi/g)	DSR(i,tmax)	G(i,tmax) (pCi/g)
Pb-210	1.000E+01	0.000E+00	0.000E+00	*7.634E+13	0.000E+00	*7.634E+13
Ra-226	1.000E+01	0.000E+00	3.298E+00	7.581E+00	3.298E+00	7.581E+00
Ra-228	2.200E+01	0.000E+00	0.000E+00	*2.726E+14	0.000E+00	*2.726E+14
Th-228	2.200E+01	0.000E+00	0.000E+00	*8.195E+14	0.000E+00	*8.195E+14
Th-230	1.000E+01	1.000E+03	5.137E-01	4.867E+01	7.146E-04	3.498E+04
Th-232	2.200E+01	0.000E+00	0.000E+00	*1.097E+05	0.000E+00	*1.097E+05
U-234	1.000E+01	1.000E+03	1.603E-03	1.560E+04	2.143E-09	*6.356E+09
U-238	1.000E+01	1.000E+03	1.358E-06	*3.361E+05	1.518E-15	*3.361E+05

*At specific activity limit

Summary : RESRAD Default Parameters
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Individual Nuclide Dose Summed Over All Pathways
Parent Nuclide and Branch Fraction Indicated

0Nuclide (j)	Parent (i)	THF(i)	DOSE(j,t), mrem/yr t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Pb-210	Pb-210	1.000E+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	Ra-226	1.000E+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	Th-230	1.000E+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	U-234	1.000E+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	U-238	9.999E-01	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	ΣDOSE(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0Ra-226	Ra-226	1.000E+00	3.298E+01	3.288E+01	3.270E+01	3.206E+01	3.031E+01	2.491E+01	1.421E+01	4.948E+00
Ra-226	Th-230	1.000E+00	7.146E-03	2.141E-02	4.982E-02	1.480E-01	4.181E-01	1.252E+00	2.898E+00	5.137E+00
Ra-226	U-234	1.000E+00	2.143E-08	1.498E-07	7.884E-07	6.954E-06	5.629E-05	5.309E-04	3.222E-03	1.603E-02
Ra-226	U-238	9.999E-01	1.518E-14	2.273E-13	2.640E-12	6.886E-11	1.607E-09	4.879E-08	8.259E-07	1.358E-05
Ra-226	ΣDOSE(j)		3.298E+01	3.291E+01	3.275E+01	3.221E+01	3.073E+01	2.616E+01	1.711E+01	1.010E+01
0Ra-228	Ra-228	1.000E+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-228	Th-232	1.000E+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-228	ΣDOSE(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0Th-228	Ra-228	1.000E+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-228	Th-228	1.000E+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-228	Th-232	1.000E+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-228	ΣDOSE(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0Th-230	Th-230	1.000E+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	U-234	1.000E+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	U-238	9.999E-01	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	ΣDOSE(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0Th-232	Th-232	1.000E+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
0U-234	U-234	1.000E+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	U-238	9.999E-01	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	ΣDOSE(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0U-238	U-238	5.400E-05	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-238	U-238	9.999E-01	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-238	ΣDOSE(j)		0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

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

Summary : RESRAD Default Parameters
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Individual Nuclide Soil Concentration
Parent Nuclide and Branch Fraction Indicated

0Nuclide (j)	Parent (i)	THF(i)	S(j,t), pCi/g t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Pb-210	Pb-210	1.000E+00	1.000E+01	9.678E+00	9.064E+00	7.208E+00	3.744E+00	3.783E-01	5.415E-04	6.006E-14
Pb-210	Ra-226	1.000E+00	0.000E+00	3.054E-01	8.844E-01	2.612E+00	5.656E+00	7.448E+00	4.472E+00	6.270E-01
Pb-210	Th-230	1.000E+00	0.000E+00	6.654E-05	5.849E-04	5.996E-03	4.348E-02	2.599E-01	7.733E-01	1.357E+00
Pb-210	U-234	1.000E+00	0.000E+00	2.001E-10	5.299E-09	1.836E-07	4.137E-06	8.880E-05	7.916E-04	3.129E-03
Pb-210	U-238	9.999E-01	0.000E+00	1.420E-16	1.131E-14	1.317E-12	9.099E-11	6.838E-09	1.869E-07	1.973E-06
Pb-210	ΣS(j):		1.000E+01	9.983E+00	9.949E+00	9.825E+00	9.444E+00	8.087E+00	5.247E+00	1.987E+00
0Ra-226	Ra-226	1.000E+00	1.000E+01	9.972E+00	9.916E+00	9.723E+00	9.192E+00	7.553E+00	4.308E+00	6.039E-01
Ra-226	Th-230	1.000E+00	0.000E+00	4.326E-03	1.294E-02	4.272E-02	1.246E-01	3.775E-01	8.767E-01	1.438E+00
Ra-226	U-234	1.000E+00	0.000E+00	1.946E-08	1.744E-07	1.910E-06	1.651E-05	1.593E-04	9.733E-04	3.355E-03
Ra-226	U-238	9.999E-01	0.000E+00	1.838E-14	4.940E-13	1.799E-11	4.635E-10	1.457E-08	2.491E-07	2.154E-06
Ra-226	ΣS(j):		1.000E+01	9.976E+00	9.929E+00	9.766E+00	9.317E+00	7.930E+00	5.186E+00	2.045E+00
0Ra-228	Ra-228	1.000E+00	2.200E+01	1.946E+01	1.521E+01	6.436E+00	5.507E-01	1.009E-04	2.124E-15	0.000E+00
Ra-228	Th-232	1.000E+00	0.000E+00	2.496E+00	6.654E+00	1.526E+01	2.103E+01	2.157E+01	2.156E+01	2.152E+01
Ra-228	ΣS(j):		2.200E+01	2.195E+01	2.187E+01	2.170E+01	2.158E+01	2.157E+01	2.156E+01	2.152E+01
0Th-228	Ra-228	1.000E+00	0.000E+00	6.269E+00	1.180E+01	8.851E+00	8.328E-01	1.528E-04	3.215E-15	0.000E+00
Th-228	Th-228	1.000E+00	2.200E+01	1.531E+01	7.419E+00	5.873E-01	4.186E-04	4.047E-15	0.000E+00	0.000E+00
Th-228	Th-232	1.000E+00	0.000E+00	4.098E-01	2.729E+00	1.232E+01	2.076E+01	2.157E+01	2.156E+01	2.152E+01
Th-228	ΣS(j):		2.200E+01	2.199E+01	2.195E+01	2.176E+01	2.159E+01	2.157E+01	2.156E+01	2.152E+01
0Th-230	Th-230	1.000E+00	1.000E+01	1.000E+01	1.000E+01	9.999E+00	9.996E+00	9.988E+00	9.965E+00	9.883E+00
Th-230	U-234	1.000E+00	0.000E+00	8.987E-05	2.687E-04	8.854E-04	2.570E-03	7.655E-03	1.706E-02	2.589E-02
Th-230	U-238	9.999E-01	0.000E+00	1.273E-10	1.141E-09	1.248E-08	1.075E-07	1.025E-06	6.075E-06	1.941E-05
Th-230	ΣS(j):		1.000E+01	1.000E+01	1.000E+01	1.000E+01	9.999E+00	9.996E+00	9.982E+00	9.909E+00
0Th-232	Th-232	1.000E+00	2.200E+01	2.200E+01	2.200E+01	2.200E+01	2.200E+01	2.199E+01	2.198E+01	2.194E+01
0U-234	U-234	1.000E+00	1.000E+01	9.967E+00	9.901E+00	9.673E+00	9.051E+00	7.173E+00	3.691E+00	3.608E-01
U-234	U-238	9.999E-01	0.000E+00	2.825E-05	8.420E-05	2.742E-04	7.698E-04	2.034E-03	3.141E-03	1.024E-03
U-234	ΣS(j):		1.000E+01	9.967E+00	9.901E+00	9.674E+00	9.052E+00	7.175E+00	3.695E+00	3.618E-01
0U-238	U-238	5.400E-05	5.400E-04	5.382E-04	5.346E-04	5.224E-04	4.888E-04	3.875E-04	1.995E-04	1.954E-05
U-238	U-238	9.999E-01	9.999E+00	9.966E+00	9.900E+00	9.673E+00	9.052E+00	7.175E+00	3.694E+00	3.618E-01
U-238	ΣS(j):		1.000E+01	9.967E+00	9.901E+00	9.674E+00	9.052E+00	7.175E+00	3.695E+00	3.618E-01

THF(i) is the thread fraction of the parent nuclide.
0RESCALC.EXE execution time = 1.97 seconds