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National Nuclear Security Administration

Corrective Action Investigation Plan for Corrective Action Unit 413: Clean Slate II Plutonium Dispersion (TTR) Tonopah Test Range, Nevada

Controlled Copy No.: ___
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/s/ Joseph P. Johnston 04/20/2016
Joseph P. Johnston, Navarro CO Date

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CORRECTIVE ACTION INVESTIGATION PLAN FOR CORRECTIVE ACTION UNIT 413: CLEAN SLATE II PLUTONIUM DISPERSION (TTR) TONOPAH TEST RANGE, NEVADA

U.S. Department of Energy, National Nuclear Security Administration
Nevada Field Office
Las Vegas, Nevada

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**CORRECTIVE ACTION INVESTIGATION PLAN
FOR CORRECTIVE ACTION UNIT 413:
CLEAN SLATE II PLUTONIUM DISPERSION (TTR)
TONOPAH TEST RANGE, NEVADA**

Approved by: /s/ Tiffany A. Lantow Date: 04/20/2016

Tiffany A. Lantow
Soils Activity Lead

Approved by: /s/ Robert F. Boehlecke Date: 04/21/2016

Robert F. Boehlecke
Environmental Management Operations Manager

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List of Acronyms and Abbreviations

Ac	Actinium
AEC	Atomic Energy Commission
Ag	Silver
Al	Aluminum
Am	Americium
amsl	Above mean sea level
ASTM	ASTM International
bgs	Below ground surface
CA	Contamination area
CAA	Corrective action alternative
CADD	Corrective action decision document
CAI	Corrective action investigation
CAIP	Corrective action investigation plan
CAS	Corrective action site
CAU	Corrective action unit
CFR	*Code of Federal Regulations*
cm	Centimeter
Cm	Curium
Co	Cobalt
COC	Contaminant of concern
COPC	Contaminant of potential concern
cps	Counts per second
Cs	Cesium
CS	Clean Slate
CSI	Clean Slate I

List of Acronyms and Abbreviations *(Continued)*

CSII	Clean Slate II
CSIII	Clean Slate III
CSM	Conceptual site model
CW	Construction Worker
day/yr	Days per year
DCF	Dose conversion factor
DOE	U.S. Department of Energy
dpm/100 cm^2	Disintegrations per minute per 100 square centimeters
DQI	Data quality indicator
DQO	Data quality objective
DRI	Desert Research Institute
DT	Double Tracks
DU	Depleted uranium
EPA	U.S. Environmental Protection Agency
Eu	Europium
°F	Degrees Fahrenheit
FAL	Final action level
FD	Field duplicate
FFACO	*Federal Facility Agreement and Consent Order*
FIDLER	Field instrument for the detection of low-energy radiation
FSL	Field-screening level
FSR	Field-screening result
ft	Foot
ft^3	Cubic foot
g/cm^3	Grams per cubic centimeter

List of Acronyms and Abbreviations *(Continued)*

g/m^3	Grams per cubic meter
g/yr	Grams per year
gal	Gallon
GPS	Global Positioning System
GZ	Ground zero
HASL	Health and Safety Laboratory
HCA	High contamination area
HEPA	High-efficiency particulate air
HPGe	High-purity germanium
hr/day	Hours per day
hr/yr	Hours per year
IDW	Investigation-derived waste
in.	Inch
in./yr	Inches per year
IP	Industrial package
K	Potassium
K_d	Distribution coefficient
LCL	Lower confidence limit
m	Meter
m/sec	Meters per second
m/yr	Meters per year
m^2	Square meter
m^3/hr	Cubic meters per hour
m^3/min	Cubic meters per minute
m^3/yr	Cubic meters per year

List of Acronyms and Abbreviations (Continued)

MDA	Minimum detectable activity
MDC	Minimum detectable concentration
mg/day	Milligrams per day
mi	Mile
mi^2	Square mile
mph	Miles per hour
mrem	Millirem
mrem/CW-yr	Millirem per Construction Worker year
mrem/yr	Millirem per year
NAC	*Nevada Administrative Code*
NAD	North American Datum
NAEG	Nevada Applied Ecology Group
NaI	Sodium iodide
Nb	Niobium
NDEP	Nevada Division of Environmental Protection
NEPA	*National Environmental Policy Act*
NNSA/NFO	U.S. Department of Energy, National Nuclear Security Administration Nevada Field Office
NNSS	Nevada National Security Site
Np	Neptunium
NTTR	Nevada Test and Training Range
Pa	Protactinium
PAL	Preliminary action level
Pb	Lead
PCB	Polychlorinated biphenyl

List of Acronyms and Abbreviations *(Continued)*

pCi/g	Picocuries per gram
PET	Potential evapotranspiration
PPE	Personal protective equipment
PSM	Potential source material
Pu	Plutonium
QA	Quality assurance
QAP	Quality Assurance Plan
QC	Quality control
r^2	Coefficient of determination
RBCA	Risk-based corrective action
RCRA	*Resource Conservation and Recovery Act*
REOP	Real Estate/Operations Permit
RRMG	Residual radioactive material guideline
SG	Study Group
Sr	Strontium
SVOC	Semivolatile organic compound
TBD	To be determined
Tc	Technetium
TCLP	Toxicity Characteristic Leaching Procedure
TED	Total effective dose
Th	Thorium
Tl	Thallium
TLD	Thermoluminescent dosimeter
TTR	Tonopah Test Range
U	Uranium

List of Acronyms and Abbreviations (Continued)

UCL	Upper confidence limit
USAF	U.S. Air Force
UTM	Universal Transverse Mercator
UXO	Unexploded ordnance
VOC	Volatile organic compound
yd^3	Cubic yard
µCi/mL	Microcuries per milliliter
µg	Microgram

Executive Summary

Corrective Action Unit (CAU) 413 is located on the Tonopah Test Range, which is approximately 130 miles northwest of Las Vegas, Nevada, and approximately 40 miles southeast of Tonopah, Nevada. The CAU 413 site consists of the release of radionuclides to the surface and shallow subsurface from the conduct of the Clean Slate II (CSII) storage–transportation test conducted on May 31, 1963. CAU 413 includes one corrective action site (CAS), TA-23-02CS (Pu Contaminated Soil).

The known releases at CAU 413 are the result of the atmospheric deposition of contamination from the 1963 CSII test. The CSII test was a non-nuclear detonation of a nuclear device located inside a reinforced concrete bunker covered with 2 feet of soil. This test dispersed radionuclides, primarily plutonium, on the ground surface.

The presence and nature of contamination at CAU 413 will be evaluated based on information collected from a corrective action investigation (CAI). The investigation is based on the data quality objectives (DQOs) developed on June 17, 2015, by representatives of the Nevada Division of Environmental Protection; the U.S. Air Force; and the U.S. Department of Energy (DOE), National Nuclear Security Administration Nevada Field Office. The DQO process was used to identify and define the type, amount, and quality of data needed to develop and evaluate appropriate corrective actions for CAU 413.

The CAI will include radiological surveys, geophysical surveys, collection and analyses of soil samples, and assessment of investigation results. The collection of soil samples will be accomplished using both probabilistic and judgmental sampling approaches. To facilitate site investigation and the evaluation of DQO decisions, the releases at CAU 413 have been divided into seven study groups, as shown in Table ES-1. The CAI process will be conducted in accordance with the *Soils Activity Quality Assurance Plan*, which establishes requirements, technical planning, and general quality practices to be applied to this activity.

This Corrective Action Investigation Plan has been developed in accordance with the *Federal Facility Agreement and Consent Order* that was agreed to by the State of Nevada; DOE, Environmental Management; U.S. Department of Defense; and DOE, Legacy Management.

Table ES-1
CAU 413 Study Groups

SG Number	SG Name
1	Undisturbed Areas
2	Disturbed Areas
3	Sedimentation Areas
4	Former Staging Area
5	Buried Debris
6	Potential Source Material
7	Soil Mounds

SG = Study Group

Under the *Federal Facility Agreement and Consent Order*, this Corrective Action Investigation Plan will be submitted to the Nevada Division of Environmental Protection for approval.

1.0 Introduction

This Corrective Action Investigation Plan (CAIP) contains activity-specific information, including a site description, environmental sample collection objectives, and criteria for conducting site investigation activities at Corrective Action Unit (CAU) 413: Clean Slate II Plutonium Dispersion (TTR).

This CAIP has been developed in accordance with the *Federal Facility Agreement and Consent Order* (FFACO) (1996, as amended) that was agreed to by the State of Nevada; U.S. Department of Energy (DOE), Environmental Management; U.S. Department of Defense; and DOE, Legacy Management.

CAU 413 is located on the Tonopah Test Range (TTR), which is approximately 130 miles (mi) northwest of Las Vegas, Nevada, and approximately 40 mi southeast of Tonopah, Nevada. The TTR is located within the Nevada Test and Training Range (NTTR), which is administered by the U.S. Air Force (USAF). CAU 413 comprises one corrective action site (CAS), TA-23-02CS (Pu Contaminated Soil). The location of CAU 413 is shown on Figure 1-1. Because CAU 413 consists of a single CAS, the CAS nomenclature is generally not used in this CAIP. Instead, the CAS is referred to as the Clean Slate II (CSII) site or CAU 413 throughout this document.

The corrective action investigation (CAI) at CAU 413 will include radiological surveys, geophysical surveys, collection and analyses of samples, and assessment of investigation results. Data will be obtained to support the evaluation of corrective action alternatives (CAAs) and waste management decisions.

1.1 Purpose

CAU 413 is being investigated because hazardous and/or radioactive contaminants have been released and may be present in concentrations that exceed risk-based corrective action (RBCA) levels. Existing information on the nature and extent of potential contamination is insufficient to evaluate and recommend CAAs for this CAU. Additional information will be generated by conducting a CAI before evaluating and selecting CAAs.

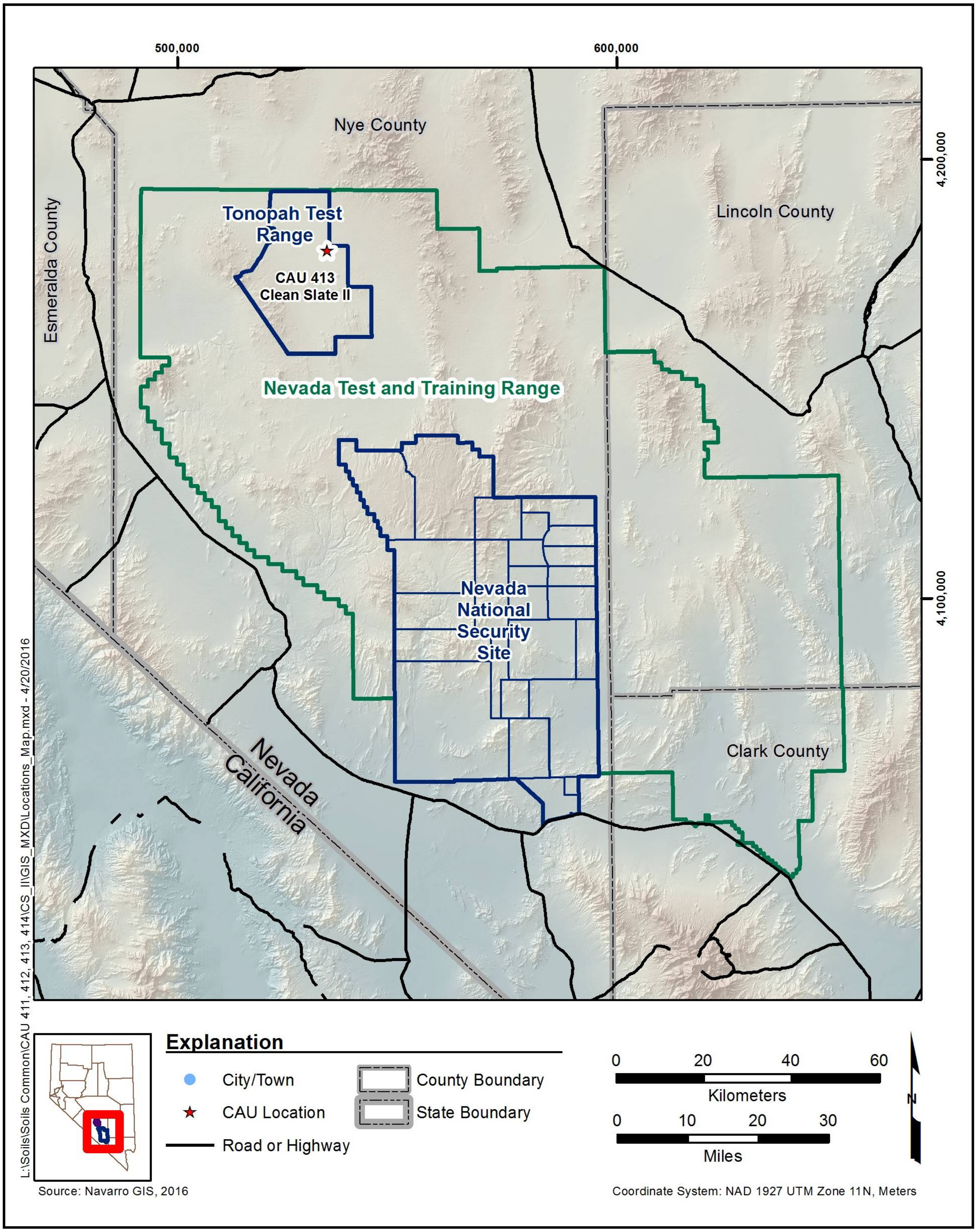


Figure 1-1
CAU 413 Location Map

1.1.1 CAU 413 History and Description

CAU 413 consists of the release of radionuclides to the surface and subsurface from a storage–transportation test conducted on May 31, 1963 (NNSA/NFO, 2015b). The operational history for CAU 413 is detailed in Section 2.2.

1.1.2 Data Quality Objective Summary

The data quality objective (DQO) strategy for CAU 413 was developed at a meeting with the Nevada Division of Environmental Protection (NDEP); USAF; and the DOE, National Nuclear Security Administration Nevada Field Office (NNSA/NFO) on June 17, 2015. The DQOs identified and defined the type, amount, and quality of data needed to develop and evaluate appropriate corrective actions for CAU 413. During the DQO discussions, the informational inputs or data needs to resolve problem statements and decision statements were documented. This CAIP describes the investigative approach developed to collect the necessary data identified in the DQO process. Discussions of the DQO methodology and the DQOs specific to CAU 413 are presented in Appendix A. A summary of the DQO process is provided below.

The DQO problem statement for CAU 413 is as follows: “Existing information on the nature and extent of contamination is insufficient to evaluate CAAs for CAU 413.” To address this problem, resolution of the decision statements presented in Section 3.4 is required. The informational inputs and data required to resolve the problem and decision statements were generated as part of the DQO process for this CAU and are documented in Appendix A. This includes using both judgmental and probabilistic sampling decisions.

For judgmental sampling decisions, any contaminant associated with CAU 413 that is present at concentrations exceeding its corresponding final action level (FAL) will be defined as a contaminant of concern (COC). For probabilistic sampling decisions, any contaminant for which the 95 percent upper confidence limit (UCL) of the mean exceeds its corresponding FAL will be defined as a COC. A COC may also be defined as a contaminant that, in combination with other like contaminants, is determined to jointly pose an unacceptable risk based on a multiple constituent analysis (NNSA/NFO, 2014).

A corrective action will be determined for any site containing a COC. The evaluation of the need for corrective action will include the potential for wastes that are present at the site to cause the future contamination of site environmental media if the wastes were to be released (see Section 3.4).

The RBCA dose evaluation does not address the potential for removable contamination under different exposure scenarios if it were to be transported to other areas. A discussion on the risks associated with removable radioactive contamination is presented in the Soils RBCA document (NNSA/NFO, 2014). This discussion proposes a requirement for corrective action at areas that exceed high contamination area (HCA) criteria even though the area may not present a potential radiation dose to a receptor that exceeds the FAL. It is assumed that areas that exceed HCA criteria require corrective action.

A probabilistic sampling design will be used to collect samples from unbiased locations within a 100-square meter (m^2) area where the assumed distribution of contamination is relatively uniform. Results from these locations will be used to infer a characteristic representative of the sampled area as a whole (i.e., representing the average of the entire area, not the maximum at any one location). The characteristic normally used to define contamination within an area is the 95 percent UCL of the mean dose. Implementation of the probabilistic sampling design is described in Section A.8.1.2.

The DQOs for CAU 413 defined similarities in the conceptual site model (CSM) properties of the releases that would allow a common investigative approach (e.g., surface deposition of relatively immobile contaminants, migration and mixing of contaminants from previous activities, migration by surface water runoff in drainages). Based on these similarities, study groups were established to simplify the planning and investigation of various releases (Table 1-1). The study groups are described in Section 2.4. While the need for corrective action is evaluated for each release, investigation strategies are defined at the study group level, and CAAs are implemented at the FFACO CAS level.

Table 1-1
CAU 413 Study Groups

SG Number	SG Name
1	Undisturbed Areas
2	Disturbed Areas
3	Sedimentation Areas
4	Former Staging Area
5	Buried Debris
6	Potential Source Material
7	Soil Mounds

SG = Study Group

1.2 Scope

To generate information needed to resolve the decision statements identified in the DQO process, the scope of the CAI for CAU 413 includes the following activities:

- Move surface debris and/or materials, as needed, to facilitate sampling.
- Conduct radiological surveys.
- Remove potential source material (PSM) and other debris for disposal.
- Conduct geophysical surveys.
- Perform radiological field screening.
- Measure *in situ* external dose rates using thermoluminescent dosimeters (TLDs).
- Collect and submit environmental samples for laboratory analyses.
- Collect quality control (QC) samples.

Soil and/or debris contamination originating from activities not identified in the CSM (see Section A.2.2) will not be considered as part of this CAU unless the CSM and the DQOs are modified to include the release. If not included in the CSM, contamination originating from these sources will not be considered for sample location selection and/or will not be considered COCs. If such contamination is present, the means for addressing the contamination will be documented in the corrective action decision document (CADD).

1.3 CAIP Contents

Section 1.0 presents the purpose and scope of this CAIP, while Section 2.0 provides background information about CAU 413. Objectives of the investigation, including the CSM, are presented in Section 3.0. Field investigation and sampling activities are discussed in Section 4.0, and waste management is discussed in Section 5.0. General field and laboratory quality assurance (QA) (including collection of QA samples) is presented in Section 6.0 and in the *Soils Activity Quality Assurance Plan* (QAP) (NNSA/NSO, 2012b). The activity schedule and records availability are discussed in Section 7.0. Section 8.0 provides a list of references.

Appendix A provides a detailed discussion of the DQO methodology and the DQOs for CAU 413. Appendix B contains information on the activity organization. Appendix C contains a review of the RESRAD computer code input parameters used in calculating residual radioactive material guidelines (RRMGs) for the site. Appendix D presents the RRMGs for the Construction Worker (CW) exposure scenario applicable to CAU 413. Appendix E contains the RESRAD model output data for the CW exposure scenario. Appendix F presents a disposal summary of the debris and equipment previously staged at the CSII site, and Appendix G presents an evaluation of personnel dose as a result of a wound exposure. Appendix H contains the NDEP comments on the draft version of this document.

2.0 Facility Description

The TTR is located in Nye County in southern Nevada, on the northwestern portion of the NTTR. The location of the TTR is indicated on Figure 1-1. The TTR is federally owned and occupies approximately 360 square miles (mi^2), and access is restricted. The TTR is bordered on the south, east, and west sides by the NTTR and on the north side by sparsely populated public land administered by the U.S. Bureau of Land Management and the U.S. Forest Service. The nearest community is Goldfield, Nevada, which is located approximately 26 mi west of the TTR boundary.

The general environmental setting of the TTR is described below. Where available, specific information relating to the CSII site is included.

2.1 Physical Setting

The topography and terrain of the TTR is typical of the basin-and-range physiographic province of Nevada, Arizona, and Utah, consisting of numerous north–south trending, linear mountain ranges separated by broad, flat-floored, and gently sloping valleys. The CSII site is located in Cactus Flat, which is bordered by the Cactus Range to the west and the Kawich Range to the east (ERDA, 1975).

2.1.1 Topography and Terrain

The TTR is situated in the high desert region of south-central Nevada between two mountain ranges. Figure 2-1 shows the major topographic features of the area surrounding CAU 413. Along the west side of the TTR is the Cactus Range, a series of low rocky mountains with a peak elevation of about 2,300 meters (m) (7,500 feet [ft]) above mean sea level (amsl). Along the eastern boundary is the Kawich Range with elevations ranging from 2,000 to 2,850 m (6,500 to 9,400 ft) amsl. The highest elevations are found on Kawich Peak at 2,866 m (9,404 ft) amsl and Cactus Peak at 2,280 m (7,482 ft) amsl. The lowest elevation is found on the valley floor approximately midway between Cactus Flat and Gold Flat at 704 m (2,310 ft) amsl (ERDA, 1975).

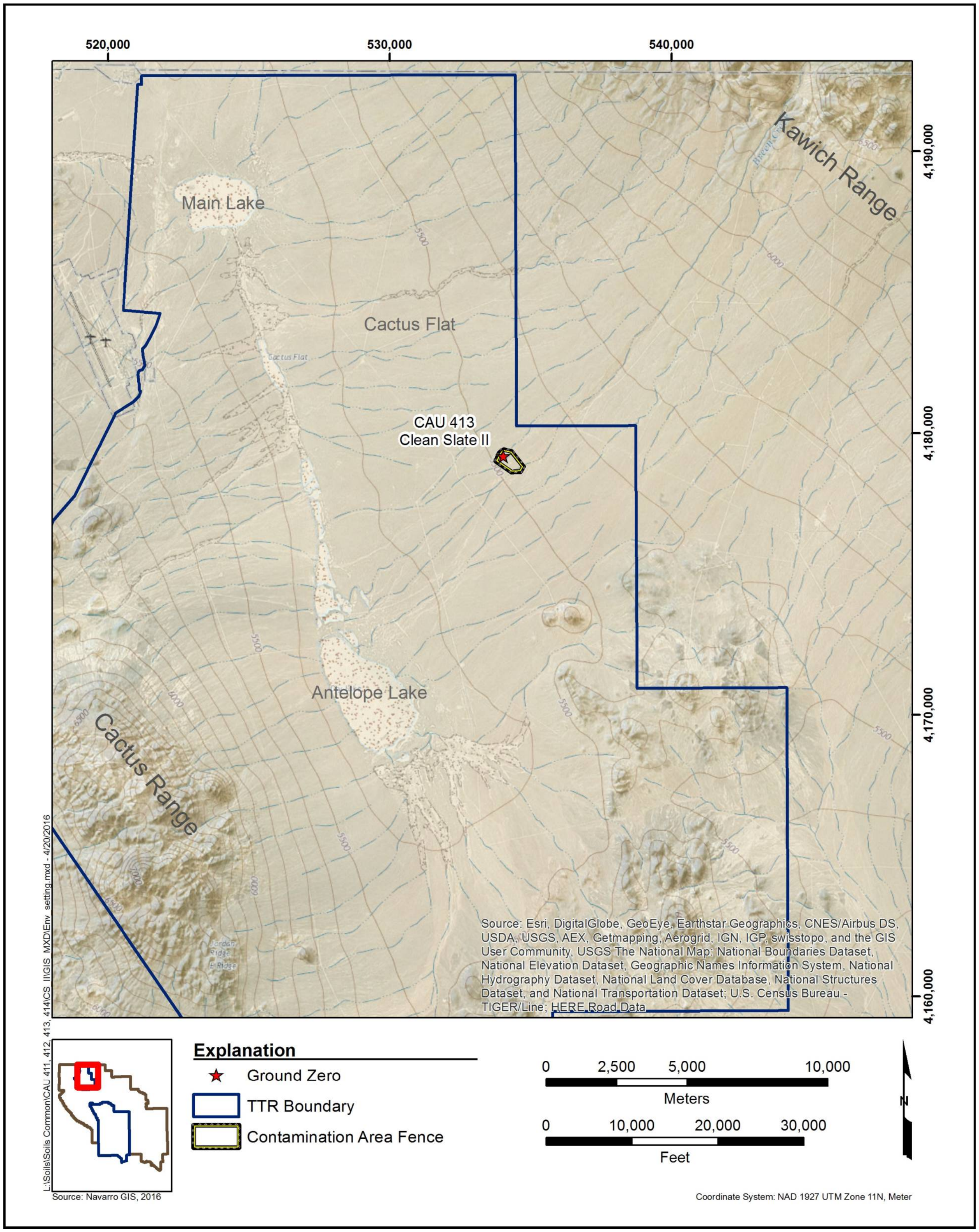


Figure 2-1
Topographical Features at CAU 413

2.1.2 Geology

The geology of the TTR comprises the following three major rock units (Ekren et al., 1971):

- Completely folded and faulted sedimentary rocks of Paleozoic age
- Volcanic tuffs, ashflows, and rhyolitic lavas of Tertiary age
- Alluvium of later Tertiary and Quaternary age derived from the surrounding exposures of Tertiary and Paleozoic rock

The Paleozoic sedimentary rocks comprise three major distinct sequences. The lower portion varies from 3,040 to 3,340 m (10,000 to 11,000 ft) thick and is composed chiefly of quartzite, siltstone, and shale formations of late Precambrian to middle Cambrian in age. This is overlaid by a middle part that may be greater than 4,255 m (14,000 ft) thick. This sequence is composed mostly of limestones and dolomites of middle Cambrian to Devonian in age. The upper portion of this sequence is estimated at more than 1,215 m (4,000 ft) in thickness. This sequence represents sporadic depositional periods mostly during late Devonian and Mississippian time. The formations are mostly clastics composed of argillite, siltstone, quartzite, and conglomerate units. The Tertiary volcanic rocks are predominantly ash-flow tuffs and include some silicic lavas that erupted from five major volcanic centers and parts of two others. The thickness of the volcanic rocks is estimated to form a composite section of approximately 6,075 m (20,000 ft), with the age of rocks ranging from 27 million to 7 million years old.

Surficial deposits at the TTR consist of late Tertiary- and Quaternary-age fluvial deposits, alluvial fans, playa deposits, colluvium, and eolian deposits that veneer volcanic and sedimentary bedrock. Alluvium is transported from the tectonically developing highlands onto piedmont slopes and intermontane basins. The piedmont slopes are mosaics of dissected and undissected alluvial surfaces commonly veneered with eolian fines that are armored by desert pavement. The alluvium may attain thicknesses of more than 1,370 m (4,500 ft) in the central portions of the valleys. Alluvium at the TTR is characteristic of young immature soils consisting of poorly graded sand with silt, gravel, and cobbles. The alluvium is deposited in series of coalescing fans that contain talus on the upper piedmont slopes varying to finer-grained material in the lowlands. The finest material, consisting of silt and clay, is deposited in the playas, normally situated at the lowest point in the flats. The lithology of the alluvium on the piedmont slopes closely reflects the adjacent bedrock. As the alluvium is transported to the lowlands, mixing with material from other fans occurs, making the lithology variable over relatively short distances.

The CSII site is located on Cactus Flat, which is in the center of the TTR. Cactus Flat is a part of a larger area of interconnecting flats that form a large intermontane basin. Mountains surrounding Cactus Flat are the Kawich Range to the east, Gold Mountain to the south, and the Cactus Range to the west (Figure 2-1). The north side of Cactus Flat is open to other flats. Cactus Flat has little variation in elevation, with Main Lake, a playa at the north end, being close to the same elevation as Antelope Lake at the south end, approximately 1,620 m (5,330 ft) amsl. The mountains surrounding Cactus Flat are highly complexed volcanic rock consisting of rhyolite, dacite, rhyodacite, quartz latite, and andesite lava flows; and intrusive masses, rhyolitic ashflows, and ash-fall tuffs. The volcanic rocks bordering Cactus Flat are of Tertiary age (Cornwall, 1972).

In the 1970s, a soil survey was completed that specifically investigated soils in the vicinity of the Clean Slate (CS) and other plutonium (Pu)-contaminated sites. The results indicated that soils in the CSII area consist of two soil types: gravelly sandy loam and sandy loam (Leavitt, 1974). These soils formed in alluvium from rhyolite, quartzite, limestone, and tuff. Soil is well drained with medium to slow runoff and permeability from 0.8 to 5.0 inches (in.) per hour (Leavitt, 1974).

2.1.3 Hydrogeology

Subsurface hydrologic data at the TTR are limited to information from water wells that were drilled to support TTR and NTTR activities. The water supply wells at the TTR were completed in the alluvium. The depth to groundwater at the TTR varies greatly, ranging from 0 m (0 ft) where springs are present to over 120 m (400 ft). The uppermost aquifer, located in the alluvium, appears to be unconfined with no laterally continuous confining units (Ekren et al., 1971). Based on the three closest wells to the CSII site, the average depth to groundwater is approximately 119 m (N-I, 2013b).

No permanent surface water streams or lakes are present at the CSII site. Two dry lake beds, Main Lake and Antelope Lake, are to the northwest and southwest of CAU 413, respectively. Ephemeral surface drainage across the CSII site is generally to the southwest toward Antelope Lake. Figure 2-1 shows the location of the CSII site in relation to the two major dry lakes. The dry lakes retain surface water after heavy rains but are normally dry again within a few days due to evaporation. Three drainage channels were identified at the CSII site during previous investigations (see Section 2.4.3). The most prominent of these drainages is Breen Creek; the other two drainages are unnamed.

2.1.4 Climate and Meteorology

The climate and meteorology of the TTR can vary significantly over short distances due to complex orographic influences. Extremes of climate are exemplified by conditions on the high plateaus that support pine forests in contrast to the dry desert lake beds in valleys. The Sierra Nevada mountain range to the west blocks most Pacific-originated storms, and the intervening desert area to the east exhausts moisture from storms arising from that area. The infrequent storms that deposit substantial moisture usually come from the southwest in the form of summer thunderstorms. Annual precipitation at the TTR is 5 to 6 in. in Cactus Flat (French, 1985). Temperature over the valley floors is characterized by a large daily range due to nocturnal air drainage, which has a pronounced influence on nighttime temperatures. Diurnal temperature oscillations on the plateaus are much less than those in the valleys. Average temperatures for the warmest and coldest hours in January from the TTR weather station are 44 degrees Fahrenheit [°F] and 18°F, respectively. Corresponding temperatures in July are 90 °F and 58 °F (Schaeffer, 1968). Winds at the TTR are generally light to moderate. In the winter, winds are more frequent than at other times of the year and are predominantly from the northwest. In the summer, the wind direction is predominantly south–southeast trending with the linear mountain ranges and at times creates strong dust devils in the valleys. The highest wind speeds occur in mid-afternoon in all seasons, especially in the spring, when dust storms are common (Schaeffer, 1968).

Meteorological data specific to the CSII site are not available. However, meteorological stations have been operating at two adjacent sites, Clean Slate I (CSI) and Clean Slate III (CSIII), since 2011 and 2008, respectively. The CSIII station (installed in June 2008) and the CSI station (installed in May 2011) are located just outside the contamination area (CA) fences on the north perimeters of the sites. For the period May 2008 through December 2012, the annual average precipitation at the CSIII site was 5.46 in. (Mizell et al., 2014). During the period of record at the CSI site (May 2011 through December 2012), the annual average precipitation was 3.71 in. At the CSI and CSIII monitoring locations, winds are most frequently from the south and southeast or the west and northwest. The average wind speeds range from 5 to 11 miles per hour (mph), with gusts from 25 to 31 mph. The strongest winds may occur during any time of the year and are typically associated with either winter/spring frontal storms or summer thunderstorms. Lighter breezes predominately occur at night and frequently come from nondominant directions; southerly oriented winds appear to occur somewhat more frequently during the summer, whereas northwesterly oriented winds appear to be slightly more common during the winter.

2.2 Operational History

The CSII test was part of Operation Roller Coaster, a joint exercise conducted by the United Kingdom, the U.S. Department of Defense, and the Atomic Energy Commission (AEC) (predecessor agency to the DOE). The CSII test was the third of four storage–transportation tests that constituted Operation Roller Coaster; the other tests were Double Tracks (DT), CSI, and CSIII.

The CSII site consists of a release of radionuclides to the ground surface from a storage–transportation test conducted on May 31, 1963 (NNSA/NFO, 2015b). This test was a detonation involving a combination of high explosives and nuclear material (Pu and depleted uranium [DU]) in a reinforced concrete bunker covered with 2 ft of soil. The objective of the test was to obtain data regarding the overall dispersion of Pu, and to study the efficiency of the concrete structure and overburden to entrain radionuclides. No fission yield was detected from the test (Shreve, 1965).

After the test, metal and concrete debris was scraped from the ground surface and mounded/buried at ground zero (GZ) (see Section 2.4.5). A 1.2-acre area around GZ consisting of contaminated soil, concrete, and metal was then fenced to prevent access (Burnett et al., 1964). This fence surrounded contamination with a mass concentration of 1,000 micrograms per square meter total transuranics (NNSA/NSO, 2004) and was posted with "Alpha Contamination" signs.

In 1963, the burial area at GZ was excavated to recover pieces of buried metal debris for further study (DASA, 1963; Johnson, 1963). This activity involved the removal of the earth cover and extraction of the debris using heavy equipment and hand tools, where necessary. The historical account of this activity does not include a discussion of site restoration after excavation.

In 1973, the outermost fence at the CSII site was constructed that encompassed approximately 120 acres, including the area previously fenced around GZ. This outer fence was established at a surface activity level of 40 picocuries per gram (pCi/g) total transuranics (NNSA/NSO, 2004) and is currently posted with CA signs. This outermost fence is referred to as the “CA fence” throughout this document. Between 1969 and 1973, an additional inner fence was established; however, the radiological criteria for this fence are unknown. Figure A.8-1 shows the two inner fences and the outer CA fence at the site.

In anticipation of remediation at the CSII site, an equipment staging area was constructed near GZ in 1997. Construction involved scraping surface soil from the staging area into stockpiles to be stored for eventual use in site revegetation after remediation. The soil stockpiles are discussed further in Section 2.4.7. Contaminated equipment and material/debris were transported from the CSI site to the equipment staging area at CSII. The staging area is more fully described in Section 2.4.4. The equipment included a large metal shaker unit and two motors. The material/debris included a high-efficiency particulate air (HEPA) vacuum, a table, large plastic liners, drums, metal fragments, wood, and various tools stored inside two metal transport containers and a wooden shack. Photographs of the equipment and material/debris are presented in Appendix F. At the time, it was anticipated that these items would be reused during remediation of the CSII site. Ultimately, remediation did not occur at the site, and the equipment and material/debris was disposed of at the Nevada National Security Site (NNSS) in late 2014. Appendix F presents a summary of waste characterization and disposal activities for the equipment and material/debris, and includes the disposal documentation for these wastes (see Attachment F-1).

In 1998, a technology demonstration project was conducted at the CSII site. This project involved the collection and mechanical processing of surface soil from areas surrounding GZ. Additional detail on this project is provided in Section 2.5.6.

2.3 Waste Inventory

The CSII test dispersed Pu and uranium (U) isotopes to surface soil, and deposited contaminated debris from the test bunker and associated structures onto the ground surface. The volume of contaminated soil and debris is unknown. After the test, the area surrounding GZ was scraped, and radioactive debris (concrete, metal) and soil were buried near GZ (AEC/NVOO, 1964; Burnett et al., 1964). Based on the materials used in the CSII test, the contaminated soil and debris deposited onto the ground surface and buried near GZ are presumed to contain Pu isotopes, DU, and americium (Am)-241 (a radioactive decay product).

Contaminated surface debris and soil from locations in SG6, PSM, may be removed under a corrective action during the CAI. This removal activity is expected to result in the generation of an unknown volume of radioactive waste.

Three unexploded ordnance (UXO) items were identified at the CSII site in 2012 and include one live flare, one spent explosive device, and one spent M38 bomb. No visible releases from these items were observed, and the items were left in place. These items, and any other UXO identified during the CAI, may be removed from the CSII as a corrective action and managed as waste. UXO items removed may be characterized as radioactive or mixed waste.

2.4 Release Information

The known releases at CAU 413 are the result of the atmospheric deposition of contamination from the 1963 CSII test. The CSII test was a non-nuclear detonation of a nuclear device located inside a concrete bunker covered with 2 ft of soil. This test dispersed radionuclides on the ground surface. The only known source of contamination at CAU 413 is the 1963 CSII storage–transportation test. As such, the CSM (detailed in Section 3.1) is based on the premise that releases of contamination at CAU 413 are all directly or indirectly associated with the test. Subsequent activities at the site immediately following the test and decades after have potentially redistributed soil contamination vertically and/or laterally. In addition, there is the potential that contamination has migrated through natural processes such as wind, precipitation, or surface water flow.

CAU 413 is located east of CAU 411 (CSI) and CAU 414 (CSIII). These two CAUs were the locations of similar Pu dispersal tests conducted in 1963 that were also part of Operation Roller Coaster. CAU 413 is approximately 4.3 mi northeast of CAU 411 and 3.6 mi east of CAU 414. There is no information that suggests contamination from CAUs 411 or 414 have impacted CAU 413.

The UXO items identified at the site during previous investigations are not associated with the CSII test. However, provisions have been made in the CAI design that would allow for the investigation of releases that may be discovered or identified during the CAI (see Section 2.4.6).

To facilitate site investigation and the evaluation of DQO decisions, the releases at CAU 413 have been divided into seven study groups, as shown in Table 1-1. The releases specific to each study group are described in the following subsections.

2.4.1 SG1, Undisturbed Areas

The Undisturbed Areas at CAU 413 include those areas not impacted by post-test operations, exclusive of the areas defined by other study groups. It is assumed that contamination from the CSII test deposited at these locations has not been mechanically disturbed since the time of the test. These areas may contain contaminated surface and shallow subsurface soil. The only movement of contamination from the surface of the Undisturbed Areas is assumed to be attributable to natural processes, such as precipitation, wind, and surface water flow. Based on soil profiling completed during the 1996 investigation, the majority of the radionuclide contamination deposited in soil by the CSII test is found within the top 9 centimeters (cm) (3.5 in.) (NNSA/NSO, 2004).

The primary exposure routes to receptors from SG1 releases are ingestion and inhalation of contaminants in surface soil (internal dose). Site workers may also be exposed to direct radiation by performing activities in proximity to radiologically contaminated soil (external dose). Because of the nature of the CSII test, it is expected that the internal dose component will be larger than the external dose component in soils at the site. Potential migration pathways from the releases include lateral dispersion via surface water runoff and wind erosion, and vertical migration via gravity and infiltration of surface water. Due to the high potential evapotranspiration (PET) at the TTR, it is expected that lateral migration will dominate over vertical migration at the CSII site.

2.4.2 SG2, Disturbed Areas

The Disturbed Areas at CAU 413 include those areas where post-test operations occurred, resulting in the potential redistribution of contamination originally deposited on the ground surface by the CSII test. Due to the arid environment at the TTR, the regeneration of vegetation on land that has been disturbed is typically very slow. As a result, areas that were disturbed in preparation for the 1963 test and afterward can be readily identified in aerial photographs. This visual evidence, coupled with historical documentation of site operations, allows the identification of areas at CAU 413 where it is possible that contamination originally deposited on the ground surface by the test has been redistributed. Five such disturbed areas were identified at the CSII site, as shown on Figure 2-2.

The large circular feature was likely disturbed both pre- and post-test. Historical documents describe an area around GZ approximately 800 ft in diameter that was scraped and compacted in preparation for the CSII test (AEC/NVOO, 1964). This area is clearly visible in a pre-test photograph (see top photograph in Figure 2-6) and is still visible in current aerial photographs of the GZ area (Figure 2-2). It is also documented that after the test, the area surrounding GZ was "bladed to a depth of several inches and out to a distance sufficient to encompass heavy throwout" from the test (AEC/NVOO, 1964). The debris and soil consolidated in this operation was then buried at GZ and covered with several feet of clean earth. The burial area was further disturbed in late 1963 when it was excavated to recover contaminated metal debris for additional study. The debris and soil that were buried and covered at GZ (i.e., subsurface contamination) are discussed as a separate release (SG5, Buried Debris) in Section 2.4.5. As a result of post-test activities, there is the potential that contamination within this circular feature has been redistributed horizontally and/or vertically. The extent of such redistribution, however, is not documented; therefore, distinguishing between the pre-test and post-test disturbances is not possible. As a result, this study group includes both pre- and post-test disturbed areas.

The four other disturbed areas in this study group and identified in Figure 2-2 are thought to be associated with the 1998 technology demonstration project. This project required soil contaminated with varying levels of radioactivity, which these four areas would have represented. Additional information on the technology demonstration project is found in Section 2.5.6.

The primary exposure routes and migration pathways for SG2 are the same as described for SG1.

2.4.3 SG3, Sedimentation Areas

Sedimentation Areas are defined as those areas within drainage channels or surface water conveyances where sediment has visibly accumulated. These channels may serve as transport mechanisms for contamination originally deposited on the ground surface during the CSII test. The potential also exists for contamination in these accumulation areas to have been buried over time by subsequent erosion events.

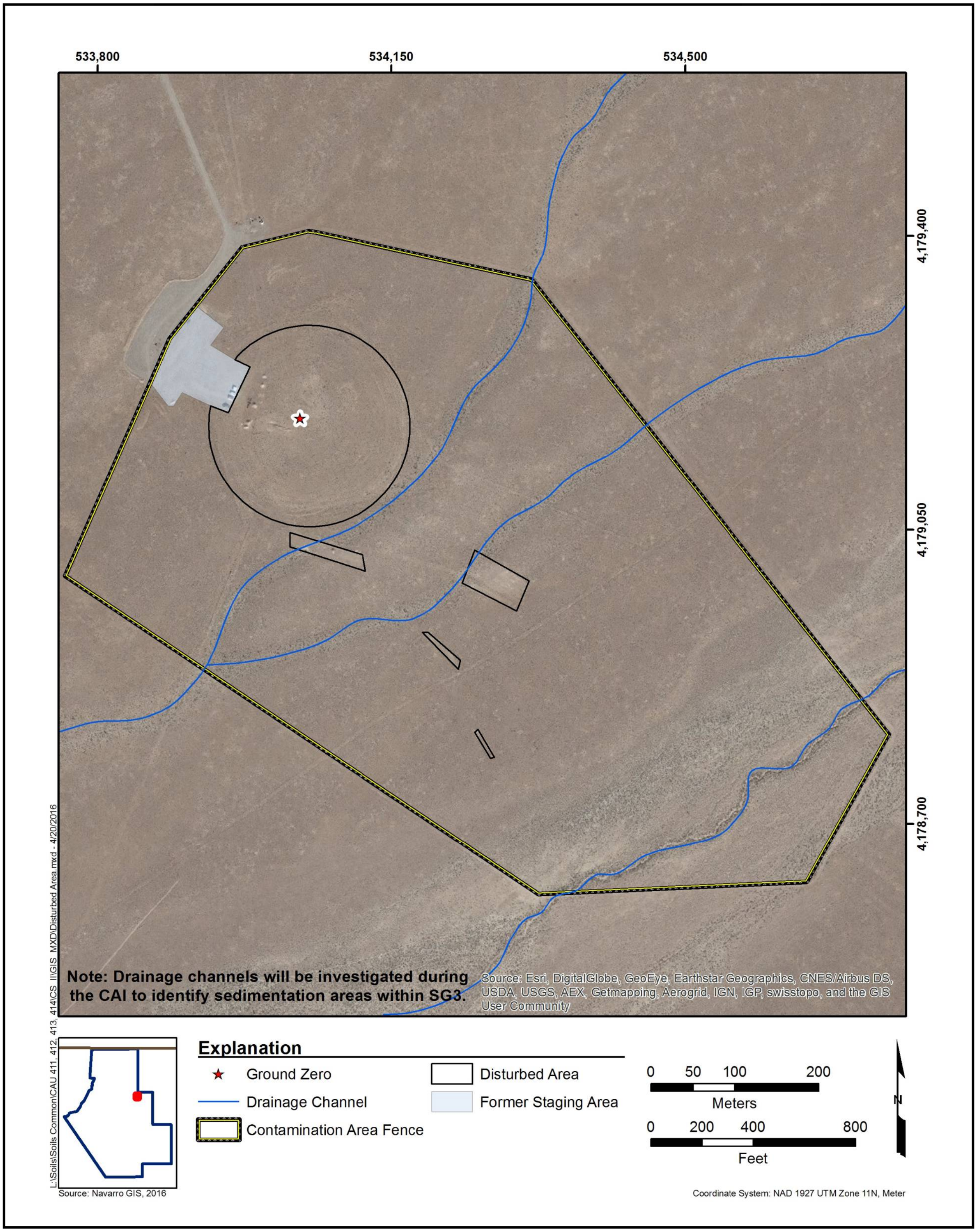


Figure 2-2
SG2, Disturbed Areas; SG3, Sedimentation Areas; and SG4, Former Staging Area

Three major drainage channels transect the CA fence at CAU 413. These channels are visible on aerial photographs and have been confirmed on the ground during site visits. Two of the channels flow south of GZ and converge at the CA fence; the third channel is just north of the southern extent of the CA fence (Figure 2-2).

The primary exposure routes and migration pathways for SG3 are the same as described for SG1.

2.4.4 SG4, Former Staging Area

The Former Staging Area is located approximately 100 m northwest of GZ and is defined as the visibly distinct area of fill located inside the CA fence (Figure 2-2). The staging area was constructed in 1997 in anticipation of remediation work at the CSII site (NNSA/NSO, 2004). At the time, it was expected that contaminated soil at the CSII site would be cleaned up after remediation of the CSI site. Before construction, the upper layer of native soil in the Former Staging Area was removed, and the pad was then covered with gravel and compacted (NNSA/NSO, 2004). It is likely that the native soil was stockpiled for eventual use in revegetating the site, as was done during construction of the staging area at the CSI site (CAU 411). The soil stockpiles located inside the CA fence are addressed in SG7, Soil Mounds (see Section 2.4.7). The contaminated equipment and material that was staged within the CA fence at CSII in the 1997 time frame was removed in the fall of 2014 and disposed of as low-level radioactive waste at the NNSS (see Appendix F).

Although the staging area extends outside the CA fence, where it connects to the site access road, the area outside the CA fence is not included in this study group based on interpretation of the 1996 KIWI survey (Figure A.8-1). This survey was completed before construction of the Former Staging Area and includes a portion of the fill area outside the CA fence. The radiation levels outside the CA fence are near the minimum detectable activity of the KIWI system (i.e., less than 70 counts per second [cps]), which suggests that radiological contamination in this area, if present, is low and would not exceed the FALs. The KIWI system consists of an array of six radiation detectors that has been used at the CSII site in previous investigations (see Section 2.5.5.1).

A receptor may potentially be exposed to contaminated soil underneath the Former Staging Area during activities that may remove the fill material or as a result of erosion over time that could expose underlying contaminated soil. Once the fill material is no longer present, the primary exposure routes to receptors are ingestion and inhalation of contaminants in soil (internal dose), and direct radiation from contaminated soil (external dose). Potential migration pathways for contaminants from the Former Staging Area include vertical migration via gravity and precipitation; and lateral migration via surface water runoff, erosion, and/or wind.

2.4.5 SG5, Buried Debris

This study group consists of the release of contaminants to subsurface soil from contaminated soil and debris buried at GZ after the CSII test in 1963. Historical documents indicate that shortly after the test, the area around GZ was scraped of debris (e.g., concrete, metal) and soil to a depth of several inches (AEC/NVOO, 1964). Contaminated debris scattered out to a radius of 1,500 to 2,500 ft was collected and buried at GZ (AEC/NVOO, 1964; Burnett et al., 1964). The debris and soil were buried at GZ and covered with "several feet of clean earth" (AEC/NVOO, 1964). The approximate extent of the buried debris area, based on a previous geophysical survey at the site, is shown on Figure 2-3.

In late 1963, the burial area at GZ was excavated to recover some of the buried metal debris for further study (DASA, 1963; Johnson, 1963). This involved the removal of the earth cover and extraction of the debris using heavy equipment (e.g., bulldozer, crane, wrecker) and hand tools (e.g., shovels) where necessary. The historical account of this activity does not include a discussion of site restoration after excavation; thus, it is not known whether uncontaminated soil was used to re-cover the burial area or if soil from the surrounding area was used.

Small pieces of concrete and metal debris have been observed at the surface of the burial area at GZ during previous investigations. It is possible that this debris and/or soil originally buried after the CSII test has been exposed over time through soil erosion and wind, or as a result of the excavation in late 1963. A receptor may potentially be exposed to contaminated soil and/or debris on the surface of the buried debris location or in the subsurface, if the buried debris is exposed through excavation or digging. The primary exposure routes to receptors are ingestion and inhalation of contaminants in soil (internal dose), and direct radiation from contaminated soil and debris (external dose). The CSM includes the potential for receptors to receive an internal dose from contaminated soil and an external dose from contaminated soil and debris. Potential migration pathways for contaminants from buried debris and soil include vertical migration via gravity and precipitation; and lateral migration if contamination is exposed, via surface water runoff, erosion, and/or wind.

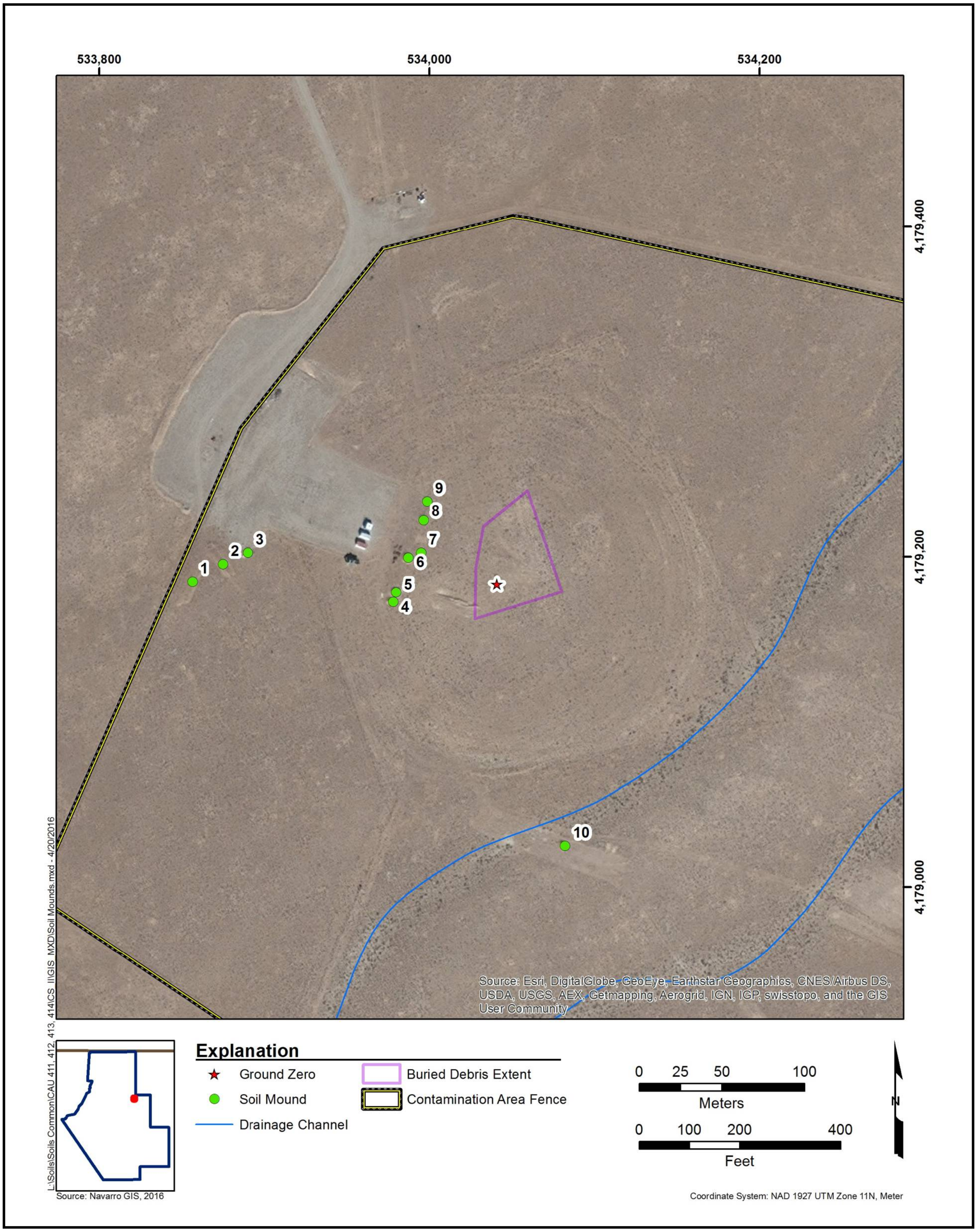


Figure 2-3
SG5, Buried Debris; and SG7, Soil Mounds

2.4.6 SG6, PSM

For the purposes of this document, PSM is defined as a material present at a site that contains radiological and/or chemical contaminants that, if released, could cause the surrounding environmental media to contain a COC (NNSA/NFO, 2014). PSM may include debris (e.g., concrete pieces, metal fragments, drums) and historical or recent spills (e.g., diesel spill from onsite generator). This study group also includes PSM that may be discovered during the CAI, such as historical spill sites or containers with unknown contents (e.g., drums). The exposure routes to receptors from PSM not yet identified at the site may vary based on the nature of the debris or spill identified, but may include ingestion and inhalation of contaminants, dermal contact with contaminants, and direct radiation (for radiological contaminants) by performing activities in proximity to the debris. Potential migration pathways may include vertical migration through the soil underlying the debris or impacted by the spill and horizontal migration via surface water runoff, erosion, and/or wind.

PSM identified at the CSII site during previous investigations includes pieces of the concrete bunker, the test device, and associated support structures (e.g., instrument towers) that were ejected or thrown out from GZ during the test explosion (see Figure 2-7 post-test photograph). A historical document describing the CSII and CSIII tests states "...great numbers of concrete and metal debris [were] thrown up to 2,500 ft (with the highest concentrations of debris east of the ground zeros as a result of jetting through the doorways, which were the weakest part of the bunker structure)..." (Burnett et al., 1964). The area inside the inner GZ fence (i.e., the 1.2-acre area fenced shortly after the test) was cleared of surface debris immediately following the 1963 CSII test (Section 2.4.2). However, environmental monitoring of the CSII site in the years after the test record the presence of highly contaminated debris east and south of the inner GZ area fence (Glora and Brown, 1964; Glora and Aoki, 1965 and 1966; REECo, 1966). As part of site investigation activities in 1996, debris within a radius of 1,000 ft from GZ was surveyed with radiological instruments and removed (NNSA/NSO, 2004). Recent visual and radiation surveys have confirmed the presence of contaminated debris within the inner fences and outside the CA fence up to 2,500 ft from GZ to the east. A faded black substance is present on the surface of some pieces of highly contaminated debris. Photographs of one of the concrete debris pieces are provided in Figure 2-4. The radiological measurements of this black substance are much higher than portions of the debris that are free of the substance. It is likely that this black substance contains Pu and DU that was fused to the bunker concrete as a result of the CSII test and thrown from GZ during the explosion.

A receptor may potentially be exposed to contaminated debris on the ground surface or in the shallow subsurface. The primary exposure routes to receptors are ingestion and inhalation of contaminants in surface soil (internal dose), and direct radiation from contaminated soil and debris (external dose). The CSM includes the potential for receptors to receive an internal dose from contaminated soil and an external dose from contaminated soil and debris.

2.4.7 SG7, Soil Mounds

This study group includes 10 distinct soil mounds identified during previous investigations at the CSII site (Figure 2-3). It is likely that two of the mounds (1 and 2) located west of GZ were soil stockpiles reserved for use in the revegetation of the CSII site after remediation. The *Clean Slate 2 Revegetation and Monitoring Plan* (DOE/NV, 1998) recommends that topsoil scraped from the Former Staging Area (SG4) be stockpiled at the current location of these mounds. A similar topsoil stockpiling process was used at the CSI site (CAU 412) before remediation. Visual features suggest that these two mounds are topsoil stockpiles that consist of the upper layer of soil removed inside the CA fence before construction of the Former Staging Area (Section 2.4.4). These two mounds have much more vegetation growth, and are elongated and flat. One of these mounds is shown in the top photograph of Figure 2-5. The CSM assumes that these two soil mounds contain primarily soil but may contain incidental debris that was scraped from the ground surface. Should a significant amount of debris be identified in either of these mounds during the CAI, the CSM will be revisited and the CAI adjusted, as necessary.

The other eight soil mounds (3 through 10) are located west and south of GZ (Figure 2-3). Although soil mound 3 is proximate to mounds 1 and 2, mound 3 is thought to be associated with the demonstration project because it shares the same physical features of mounds 4 through 10 (i.e., little to no vegetation and conical in shape). Based on historical documents, previous activities at the site, and visual cues, it is probable that these mounds are remnants of a soil technology demonstration project conducted at the site in 1998 (BN, 1998). The conical shape of these mounds is consistent with the expected shape resulting from soil falling off a conveyor belt, which was used in the processing of soil during the technology demonstration project. Figure 2-5 (bottom photograph)

Figure 2-4
Concrete Debris at CSII

Figure 2-5
Soil Mounds at CSII

shows three of the conical-shaped soil mounds. Further details of the technology demonstration project may be found in Section 2.5.6. The CSM assumes that these eight soil mounds are a result of the technology demonstration project; therefore, they are not expected to contain debris (metal, cable), as debris would have hindered soil processing through the conveyer belt system. Should debris be identified in any of these mounds during the CAI, the CSM will be revisited and the CAI adjusted, as necessary.

The primary exposure routes to receptors from this study group are ingestion and inhalation of contaminants in soil found on the mound surface and/or the interior of the mound, if disturbed (internal dose). Site workers may also be exposed to direct radiation by performing activities in proximity to the mounds (external dose). Potential migration pathways from the soil mounds include vertical migration through the soil underlying the mounds and horizontal migration via surface water runoff, erosion, and/or wind.

2.5 Investigative Background

The CSII site was studied extensively in the years after the test and well into the 1970s. Studies included ground-based and aerial radiological surveys, and collection and analysis of soil and vegetation samples. In 1996, the CSII site became subject to the FFACO, and a relatively comprehensive investigation (herein referred to as the 1996 CAI) was completed in accordance with the *Clean Slate Corrective Action Investigation Plan,* Rev. 0 (DOE/NV, 1996). The scope of that CAIP included all three CS sites on the TTR (CSI, CSII, and CSIII). In 1998, further action at the CSII site was suspended because concurrence could not be reached regarding future land use at the site, a final corrective action level, and the parameters used to determine the corrective action level. DOE discussions with USAF (as landowner) and NDEP (as regulator) continued in the years following. The *Corrective Action Decision Document for Corrective Action Unit 413: Clean Slate II Plutonium Dispersion (TTR),* Rev. 1 (NNSA/NSO, 2004) was submitted to NDEP in 2005 but was disapproved, and work at the CSII site was deferred.

The following is a list of FFACO and supporting documents drafted from 1995 to 2006 in support of CAU 413 site closure. Relevant information from these documents is referenced throughout this CAIP, as appropriate:

FFACO documents

- *Clean Slate Corrective Action Investigation Plan,* Rev. 0 (DOE/NV, 1996). Final document, approved by NDEP.
- *Corrective Action Decision Document for Corrective Action Unit 413: Clean Slate II Plutonium Dispersion (TTR),* Rev. 1 (NNSA/NSO, 2004). Final document, disapproved by NDEP.

Supporting documents

- *Cost/Risk/Benefit Analysis of Alternative Cleanup Requirements for Plutonium-Contaminated Soils On or Near the Nevada Test Site* (DOE/NV, 1995)
- *Clean Slate Soils Disposal Options Cost Analysis, Corrective Action Units 412, 413 and 414* (DOE/NV, 1997a)
- *Clean Slate Transportation and Human Health Risk Assessment* (DOE/NV, 1997b)
- *Radiological Dose Assessment for Residual Radioactive Material in Soil at the Clean Slate Sites 1, 2, and 3, Tonopah Test Range* (DOE/NV, 1997c)
- *Clean Slate 2 Revegetation and Monitoring Plan* (DOE/NV, 1998)

Due to the length of time that has transpired since the 1996 CAI; the turnover of DOE, NDEP, and USAF personnel involved in the project; and the successful use of a risk-based cleanup approach at other Soils Activity sites, the NNSA/NFO decided to recommence the FFACO closure process with the development of new DQOs and this site-specific CAIP.

Table 2-1 and the following subsections summarize relevant CSII studies and indicate how the data from each study were used in the development of the DQOs for CAU 413. Further details of these studies may be found in the documents referenced in the subsections.

Table 2-1
Chronological Summary of Relevant Studies at CAU 413

Activities	Year	Work Completed	Data Use
Operation Roller Coaster	1963 1964	Pu distribution studies/mapping	Informational Data
Environmental Surveillance Radiation Surveys	1964 1965 1966	Ground-based alpha radiation surveys	Informational Data
NAEG Studies	1975	FIDLER surveys, soil and vegetation sampling	Informational Data
TTR Annual Sampling	1992	Soil sampling	Informational Data
1996 CAI	1996	Radiological surveys (KIWI, HPGe detector, FIDLER), soil sampling, depth profile sampling, treatability testing, geophysical surveys at GZ	Decision-Supporting Data (soil sample data only); Informational Data
Technology Demonstration Project	1998	Segmented gate system processing of contaminated surface soil	Informational Data
Aerial Radiation Surveys	2006	Aerial radiation surveys	Decision-Supporting Data
Radiological Posting Compliance Survey	2010	Swipe sampling for removable contamination, *in situ* radiological measurements	Informational Data
Preliminary Investigation	2012	Visual surveys, FIDLER surveys, removable contamination surveys	Decision-Supporting Data (FIDLER data); Informational Data (removable contamination data)
Meteorological and Airborne Particulate Monitoring	2008 to 2012	Monitoring of airborne particulates, ambient gamma radiation, and meteorological conditions	Informational Data

FIDLER = Field instrument for the detection of low-energy radiation
HPGe = High-purity germanium
NAEG = Nevada Applied Ecology Group

2.5.1 Operation Roller Coaster

Soil contamination in the vicinity of the CSII site resulted from activities that were part of Operation Roller Coaster. The objective of this operation was to obtain data pertaining to dispersion of Pu from a simulated, nonnuclear detonation of a nuclear weapon inside a structure. Pre- and post-test photographs of the CSII site are presented in Figures 2-6 and 2-7, respectively. Figure 2-6 presents the test bunker viewed from the south (top photograph) and west (bottom photograph). The top photograph also includes a view of the arming and firing building. Figure 2-7 shows two post-test views of the test bunker looking west. The top figure also shows the collapsed instrument tower, sandbagged instruments, and the remains of the arming and firing building.

Figure 2-6
Pre-test Photographs of the CSII Structure (1963)
Source: NNSA/NSO, 2004

Figure 2-7
Post-test Photographs of the CSII GZ Area (1963)
Source: NNSA/NSO, 2004

The CSII test involved several experiments that included air measurements, soil deposition and fallout sampling, micrometeorological measurements, surface measurements, special particulate analyses, and the effects of soil scavenging, among others (Dick et al., 1963). Much of the data collected in these experiments are specific to the experiment objectives, and are not directly applicable to site characterization or closure.

In accordance with the Soils Activity QAP (NNSA/NSO, 2012b), the quality required of a dataset will be determined by its intended use in decision making. The CSII experiment data were considered when developing the CSM, identifying contaminants of potential concern (COPCs), and reviewing the general distribution of radiological contaminants at CAU 413. Because the quality of these data is unknown, the data collected during and shortly after the CSII test are considered informational data.

2.5.2 Environmental Surveillance Radiation Surveys

Historical documents were identified that present the results of semi-annual and annual surveillance activities at the four Operation Roller Coaster sites for the years 1964, 1965, 1966, 1968, and 1969 (Glora and Brown, 1964; Glora and Aoki, 1965 and 1966; REECo, 1966, 1968, and 1969). Surveillance activities were conducted to determine the radiological conditions at the sites and included collecting air, water, and vegetation samples; and conducting alpha radiation surveys. At the CSII site, alpha radiation surveys were conducted east of the inner fence surrounding GZ out to 500 ft. These surveys identified contaminated concrete debris with “relatively fixed activity” (REECo, 1966). The present-day CA fence at the CSII site encompasses this eastern area surveyed in the mid-1960s.

The alpha radiation survey maps were used in the design of the CAI to identify the general area (i.e., east of GZ) to be investigated for the presence of ejected debris. However, because the quality of these data are unknown, the data collected in the environmental surveillance efforts are considered informational data and will not be used to support or make DQO decisions.

2.5.3 NAEG Studies

The NAEG conducted studies of Pu, U, Am, and other radionuclides in the environment on and near testing sites of nuclear devices from July 1970 to September 1986. About 540 reports and papers were prepared during this 16-year effort. The findings of the NAEG were published in the *Summary of the Nevada Applied Ecology Group and Correlative Programs* (Friesen, 1992). This report effectively traces Pu from its introduction into the environment and movement in the ecosystem to the development of potential cleanup techniques.

Two NAEG studies of particular interest to CAU 413 include the collection of *in situ* radiation measurements using a FIDLER and discrete soil sample collection to determine the distribution of contamination (Gilbert et al., 1975; Gilbert, 1993) and the collection of soil profile samples to determine the percentage of Pu in depth intervals from 0 to 25 cm (0 to 10 in.) (Essington et al., 1976). The FIDLER and soil sample data from the first study were reviewed and are consistent with the general distribution of contamination at the CSII site as shown in the 1996 KIWI and the 2006 aerial surveys. The second study involved the collection of soil samples from five locations in areas of varying surface Pu activity. This study demonstrated that the highest concentrations of Pu were in the top 5 cm of soil and that Pu activity generally decreased with depth. These data were considered when determining a suitable depth for sample collection during the CAI. The data from both of these NAEG studies are considered informational data and were not directly used in the development of the CAI sample design.

2.5.4 TTR Annual Sampling

As part of a limited soil sampling effort at the TTR in 1992, 21 surface soil samples were collected outside the CA fence at CSII (Culp and Howard, 1993). The majority of sample locations were concentrated outside the CA fence at the southern end of the site. In this southern area, the total Pu activity detected in the soil samples ranged from 1 to 230 pCi/g.

Soil sampling has been performed at the TTR as part of annual surveillance activities at the CS sites for several years. An annual soil sample has been collected outside the perimeter fence at the CSII site to assess radiological contamination since 1993. The soil sample was collected north of the exclusion fence, although the exact location of sample collection was not provided in the annual reports.

The majority of the TTR sample data were collected from a single location at the CSII site, limiting the data's usefulness for site characterization. As such, the TTR sample data were not directly used in the design of the CAI and serve as informational data.

2.5.5 1996 Corrective Action Investigation

Investigation activities were performed at the CAU 413 site in 1996 in accordance with the *Clean Slate Corrective Action Investigation Plan,* Rev. 0 (DOE/NV, 1996).

The scope of the 1996 CAI included the following activities:

- Collecting *in situ* radiological data using a variety of instruments to define the horizontal extent of contamination.
- Determining the vertical extent of contamination by obtaining soil depth profiles and *in situ* radiation measurements at discrete locations.
- Removing "hot spot" materials.
- Locating buried debris near GZ using geophysical methods.
- Conducting geotechnical, chemical, and radiological analysis of selected soil samples to aid in developing closure strategies and characterizing waste.

A detailed account of the results of the 1996 CAI may be found in the 2004 CADD for CAU 413 (NNSA/NSO, 2004) and is not repeated herein. The data collected during the 1996 CAI that were used in support of the DQOs developed for this CAIP are summarized in the subsections below. In order to distinguish between the 1996 CAI and the CAI governed by this CAIP, the previous CAI will be referred to as the "1996 CAI" in the remainder of this document.

2.5.5.1 KIWI Radiation Survey

In situ radiation surveys using an array of six mobile sodium iodide (NaI) detectors (i.e., the KIWI system) were conducted at the CSII site to define the horizontal extent of the radiological contaminants. The KIWI system has an approximate 3-ft-width-by-10-ft-length field of view, and at the 60-kiloelectron-volt energy range, the detectors are collimated. The KIWI survey covered approximately 100 percent of the inside of the CA fence and a 33-ft perimeter outside the fence. In addition, the contaminant plume area south of the CA fence was surveyed based on the results from the 1993 aerial survey.

The full extent of the KIWI survey data is presented in Figure 2-8. The KIWI survey results show a radioactivity distribution in the area around GZ where some areas close to GZ appear less contaminated than areas farther from GZ. Relatively uniform contamination levels that decrease with increasing distance from GZ would be expected if no post-test disturbance of the area had occurred. As discussed in Sections 2.4.2 and 2.4.5, however, soil and debris in the area around GZ was scraped and buried after the test. In addition, the burial area was excavated in late 1963 to collect contaminated metal debris for further study (Section 2.2). Thus, it is highly probable that the non-contiguous contamination observed in the survey is attributable to the redistribution of contamination during post-test activities.

The KIWI data meet the definition of decision-supporting data in accordance with the Soils Activity QAP (NNSA/NSO, 2012b). These data were used to guide the selection of biased sampling locations.

2.5.5.2 Depth Profiling

In order to characterize the vertical extent of site contaminants, *in situ* measurements were collected using an HPGe detector system at 17 locations (D1 through D17). Figure 2-9 presents the locations where depth measurements were collected; Table 2-2 presents the net Am-241 depth profile measurements. These results indicate the approximate depth of contamination is 0 to 3.5 in. in the general plume area, with the Am-241 activity generally decreasing with increasing depth. Contamination was detected up to 8 in. at one depth profile location (D6) in the vicinity of GZ (Table 2-2). This location, however, is close to the GZ burial area and may not be representative of the contaminant plume outside the GZ area (NNSA/NSO, 2004). Depth profile sampling in the vicinity of GZ was not conducted during the 1996 CAI.

The soil profile data are considered informational data and were considered with other soil profile data in determining a suitable depth at which to collect soil samples during the CAI.

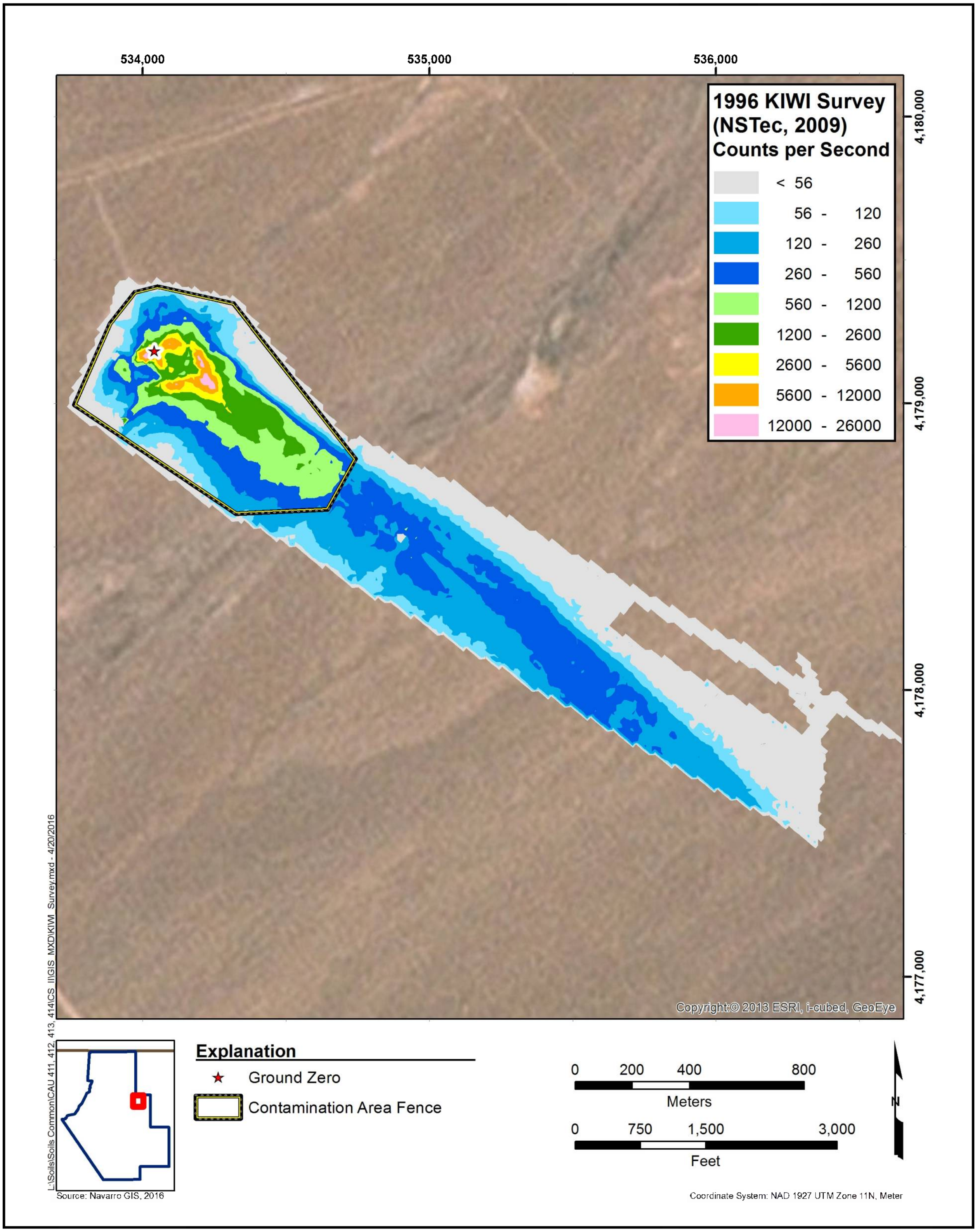


Figure 2-8
KIWI Survey of CAU 413

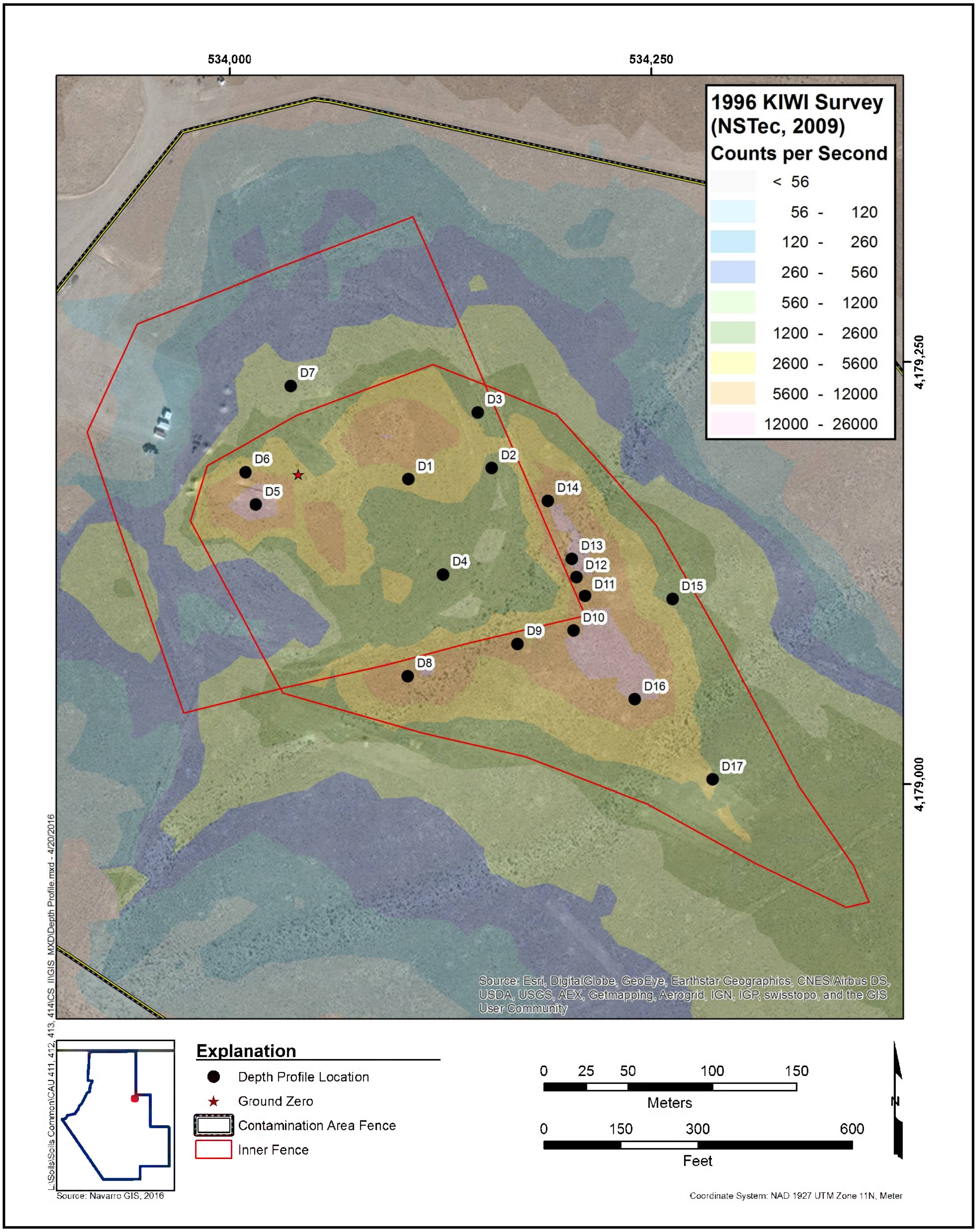


Figure 2-9
Depth Profile Locations at CAU 413

Table 2-2
Depth Profile HPGe Measurements at CAU 413
(Page 1 of 2)

Location ID	Depth (in.)	Net Counts per 5 minutes Am-241	Qualifier
D1	0	96	<MDA
	2.5	113	<MDA
	3.5	Negative	<MDA
D2	0	193	<MDA
	2.5	130	<MDA
	3.5	9	<MDA
D3	0	177	<MDA
	1.5	Negative	<MDA
D4	0	200	<MDA
	1	155	<MDA
	2	92	<MDA
	3	Negative	<MDA
D5	0	8,514	None
	1	1,345	None
	2	377	None
D6	0	795	None
	1	623	None
	2	594	None
	3	366	None
	4	430	None
	5.5	294	None
	6.25	344	None
	8	22	<MDA
D7	0	125	<MDA
	1	Negative	<MDA
D8	0	1,171	None
	0.5	841	None
	2	Negative	<MDA

Table 2-2
Depth Profile HPGe Measurements at CAU 413
(Page 2 of 2)

Location ID	Depth (in.)	Net Counts per 5 minutes Am-241	Qualifier
D9	0	130	<MDA
	1.5	21	<MDA
D10	0	1,670	None
	1	507	None
	2	100	<MDA
D11	0	6,948	None
	1.75	3,823	None
	2.5	1,581	None
	3.5	Negative	<MDA
D12	0	626	None
	1	211	<MDA
	2	Negative	<MDA
D13	0	2,542	None
	1.5	1,730	None
	2.5	46	<MDA
D14	0	4,583	None
	1	4,337	None
	2	1,116	None
	3	216	<MDA
D15	0	235	None
	1	108	<MDA
	2	147	<MDA
	2.5	11	<MDA
D16	0	1,027	None
	1	371	None
	2	66	<MDA
D17	0	375	None
	1	30	<MDA

MDA = Minimum detectable activity

2.5.5.3 Soil Sampling

A total of 21 soil samples from 20 locations were collected for laboratory analyses during the 1996 CAI at CAU 413. Soil samples were collected to meet various objectives, including site characterization, treatability studies, geotechnical studies, and waste characterization. Sample analyses were tailored to the sampling objectives and were not uniform for all soil samples. This section focuses on the soil samples collected for site characterization purposes and provides a summary of the results of the other sampling objectives.

Soil sampling during the 1996 CAI was conducted in two phases. The first phase included the collection of a total of 11 samples from the locations shown in Figure 2-10. Surface soil samples were collected from 0 to 3 in. below ground surface (bgs). These samples were analyzed for gross alpha and beta, Am-241, isotopic Pu, isotopic U, toxicity characteristic leaching procedure (TCLP) metals, TCLP volatile organic compounds (VOCs), TCLP semivolatile organic compounds (SVOCs), TCLP herbicides and pesticides, and polychlorinated biphenyls (PCBs).

Table 2-3 presents the radiological data for the 11 surface soil samples collected during the first sampling phase at CSII. The Pu-239/240 activity of these samples ranges from 196 to 38,000 pCi/g, and the Am-241 activity ranges from 4.09 to 655 pCi/g. As documented for the DT and CSI sites, radiological contamination of surface soil at the Operation Roller Coaster sites is highly variable over small distances. For example, evaluation of the field duplicate (FD) sample CSS20027 (duplicate of sample CSS20020) indicates Am-241 activities of 655 and 487 pCi/g and Pu-239/240 activities of 17,300 and 38,000 pCi/g, respectively. Activities for U-238 for the duplicate samples were 19.3 and 22.0 pCi/g, respectively.

During the second sampling phase, 10 additional soil samples were collected (CSS20062 to CSS20071, including 2 FDs) and were analyzed for TCLP metals, TCLP VOCs, TCLP SVOCs, and TCLP herbicides and pesticides; no radiological analyses were performed on the second-phase samples. The results of the second-phase samples indicate no analytes were detected above the laboratory detection limit. The results of the second sampling phase are included in the 2004 CAU 413 CADD (NNSA/NSO, 2004).

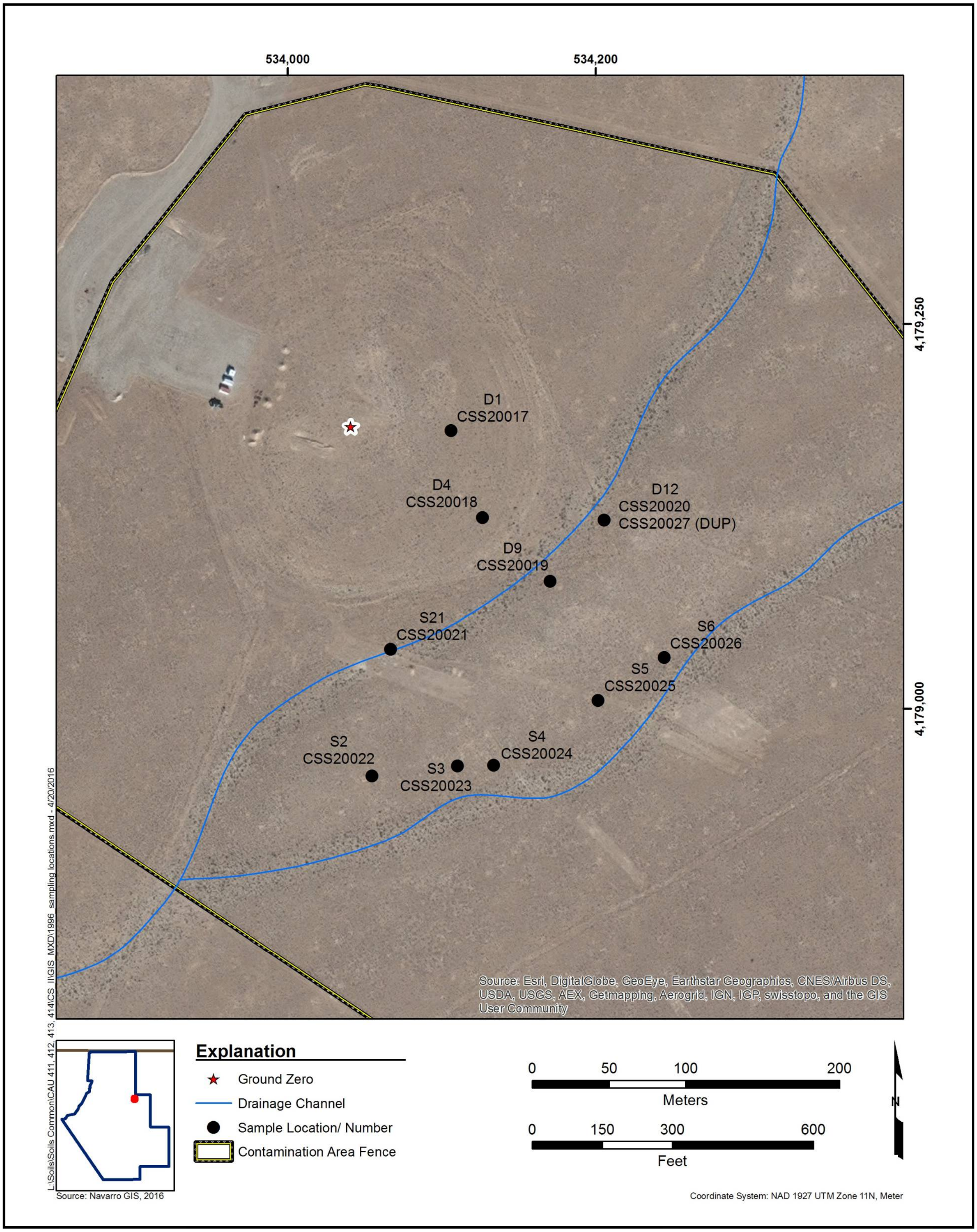


Figure 2-10
1996 CAI Sample Locations and Numbers

Table 2-3
Summary of Soil Sample Radiological Analytical Results
1996 CAI

Sample Number	Sample Location	Am-241	Pu-238	Pu-239/240	U-234	U-235/236	U-238
		(pCi/g)					
CSS20017	D1	14.4	-1.1	227	1.07	-0.34	-0.37
CSS20018	D4	323	46.4	4,230	8.20	5.00	6.18
CSS20019	D9	475	48.2	7,850	4.20	-0.59	11.2
CSS20020	D12	487	250	38,000	22.1	17.8	22.0
CSS20027		655	187	17,300	-0.8	3.4	19.3
CSS20021	S1	109	-0.8	2,360	0.58	2.39	0.00
CSS20022	S2	13.4	2.27	196	9.2	-0.4	9.8
CSS20023	S3	4.09	2.35	246	2.44	1.28	1.72
CSS20024	S4	55.8	8.2	758	2.07	-0.11	2.15
CSS20025	S5	111	19.8	2,030	1.02	-0.09	1.34
CSS20026	S6	71.2	45	5,410	1.10	1.74	3.12

The soil sample data collected in the 1996 CAI were classified as decision-supporting data because they were used to guide the selection of sample locations for this CAI.

2.5.5.4 Geophysical Surveys

Magnetic and electromagnetic surveys were performed during the 1996 CAI to characterize the GZ area. The results of the electromagnetic conductivity survey are presented in Figure 2-11. The results of the surveys indicated the presence of buried materials that are likely remnants of the concrete bunker that housed the CSII device and/or other test instrumentation. No other burial areas were detected at the CSII site. Historical photographs and as-built drawings indicate the concrete bunker was approximately 27 ft long, 12 ft wide, and 9 ft in height. The bunker was covered with 2 ft of soil that was mounded over the corrugated roof of the structure (AEC/NVOO, 1964).

These geophysical data collected in the 1996 CAI are considered informational data and will not be used to support or make DQO decisions. The geophysical data from the 1996 CAI will be used to confirm the extent of the buried debris.

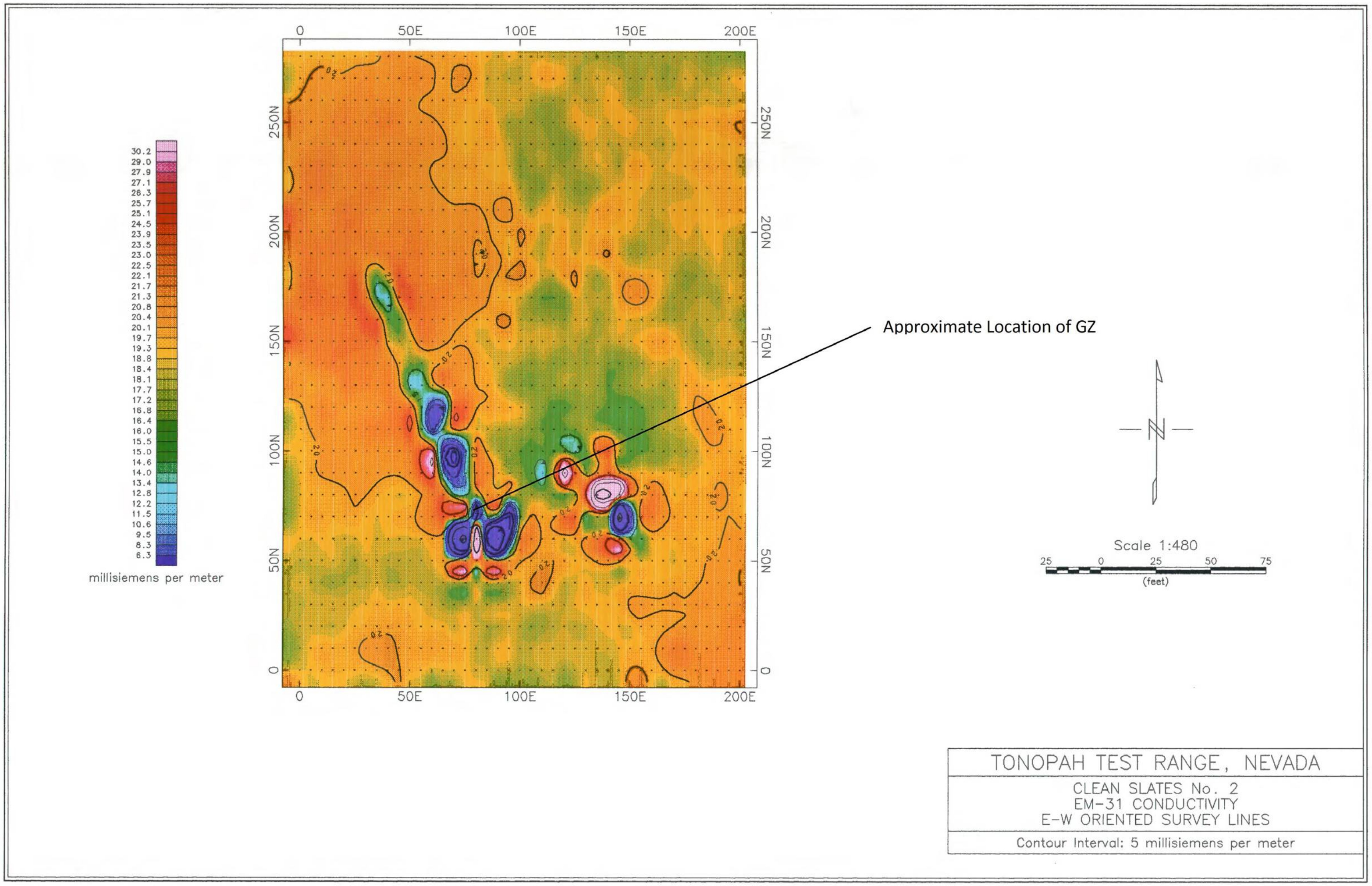


Figure 2-11
1996 CAI Geophysical Results

2.5.6 Technology Demonstration Project

In 1998, a technology demonstration project was conducted at the CSII site. The project used a segmented gate system in an attempt to physically separate "contaminated soil" from "clean soil" (i.e., soil with lower contaminant concentrations). The demonstration involved scraping surface soil from areas of the CSII site with varying levels of radioactive contamination and processing the soil through a conveyer belt system with attached radiation instrumentation. These scraped areas are included in SG2, Disturbed Areas (Section 2.4.2). Eight of the 10 soil mounds in SG7, Soil Mounds, are presumed to be associated with this demonstration project. The historical record indicates that "clean soil" was left stockpiled on site and "contaminated soil" was loaded into trailers (BN, 1998), presumably for transport to an offsite facility for disposal. A total of approximately 300 cubic yards (yd^3) of soil was processed through the segmented gate system during the demonstration.

The data collected in the technology demonstration were used to support CSM assumptions for SG2, Disturbed Areas; and SG7, Soil Mounds. These data are considered informational data and will not be used to support or make DQO decisions.

2.5.7 Aerial Radiation Surveys

Aerial radiological surveys were conducted at the CSII site in 1977, 1993, and 2006. Although the surveys are in general agreement with one another with regard to general contamination distribution across the site, the spatial resolution of each subsequent survey improved over time, with the 2006 survey results showing the best resolution. Therefore, only the 2006 aerial data were considered in the development of the CAI design for CSII. The 2006 survey was flown at an altitude of 50 ft (the 1993 survey was flown at 100 ft), with flight lines approximately 75 ft apart. The aerial radiation surveys provide spectral information that is used to differentiate ranges of isotopic signatures. This allows the separate mapping of Am-241, which is used as an indicator of the presence of Pu.

The full extent of the 2006 survey data is shown on Figure 2-12. As evidenced in this figure, the radioactivity in the area around GZ is not uniform, and some areas close to GZ appear less contaminated than areas further away. This pattern is also evident in the ground-based KIWI survey results and is believed to be the result of post-test activities (Section 2.5.5.1).

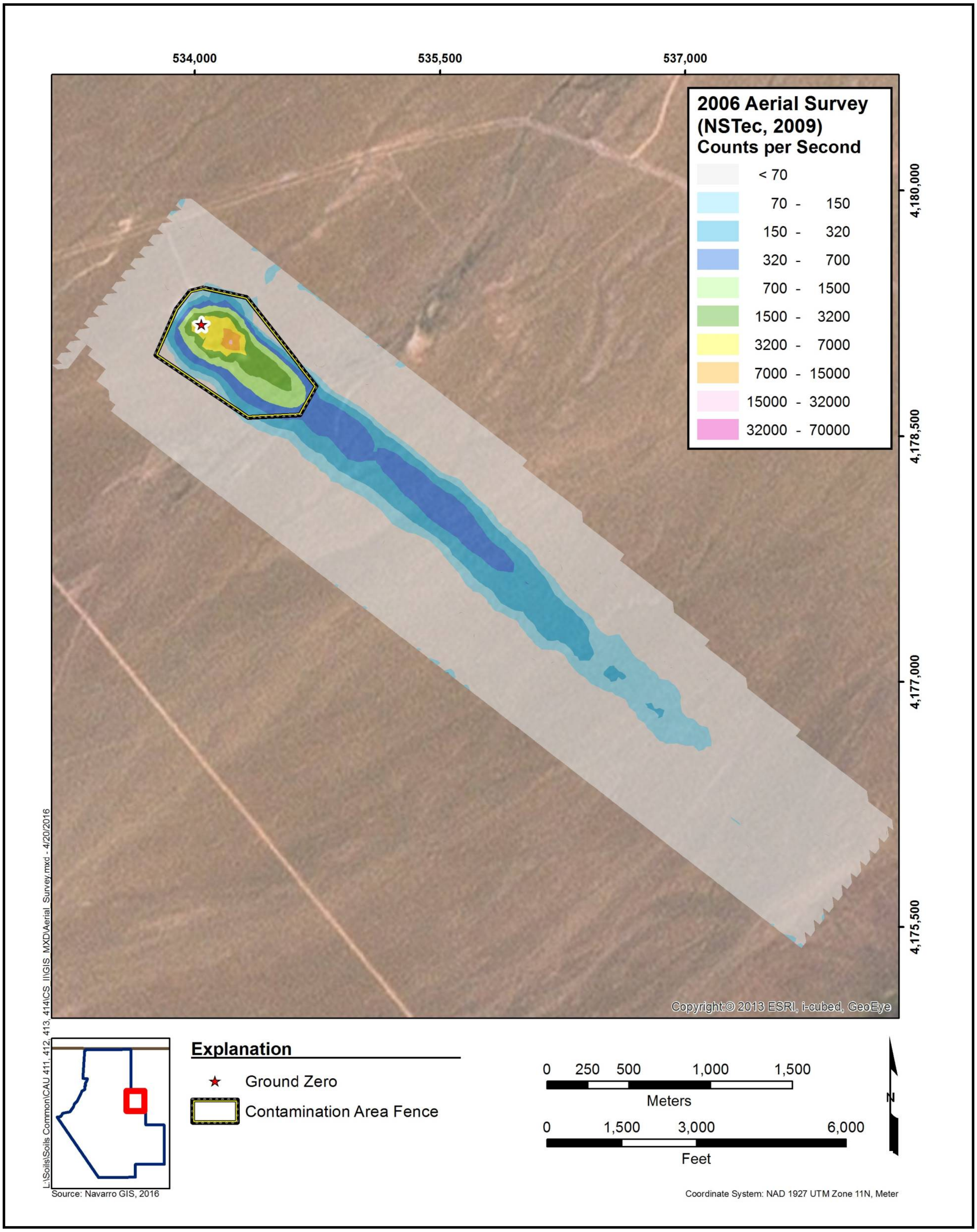


Figure 2-12
Aerial Radiation Survey Results

The data from the 2006 aerial radiation survey meet the definition of decision-supporting data, as defined in the Soils Activity QAP (NNSA/NSO, 2012b). The radiation survey data were considered in the selection of sampling locations for the CAI.

2.5.8 Radiological Posting Compliance Survey

In the fall of 2010, a radiological control posting compliance investigation was performed at the four Operation Roller Coaster sites, including the CSII site (NSTec, 2011). The purpose of this investigation was to determine whether the existing postings and associated boundaries were compliant with the DOE Occupational Radiation Protection Program requirements found in 10 *Code of Federal Regulations* (CFR) 835 (CFR, 2015). The investigation included removable contamination surveys and *in situ* soil measurements of radioactivity at locations outside the existing fences. Removable contamination is defined as radioactive material that can be removed from surfaces by nondestructive means, such as casual contact, wiping, brushing, or washing (NNSA/NSO, 2012a). The removable contamination surveys were completed along the center line of the detectable radiation plume identified outside the existing fence by the 2006 aerial radiation surveys at each site. Figure 2-13 presents the 2010 removable contamination survey locations at CAU 413. These surveys were completed using the "stomp and tromp" methodology, which uses swipe samples of the ground surface to determine the activity of removable radioactive material in the soil in units of disintegrations per minute per 100 square centimeters (dpm/100 cm^2). The results of the removable contamination survey indicate that conditions outside the fence at the CSII site do not require posting as a CA (i.e., the areas surveyed have removable alpha contamination at levels below 20 dpm/100 cm^2). The removable contamination data collected in the posting compliance investigation are informational data. These data were used to assess the removable contamination conditions outside the CA fence at the site.

The *in situ* data were collected using an *In Situ* Object Counting System that measures radioactivity in counts per second using portable gamma spectroscopy (NSTec, 2011). These data were correlated with the 2006 aerial survey data to allow conversion to activity concentrations (pCi/g). The *in situ* data are considered informational data and were not directly used in the planning of the CAI.

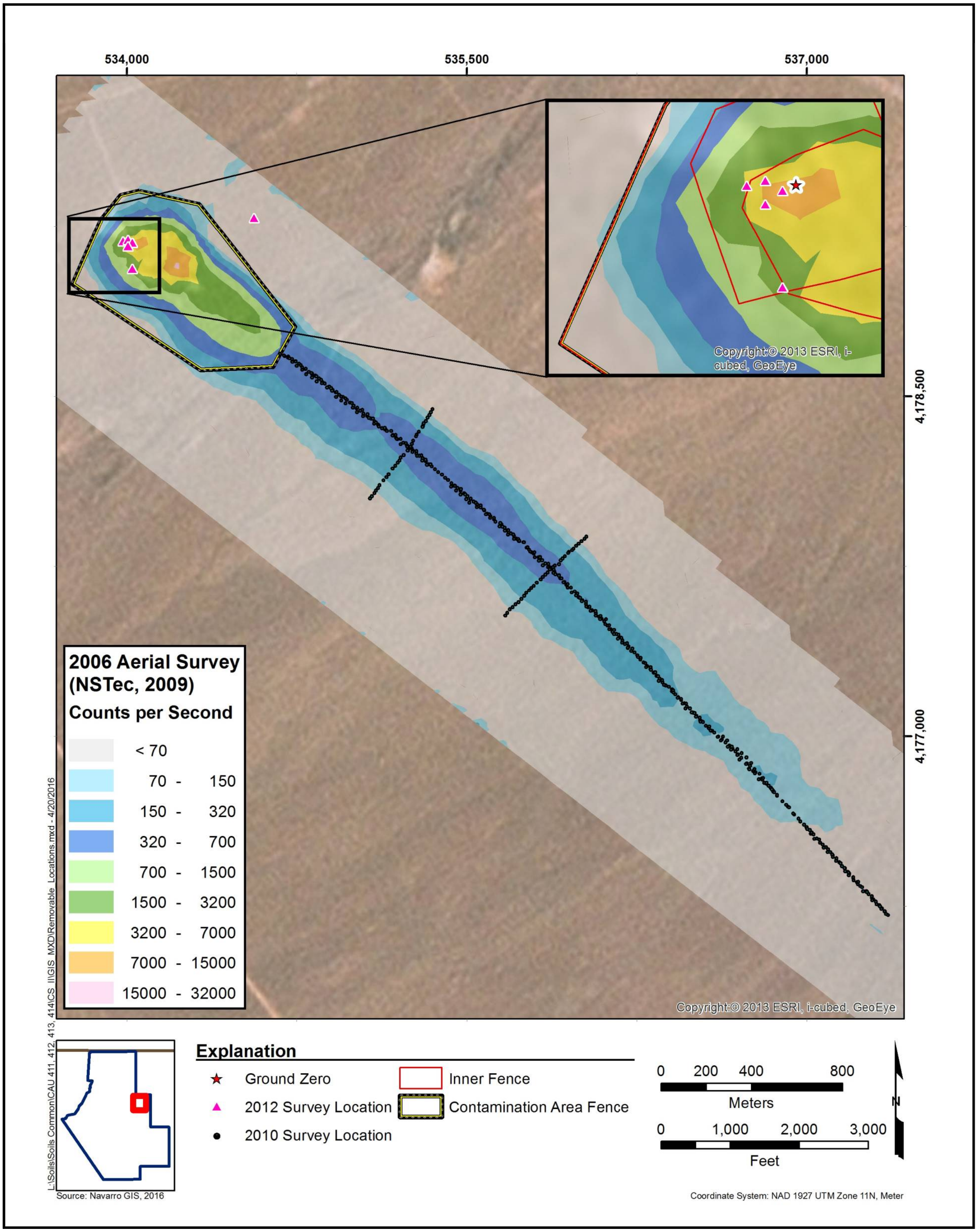


Figure 2-13
Removable Contamination Survey Locations at CAU 413

2.5.9 Preliminary Investigation

In the summer of 2012, additional investigation work referred to as the "preliminary investigation" was completed at the CSII site. Preliminary investigation fieldwork included visual surveys and ground-based radiological surveys. The radiological surveys included continuous scanning surveys using a FIDLER instrument and limited removable contamination surveys. A summary of the preliminary investigation results are presented in the following subsections. Details of the investigation and analytical results may be found in the *Preliminary Investigation Results and Recommendations for CAUs 411, 412, 413, and 414* report (N-I, 2013a).

2.5.9.1 FIDLER Survey

FIDLER surveys were conducted inside and outside the CA fence, and at select locations on the periphery of the 2006 aerial survey flight path. The FIDLER survey (Figure 2-14) displayed better spatial resolution than the 2006 aerial survey, as indicated by the detection of small metal fragments and other localized areas of elevated radioactivity that were not evident in the aerial survey. The FIDLER survey provided a general distribution of radiological contamination consistent with the 2006 aerial and 1996 KIWI surveys.

The radiological survey data collected in the preliminary investigation meet the definition of decision-supporting data, as defined in the Soils Activity QAP (NNSA/NSO, 2012b). The FIDLER data were used to guide the selection of sample locations for the CAU 413 CAI, specifically to locate areas of elevated radioactivity and/or radioactive debris.

2.5.9.2 Removable Contamination Survey

Removable contamination surveys were conducted at six areas at the CSII site: five areas within the CA fence near GZ and one location outside the fence (Figure 2-13). These locations were selected based on elevated FIDLER readings as compared to surrounding background areas. The maximum removable alpha contamination level detected at the sample locations inside the CA fence was 568 dpm/100 cm^2; the maximum level detected at the area outside the CA fence was 14.2 dpm/100 cm^2.

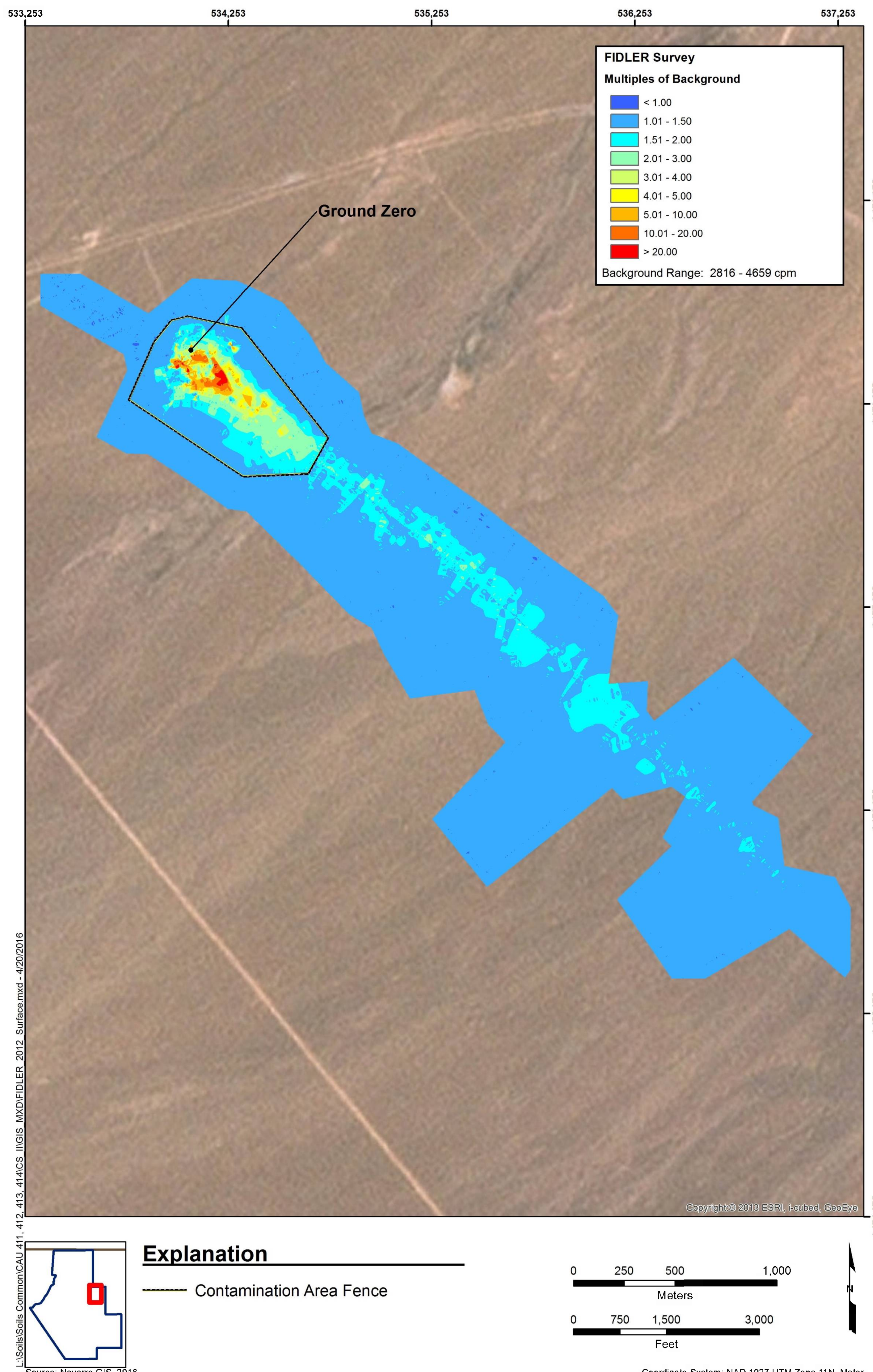


Figure 2-14
2012 FIDLER Survey Results

The removable contamination survey data are categorized as informational data. These data were used to assess the removable contamination conditions at select locations inside and outside the CA fence.

2.5.9.3 Visual Survey

Visual surveys were conducted inside the CA fence and around the fence perimeter. The visual surveys identified physical features (e.g., soil mounds), UXO, PSM, and waste. The visual survey at CSII identified the following surface features:

- Three UXO items (Section 2.3)
- PSM and waste items (removed and disposed of in 2014 [Section 2.2])
- Soil mounds (see Section A.8.7)
- A drainage channel at the northern end of the site (see Section A.8.3)
- An earthen dam east of the site
- Former location of a temporary pad outside the CA fence

The earthen dam is approximately 0.4 mi from the easternmost corner of the CA fence at the CSII site. U.S. Geologic Survey topographic maps and historical aerial photographs show this unnamed feature, which appears man-made. The dam is not mentioned in any of the historical documentation regarding the test or any post-test operation conducted at the site. This feature is upstream of CAU 413 and may have served to restrict surface water flow in Breen Creek at one time. However, the existing drainage pattern at this feature appears to allow uninhibited flow of surface water in Breen Creek and across the southern end of the CAU 413 site. The dam feature is upstream of CAU 413, and there is no evidence that it was associated with, or impacted by, the CSII test. As a result, this feature will not be investigated as part of the CAI.

A square area that appears to be the former location of a temporary pad was identified northwest of the CA fence. There are no visible stains present; however, the remnants of a black plastic liner material are visible on the outer edge of the area. Because of its location outside the CA fence, it is unlikely that this area was used to decontaminate or stage radiologically contaminated equipment. A radiation survey of the square area will be conducted during the CAI to confirm that contamination is not present. If the survey indicates the potential presence of contamination, the DQO process and sampling design for SG6, PSM, in Section A.8.6 will be followed.

2.5.10 Meteorological and Airborne Particulate Monitoring

From 1996 to 1997, the TTR maintained a continuous air monitoring station in Area 3 of the TTR to determine compliance with federal regulations for hazardous air pollutants. Area 3 of the TTR is approximately 4.5 mi northwest of the closest CS site, CSIII. This year-long study estimated a dose of 0.024 millirem per year (mrem/yr) to an individual from the diffuse sources of Pu and Am attributed to the CS sites (Culp et al., 1998).

Air monitoring at a single location north of the CA fence at the CSII site was conducted by the NNSS contractor from 1998 through 2000 (Black and Townsend, 1999; Townsend and Grossman, 2000 and 2001). Data were analyzed for gross alpha, gross beta, beryllium, and Pu. Because this monitoring station was included as part of a wide network of air samplers on NNSS, the data were reported in summary tables and were not evaluated on a site-specific basis. The highest Pu-238 and Pu-239/240 values detected over this three-year period were 9.1×10^{-19} microcuries per milliliter (µCi/mL) and 1.4×10^{-16} µCi/mL.

In 1997, the Desert Research Institute (DRI) published the results of Pu analyses of ambient airborne particulate matter from the CS sites (Bowen, 1997). A single air monitoring station located approximately 5.5 mi west of the CSII site was operated from 1996 through 1997. Filter samples from the station were composited over three month periods and analyzed for Pu. Of the four composite samples, one sample (February through April 1996) had Pu-239/240 detected above the detection limit. The estimated committed effective dose equivalent for inhaled Pu-239/240 was estimated at 0.26 millirem (mrem) per 91 days for this sample.

In 2014, DRI published a report (Mizell et al., 2014) on the results of three monitoring stations installed at the TTR to measure environmental conditions. Two of the monitoring stations, one located near the TTR airport and the other at the CSIII site, were installed in 2008; the third station was installed at the CSI site in 2011. The report includes data collected through 2012. The CSI and CSIII stations are located west/southwest of the CSII site and east of Antelope Lake on Cactus Flat. The stations collect data pertaining to meteorological conditions, radiological characteristics of suspended airborne particulates, and ambient gamma radiation. With the exception of cesium detections attributable to worldwide fallout, the gamma spectroscopy analyses of airborne particulates detected only naturally occurring radionuclides. The report concludes there is no indication that wind is transporting gamma-emitting radionuclides from the CS sites. Monitoring at the three stations is ongoing.

These air monitoring data are considered informational data and were used to support the CSM premise that wind transport is not a significant migration pathway. These data were not used in the development of the CAI sampling design.

2.5.11 National Environmental Policy Act

The *Final Site-Wide Environmental Impact Statement for the Continued Operation of the Department of Energy/National Nuclear Security Administration Nevada National Security Site and Off-Site Locations in the State of Nevada* (NNSA/NSO, 2013) includes site investigation activities such as those proposed for CAU 413.

In accordance with the NNSA/NFO *National Environmental Policy Act* (NEPA) Compliance Program, a NEPA checklist will be completed before beginning site investigation activities at CAU 413. This checklist requires NNSA/NFO activity personnel to evaluate their proposed activities against a list of potential impacts that include, but are not limited to, air quality, chemical use, waste generation, noise level, historical and cultural features, and land use. Completion of the checklist results in a determination of the appropriate level of NEPA documentation by the NNSA/NFO NEPA Compliance Officer.

3.0 Objectives

This section presents an overview of the DQOs for CAU 413 and formulation of the CSM. Also presented is a summary listing of the COPCs, the preliminary action levels (PALs), and the process used to establish FALs. Additional details and figures depicting the CSM are located in Appendix A.

3.1 Conceptual Site Model

The CSM describes the most probable scenario for current conditions at the site and defines the assumptions that are the basis for identifying the future land use, contaminant sources, release mechanisms, migration pathways, exposure points, and exposure routes. The CSM was used to develop appropriate sampling strategies and data collection methods. The CSM was developed for CAU 413 using information from the physical setting, potential contaminant sources, release information, historical background information, knowledge from similar sites, and physical and chemical properties of the potentially affected media (e.g., soil, debris) and COPCs.

Figure A.2-1 depicts a representation of the conceptual pathways to receptors from CAU 413 sources. Figure A.2-2 depicts a graphical representation of the CSM. If evidence of contamination that is not consistent with the presented CSM is identified during CAI activities, the situation will be reviewed; the CSM will be revised; the DQOs will be reassessed; and a recommendation will be made as to how best to proceed. In such cases, decision makers listed in Section A.2.1 will be notified and given the opportunity to comment on and/or concur with the recommendation.

3.1.1 Land-Use and Exposure Scenario

In consultation with USAF and NDEP, a CW land use scenario was determined applicable to the CAU 413 site (Cornish, 2014). This scenario assumes primarily outdoor construction activities that may include road construction/maintenance, underground utilities excavation, and/or target or other structure placement in the vicinity of CAU 413. The most exposed individual in this scenario is defined as an adult construction worker who works at the site for 120 days per year (day/yr), 8 hours per day (hr/day), for a total of 960 hours per year (hr/yr). The construction worker spends an average of 6 hr/day outdoors, and 2 hr/day indoors during the work day. The worker is exposed to surface soil and to subsurface soil to 0.45 m bgs to account for the placement of structure footers and/or building foundations. The worker receives an internal dose through incidental ingestion of surface and subsurface soil and inhalation of soil particulates, and an external dose by external irradiation. Dermal exposure to soil and debris is limited to the face, hands, and forearms. It is assumed the construction worker does not obtain drinking water from the site. Using the CW exposure scenario assumptions, RRMGs specific to CAU 413 were calculated using the RESRAD computer code (Yu et al., 2001). The RRMGs are radionuclide-specific activities, in picocuries per gram, that will present a radiological dose of 25 mrem/yr, independent of other radionuclides. The input parameters for the RESRAD model are discussed in detail in Appendix C. Where possible, site-specific data were used for model input.

At the request of the CAU 413 stakeholders, the impact a wound may have on total dose to a receptor was evaluated and is presented in Appendix G.

3.1.2 Contaminant Sources

The contaminant source for CAU 413 is the CSII test conducted in 1963. The test dispersed nuclear material to soil on the ground surface and to contaminated pieces of the bunker and test device (concrete and metal debris).

3.1.3 Release Mechanisms

The CSM assumes two primary release mechanisms for the dispersal of contaminants from the CSII test: (1) the test explosion and (2) post-test disturbance of contaminated soil and debris.

Based on post-test observations of contaminant distribution, it is thought that the radionuclide test material (Pu and DU) separated into three phases during the explosion that resulted in the following: (1) solid particles that were thrown from the blast and landed relatively close to GZ; (2) liquid metal that coated concrete and metal surfaces, which were subsequently thrown from the blast; and (3) gaseous particles that became airborne and followed the predominant wind direction at the time. The majority of radioactive material, in the form of solid particles deposited close to GZ was most likely scraped from the ground surface, and was buried with the test debris and contaminated soil after the test.

The solid and liquid phases of the release were thrown out in all directions with bunker and other test materials as a result of the CSII test. However, a preferential path for this ejecta was to the east associated with the initial failure of the bunker door structure (Burnett et al., 1964; Myers, 1963). Some pieces of the highly contaminated debris have a faded black substance on one side of the debris. Based on field readings of this surface, it is likely that this black substance contains Pu and DU that were fused to the bunker concrete as the liquid portion of the contaminant release. Recent field observations suggest that radiological contamination is not distributed evenly on individual debris pieces, or among the collection of debris identified to date (i.e., some pieces are contaminated; others are not). It is assumed that the more highly contaminated debris surfaces represent pieces of the bunker interior that may have been exposed to molten metal from the test device during detonation.

The gaseous portion of the contaminant plume generally followed the prevailing southeasterly wind direction at the time of the test. This contamination plume generally decreases in activity with increased distance from GZ, except in areas near GZ that were disturbed by post-test activities. A non-contiguous pattern may be seen in both the ground-based KIWI survey (Figure 2-8) and the 2006 aerial survey (Figure 2-12). As discussed in Sections 2.4.2 and 2.4.5, soil and debris in the area around GZ was scraped and buried after the test. In addition, the burial area was excavated in late 1963 to collect contaminated metal debris for further study (Section 2.2). Thus, it is highly probable that the non-contiguous contamination observed in the radiation surveys is attributable to the redistribution of contaminated soil during post-test activities.

Post-test activities included the consolidation and burial of contaminated soil and debris near GZ shortly after the test (Sections 2.4.2 and 2.4.5), the recovery of metal debris from the burial location some months later (Section 2.4.5), the scraping of surface soil during construction of an equipment staging area (Section 2.4.4), and the scraping of the ground surface at select areas to support a technology demonstration project (Section 2.4.2). Each of these activities redistributed, or had the potential to redistribute, contamination originally deposited on the ground surface by the CSII test. The location near GZ where contaminated soil and debris were buried shortly after the test was reportedly covered with clean soil. However, it is not known whether the area was re-covered with clean soil after the metal debris was removed some months later. As a result, it is possible that contaminated soil and/or debris is present on the surface at the burial location. This location of buried debris (SG5) is the only known area at the CSII site at which contaminated material was buried in the subsurface (possibly to a depth of 5 ft or more).

Based on soil profile data from previous investigations, including data presented in Table 2-2, the CSM assumes that subsurface contamination is not present at any of the disturbed areas within SG2 with activities higher than that of the surface. This assumption is based on the premise that the objective of these activities was not to bury contamination, but to remove it from the ground surface (i.e., to clear an area for construction or to obtain contaminated soil to study). Therefore, the contamination initially deposited on the surface would have been mixed with less contaminated soil in the shallow subsurface, forming a deeper and less concentrated layer of contamination from the surface to the depth of disturbance. Investigation of the SG2 release mechanism is discussed in Section A.8.2.1.

3.1.4 Migration Pathways

Migration pathways include the lateral migration of potential contaminants as a result of airborne (wind) dispersion, surface water runoff, and mechanical disturbance of soils. Vertical migration pathways for contaminants include infiltration of surface water and precipitation, and mechanical disturbance of surface and subsurface soils. The migration of Pu in all pathways is primarily due to the migration of soil particles upon which they are adsorbed (see Section A.2.2.5). This, coupled with the high PET rate of the TTR (see Section A.2.2.4), indicate that the lateral migration pathway will dominate over the vertical at CAU 413.

The CSII test resulted in the airborne dispersal of Pu and DU to the surface soil. Onsite monitoring of airborne particles has been conducted at the meteorological stations at the CSI and CSIII sites since 2011 and 2008, respectively. With the exception of cesium (Cs)-134 and -137 attributed to the 2011 Fukushima event, the gamma spectroscopy analyses only detected naturally occurring radionuclides in airborne soil particulate samples throughout the monitoring period (Mizell et al., 2014).

Contaminants present in drainage systems are subject to much higher transport rates than contaminants present in other surface areas. The drainage channels/ephemeral washes at the CSII site are generally dry but are subject to infrequent stormwater flows. These stormwater flow events provide an intermittent mechanism for both lateral and vertical transport of contaminants.

Contaminated sediments entrained by these stormwater events would be carried by the drainage channel flow to locations where the flowing water loses energy and the sediments drop out. These locations are readily identifiable as sedimentation areas. Surface water flows to the southwest in the direction of Antelope Lake through drainage channels that transect the CSII site (Figure 2-1).

Infiltration and percolation of precipitation serves as a driving force for downward migration of contaminants. However, due to high PET (58 to 69 in.), and limited annual precipitation for this region (6 in.), percolation of infiltrated precipitation at the CSII site does not provide a significant mechanism for vertical migration of contaminants to groundwater (French, 1983 and 1985). The average depth to groundwater at the CSII site is 390 ft bgs (N-I, 2013b).

Mechanical disturbance and redistribution of contaminated surface and/or subsurface soil is another likely migration pathway/transport mechanism at the site. Documented post-test operations involved the collection and burial of surface soil and debris immediately following the CSII test, excavation of metal debris months after burial, removal of topsoil for construction of an equipment and material staging area, and scraping of contaminated surface soil in support of a technology demonstration project. These post-test activities are further discussed in Sections 2.4.2, 2.4.4, 2.4.5, and 2.4.7.

Migration is influenced by the chemical characteristics of the contaminants and the physical characteristics of the vadose zone material. The contaminant characteristics of the major contaminants that contribute to dose (Pu and Am) are very low solubility and very high adsorption potential (see Section A.2.2.5). The gravelly sandy loam and sandy loam soils at CAU 413 (Leavitt, 1974) show moderate permeability, porosity, and water-holding capacity; low organic content; and relatively high adsorption potential. In general, contaminants with low solubility and high affinity for media are expected to be found relatively close to release points.

3.1.5 Exposure Points

Exposure points are expected to be areas of surface contamination where visitors or site workers may come in contact with contaminated surface soil or debris. Subsurface exposure points may exist if construction workers come in contact with contaminated media during excavation or other construction activities.

3.1.6 Exposure Routes

Exposure routes to potential site receptors include ingestion, inhalation, and dermal contact from disturbance of, or direct contact with, contaminated soil and/or debris. Receptors may also be exposed to direct ionizing radiation by performing activities in proximity to radioactive materials. Due to the internal radiation hazards presented by Pu and Am, the inhalation or ingestion of contaminated material presents the greatest exposure hazard to a receptor.

3.1.7 Additional Information

Information concerning topography, geology, climatic conditions, and hydrogeology at CAU 413 is presented in Section 2.1 as it pertains to the investigation. This information has been addressed in the CSM and will be considered during the evaluation of CAAs, as applicable. Climatic and site conditions (e.g., surface and subsurface soil descriptions) as well as specific structure descriptions will be recorded during the CAI. Areas of erosion and deposition within the drainages will be qualitatively evaluated to provide additional information on potential offsite migration of contamination.

3.2 Contaminants of Potential Concern

The COPCs for CAU 413 are defined as the contaminants reasonably expected at the site that could contribute to a dose or risk exceeding FALs. Release-specific COPCs were identified during the planning process through the review of site history, process knowledge, personnel interviews, past investigation efforts, and inferred activities associated with the CAU.

The COPCs for CAU 413 are as follows:

- Pu-238
- Pu-239/240
- Pu-241
- Am-241
- U-234
- U-235
- U-238

Historical records indicate that the CSII test device contained Pu, DU, and Am-241 (AEC/NVOO, 1964; Menker et al., 1966).

Samples collected at CAU 413 will be submitted to the laboratory for the analyses specified in Table A.2-2. The analytes that are reported by the laboratory for each of these analytical methods are presented in Table A.2-3.

3.3 Preliminary Action Levels

NNSA/NFO uses an RBCA process to evaluate the need for corrective actions. This process conforms with *Nevada Administrative Code* (NAC) 445A.227, which lists the requirements for sites with soil contamination (NAC, 2014a). For the evaluation of corrective actions, NAC 445A.22705 (NAC, 2014b) requires the use of ASTM International (ASTM) Method E1739 (ASTM, 1995) to "conduct an evaluation of the site, based on the risk it poses to public health and the environment, to determine the necessary remediation standards or to establish that corrective action is not necessary." For the evaluation of corrective actions, the FALs are established as the necessary remedial standard.

The RBCA process, summarized in Figure 3-1, defines three tiers (or levels) of evaluation involving increasingly sophisticated analyses:

- **Tier 1 evaluation.** Sample results from source areas (highest concentrations) are compared to action levels based on generic (non-site-specific) conditions (i.e., PALs).
- **Tier 2 evaluation.** Conducted by calculating Tier 2 action levels using site-specific information as inputs to the same or similar methodology used to calculate Tier 1 action levels. The Tier 2 action levels are then compared to individual sample results from reasonable points of exposure (as opposed to the source areas as is done in Tier 1) on a point-by-point basis.
- **Tier 3 evaluation.** Conducted by calculating Tier 3 action levels on the basis of more sophisticated risk analyses using methodologies described in ASTM Method E1739 that consider site-, pathway-, and receptor-specific parameters.

The PALs (i.e., Tier 1 action levels) presented in this document are used for site screening purposes and are not necessarily intended to be used as cleanup action levels or FALs. However, they are useful in screening out contaminants that are not present in sufficient concentrations to warrant further evaluation, thereby streamlining the consideration of remedial alternatives. All analytical data collected during the CAI will initially be compared to the PALs. The FALs may then be established as the PALs, or different FALs may be calculated using a Tier 2 evaluation. DQO decisions are based on comparison of data to FALs, not the PALs. The FALs, along with the basis for their selection, will be

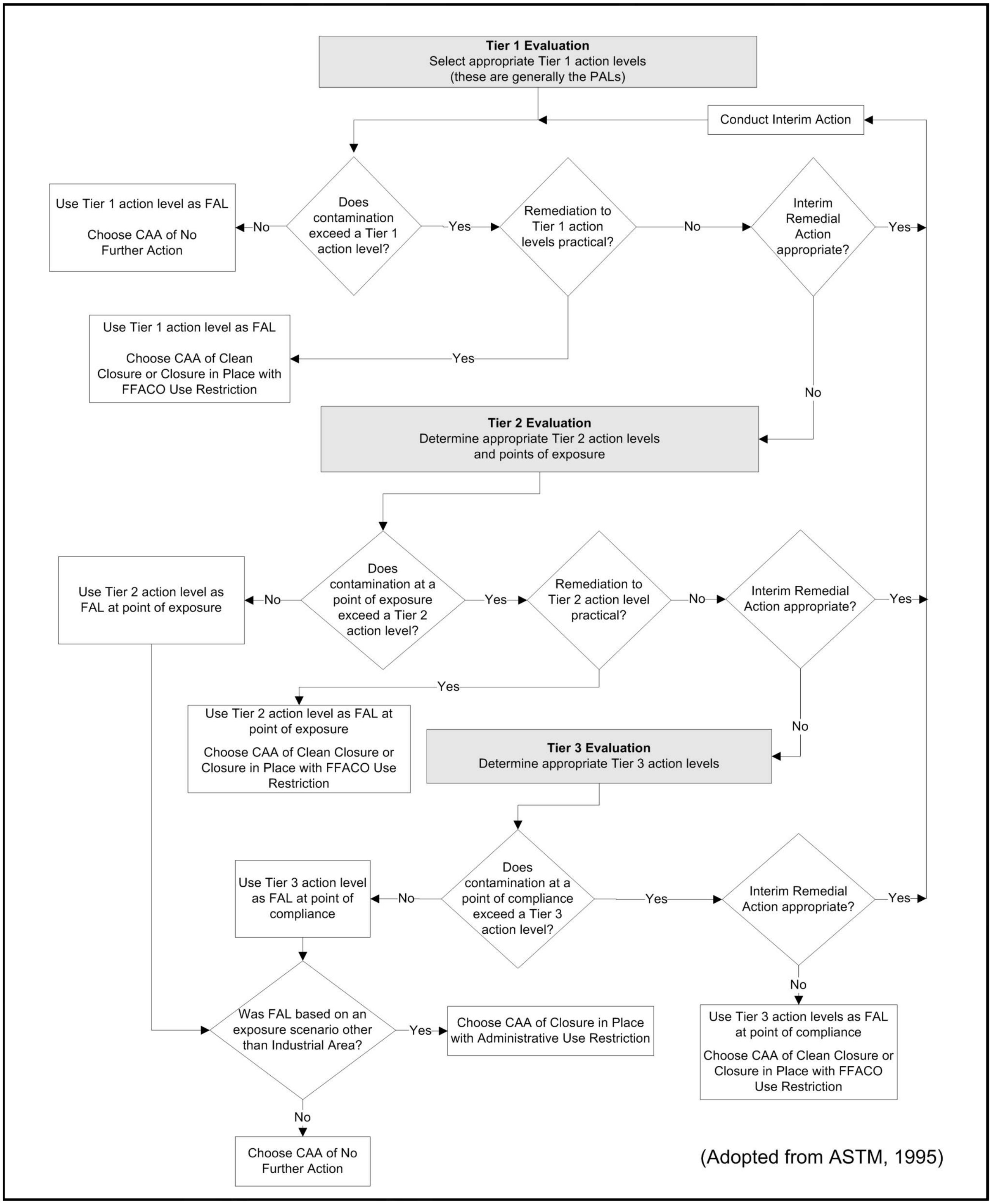


Figure 3-1
RBCA Decision Process

proposed in the CAU 413 CADD. The RBCA process used to establish FALs is described in the Soils RBCA document (NNSA/NFO, 2014).

This RBCA process includes a provision for conducting an interim remedial action if necessary and appropriate. The decision to conduct an interim action may be made at any time during the investigation and at any level (tier) of analysis. Concurrence of the decision makers listed in Section A.2.1 will be obtained before any interim action is implemented. Evaluation of DQO decisions will be based on conditions at the site after any interim actions are completed. Any interim actions conducted will be reported in the investigation report.

3.3.1 Chemical PALs

Except as noted herein, the chemical PALs are defined as the U.S. Environmental Protection Agency (EPA) Region 9 Regional Screening Levels for chemical contaminants in industrial soils (EPA, 2015). Background concentrations for *Resource Conservation and Recovery Act* (RCRA) metals will be used instead of screening levels when natural background concentrations exceed the screening level. Background is considered the average concentration plus two standard deviations of the average concentration for sediment samples collected by the Nevada Bureau of Mines and Geology throughout the NTTR (formerly the Nellis Air Force Range) (NBMG, 1998; Moore, 1999). For detected chemical COPCs without established screening levels, the protocol used by EPA Region 9 in establishing screening levels (or similar) will be used to establish PALs. If used, this process will be documented in the investigation report.

3.3.2 Radiological PAL

The radiological PAL is based on the guidelines for residual concentration of radionuclides in DOE Order 458.1 (DOE, 2013) and the exposure scenario developed by DOE, NDEP, and USAF. In consultation with stakeholders, the CW exposure scenario was determined applicable to CAU 413 (Cornish, 2014). Thus, the PAL is a total effective dose (TED) of 25 mrem/yr, based upon the CW exposure scenario. The TED is calculated as the sum of external dose and internal dose. Because of the nature of the CSII test, it is expected that the internal dose component will be larger than the external dose component in soils at the site. External dose is calculated from TLD measurements. Internal dose is determined by comparing analytical results from soil samples to RRMGs that are established using the RESRAD computer code (Yu et al., 2001). The RRMGs are radionuclide-specific values for radioactivity in surface soils. The RRMG is the value, in pC/g of surface soil, for a particular radionuclide that would result in an internal dose of 25 mrem/yr to a receptor (under the appropriate exposure scenario) independent of any other radionuclide (assuming that no other radionuclides contribute dose). The input parameters used in the RESRAD calculation of RRMGs for the CW exposure scenario are presented in Appendix C. The calculated RRMGs for the CW scenario are presented in Appendix D.

The RBCA dose evaluation does not address the potential for removable contamination under different exposure scenarios, to be transported to other areas. In order to address removable contamination that may be encountered at CAU 413, removable contamination levels will be compared to the HCA criterion of 2,000 dpm/100 cm^2 alpha contamination. The HCA criterion is a numeric threshold for removable alpha contamination that is used in the DOE Occupational Radiation Protection Program (CFR, 2015) to determine area posting requirements. For removable contamination, it is assumed that if this threshold is exceeded, the dose-based FAL is also exceeded and corrective action is required. Thus, in order to determine whether corrective action is necessary at CAU 413, radiological dose as well as removable contamination levels must be considered. A discussion on the risks associated with removable radioactive contamination is presented in the Soils RBCA document (NNSA/NFO, 2014).

3.4 DQO Process Discussion

This section contains a summary of the DQO process that is presented in Appendix A. The DQO process is a strategic planning approach based on the scientific method that is designed to ensure that the data collected will provide sufficient and reliable information to identify, evaluate, and technically defend the recommendation of viable corrective actions (e.g., no further action, clean closure, or closure in place).

The DQO strategy for CAU 413 was developed at a meeting on June 17, 2015. DQOs were developed to identify data needs, clearly define the intended use of the environmental data, and design a data collection program that will satisfy these purposes. During the DQO discussions for this CAU, the informational inputs or data needs to resolve problem statements and decision statements were documented.

The problem statement for CAU 413 is as follows: "Existing information on the nature and extent of potential contamination is insufficient to evaluate and recommend CAAs for CAU 413." To address this problem statement, resolution of the following decision statements is required:

- **Decision I.** "Does any location exceed the FALs?" If a COC is detected, then Decision II must be resolved.
- **Decision II.** "Is there sufficient information to evaluate potential CAAs?" Sufficient information is defined to include the following:
  - The lateral and vertical extent of contamination at levels exceeding the FAL
  - The information needed to estimate potential remediation waste types and volumes

For a judgmental sampling design (i.e., biased sampling), any analytical result for a COPC above the FAL will result in that COPC being designated as a COC. For a probabilistic sampling design (i.e., unbiased sampling), any COPC that has a 95 percent UCL of the average concentration above the FAL will result in that COPC being designated as a COC. The presence of a COC would require a corrective action. The evaluation of the need for corrective action will include the potential for wastes that are present at the site to contain contaminants that, if released, could cause the surrounding soil to contain COCs. Such a waste will be evaluated using the PSM criteria listed in the Soils RBCA document (NNSA/NFO, 2014) to determine the need for corrective action.

The informational inputs and data required to resolve the problem statement and the decision statements were generated as part of the DQO process for CAU 413 and are documented in Appendix A. The information necessary to resolve the DQO decisions will be generated for CAU 413 by collecting and analyzing samples generated during a field investigation. The presence of a COC will be determined by collecting and analyzing samples from locations determined most likely to contain a COC (based on the presence of a biasing factor).

A probabilistic sampling design will be used to collect samples from unbiased locations within an area that can be readily defined by distinct characteristics where the assumed distribution of contamination is relatively uniform. Results from these locations will be used to infer a characteristic representative of the sampled area as a whole (i.e., representing the average of the entire area, not the maximum at any one location). The characteristic normally used to define contamination within an area is the 95 percent UCL of the mean concentration or dose.

Protection against false negative decision errors are provided by the following:

- *Judgmental sampling* when contamination concentrations or dose levels from locations of the greatest degree of the selected biasing factor are used to make decisions for a larger area (e.g., a release site).
- *Probabilistic sampling* when the 95 percent UCL of the mean concentration or dose is used to make decisions for the defined sampling area.

Decisions are even more conservative when probabilistic results (i.e., 95 percent UCL) from biased locations are used to make a decision on the presence of COCs for the entire release site. This is typically the case when the 95 percent UCL of contamination at a sample plot located in the area of the highest radiation survey values are used to resolve the decision on the presence of COCs (i.e., Decision I).

For SG1, Undisturbed Areas, the DQO process resulted in an assumption that TED exceeds the FAL. It was also assumed for SG5, Buried Debris, that the contaminated debris and soil buried near GZ after the CSII test exceeds the FAL. Thus, Decision I for these two releases is resolved, and Decision II must be evaluated for each. For all other study groups, Decision I and Decision II, as appropriate, must be evaluated.

For the laboratory data, the data quality indicators (DQIs) of precision, accuracy, representativeness, comparability, completeness, and sensitivity needed to satisfy DQO requirements are discussed in Section 6.2. Laboratory data will be assessed in the investigation report to confirm or refute the CSM and determine whether the DQO data needs were met.

4.0 Field Investigation

This section contains a description of the activities to be conducted to gather and document information from the CAU 413 field investigation.

4.1 Technical Approach

The information necessary to satisfy the DQO data needs will be generated for CAU 413 by collecting and analyzing samples generated during a field investigation. The presence and nature of contamination decision (Decision I) will be a judgmental decision determined using sample results from biased locations under a judgmental sampling design. For sample plot locations, each Decision I sample plot will generate a TED value for the judgmental decision that represents the population of doses within the 100-m^2 area of the sample plot. This representative TED value will be determined using a probabilistic sampling design to generate a 95 percent UCL of the average TED within the plot area. For grab sample locations, DQO decisions will be based on a direct comparison of sample results to the FAL. The TED will be calculated using the methodologies described in the Soils RBCA document (NNSA/NFO, 2014).

The extent of COC contamination portion of Decision II will be resolved using one of the methods listed in Section A.4.1. The extent of radiological COC contamination decision (Decision II) will be a probabilistic decision determined by correlating TED and radiological survey values as described in the Soils RBCA document. A correlation for each radiation survey will be established to identify the radiation survey that has the best correlation to TED values. This correlation will be used to establish a radiation survey value corresponding to the FAL when establishing a corrective action boundary. This method will only be used if the correlation between TED and the survey values has a coefficient of determination (r^2) greater than 0.8. The statistical relationship among the correlated values can then be used to estimate a 95 percent lower confidence limit (LCL) of the correlation. The radiation survey value that intersects the LCL of the correlation at the TED value of 25 mrem/yr under the CW exposure scenario will be used as the radiation survey isopleth that defines the extent of contamination.

Modifications to the investigative strategy may be required should unexpected field conditions be encountered at any site. Significant modifications must be justified and documented before implementation. If an unexpected condition indicates that conditions are significantly different from the CSM, the activity will be rescoped, and the identified decision makers will be notified.

4.2 Field Activities

Field activities at CAU 413 will include site preparation, radiation surveys, geophysical surveys, sample collection, and site restoration.

4.2.1 Site Preparation Activities

Site preparation activities to be conducted before the start of environmental sampling may include relocating or removing surface debris, constructing site exclusion zones, and providing sanitation facilities.

4.2.2 Radiation Surveys

Radiation surveys conducted during the CAI may consist of mobile surveys using the FIDLER, static surveys using alpha/beta detection instruments, and/or removable contamination surveys. Other radiation detection instrumentation, such as a mobile gamma spectrometer or a PRM-470 instrument, may also be employed during the CAI.

4.2.2.1 FIDLER Surveys

Radiation surveys using a FIDLER instrument will be conducted in the northeast vicinity of the site outside the CA fence where contaminated concrete pieces, small metal fragments, and other localized areas of elevated radioactivity have been identified. Additional FIDLER surveys may also be conducted within the CA fence to fill in data gaps from the 2012 survey and provide additional data for use in dose determination around GZ. The FIDLER instrument will also be used to perform localized surveys before soil sample plot and grab sample locations are established.

4.2.2.2 Removable Contamination Surveys

Removable contamination surveys will be conducted to determine removable contamination levels in soil and on individual pieces of PSM (e.g., concrete, metal fragments).

4.2.3 Geophysical Surveys

Geophysical surveys using an EM-31 and/or EM-61 system will be conducted in the vicinity of the GZ area to determine the vertical and lateral extent of the Buried Debris release (SG5). These data will supplement geophysical data acquired in 1996.

4.2.4 Sample Location Selection

Rationale for selecting areas for sampling is discussed in the following subsections. For all investigations, if a spatial boundary is reached, the CSM is shown to be inadequate, or the Site Supervisor determines that extent sampling needs to be reevaluated, then work will be temporarily suspended; NDEP will be notified; and the investigation strategy will be reevaluated.

The sampling strategy and the proposed locations of biased samples are presented in Appendix A. The number, location, and spacing of step-outs may be modified as warranted by site conditions to achieve DQO criteria. Where sampling locations are modified, the justification for these modifications will be documented in the investigation report.

4.2.4.1 SG1, Undisturbed Areas

As agreed to in the DQO meeting with the CAU 413 stakeholders, it is assumed that the radiological dose-based FAL is exceeded in SG1. Thus, Decision I is resolved (i.e., corrective action is required at the site). Decision II will be addressed by placing soil sample plots and TLDs to determine the extent of COCs that exceed the FAL of 25 mrem/yr using the CW exposure scenario. Sample locations were selected using the 1996 KIWI survey results and available FIDLER data. These radiation survey data were reviewed to identify sample locations that present varying dose levels. Using a range of dose levels is recommended to establish a correlation of dose to radiation survey values, as explained in the Soils RBCA document (NNSA/NFO, 2014). The NAEG data (FIDLER and Pu-239/240 analytical results) and the limited results of the FIDLER survey completed in 2012 were also reviewed to ensure the sample locations were placed in areas of elevated radioactivity. The proposed sample locations are shown in Figure A.8-1.

The need for corrective action based on the presence of removable contamination will be assessed by collecting removable contamination samples from random locations at the soil sample plots located inside the CA fence. Additional removable contamination data may be collected at the discretion of the Site Supervisor to better define removable contamination conditions within the CA fence. These data, combined with removable contamination data from previous investigations, will be compared to the HCA criterion to determine whether corrective action is required.

4.2.4.2 SG2, Disturbed Areas

The primary concern at SG2 is to determine whether mechanical movement of contaminated soil resulted in the presence of COCs below the surface. To determine whether COCs are present below the ground surface (0 to 5 cm), one sample location will be evaluated within each of the five areas delineated on Figure A.8-3. Because of the size of this area and the proximity to GZ, the 1996 KIWI survey was used to bias the sample location within the 800-ft-diameter circular area surrounding GZ to the location of highest radiation. Sample locations at the other four areas were selected using the 2012 FIDLER survey results, as it is likely these four areas were disturbed in 1998 during the technology demonstration project (i.e., two years after completion of the KIWI survey). The 2012 FIDLER data are limited, so where no survey data were available, the sample location will be placed in the approximate center of the area. At each location, additional FIDLER surveys will be conducted to determine whether elevated radioactivity (i.e., above background levels) is present. Soil samples will be collected in the areas of highest radioactivity.

Disturbed area soil samples will be screened for contamination at depth and evaluated in accordance with the criteria presented in Section A.8.2.1. It will be conservatively assumed that the highest TED from either surface or subsurface samples will be used to resolve DQO decisions. If a subsurface sample results in a higher internal dose than a surface sample, a TLD-equivalent external dose will be calculated for the subsurface sample in accordance with the Soils RBCA document (NNSA/NFO, 2014).

If buried contamination in excess of the FALs is present at any of the disturbed areas, it will be assumed that the entire visibly disturbed area contains buried contamination in excess of the FALs.

4.2.4.3 SG3, Sedimentation Areas

The determination of the presence and nature of contamination (Decision I) will be made using sample results from biased locations under a judgmental sampling design. Aerial photographs and visual surveys at the site were used to identify three major drainage channels that transect the CA fence at CAU 413 (Figure 2-2). The three drainage channels will be visually surveyed to locate sedimentation areas within and outside the CA fence. A minimum of two areas in each drainage channel within the CA fence and two areas in each drainage channel outside the fence will be sampled. The drainage sample locations inside the CA fence will be selected outside and downgradient of the 25-millirem per construction worker year (mrem/CW-yr) boundary established using the soil sample and TLD data. The first and second visible accumulation areas downgradient of the boundary will be sampled. The two locations in each drainage channel located outside the CA fence will be the two closest sediment accumulation areas to the fence.Within each sedimentation area, a FIDLER survey will be conducted and the sample location selected at the highest radiological reading. Sedimentation area soil samples will be screened for contamination at depth and evaluated in accordance with the criteria presented in Section A.8.3.1. One TLD will also be placed at each drainage sample location.

It will be conservatively assumed that the highest TED from either surface or subsurface samples will be used to resolve DQO decisions. If a subsurface sample results in a higher internal dose than a surface sample, a TLD-equivalent external dose will be calculated for the subsurface sample in accordance with the Soils RBCA document (NNSA/NFO, 2014). If a COC is found in a sediment accumulation area, additional sedimentation areas will be sampled until at least two consecutive, downgradient sedimentation areas are found that do not contain a COC. Decision II will be resolved by the assumption that the entire volume of sediment where a COC is identified is contaminated above the FAL (i.e., 25 mrem/CW-yr).

4.2.4.4 SG4, Former Staging Area

To address Decision I, soil samples will be collected at two locations within the pad footprint inside the CA fence. The two locations were selected on the edge of the pad in the location closest to the GZ area where radiological activity, if present underneath the fill material, would likely be the most elevated. If COCs are detected at either of the Former Staging Area sample locations, the extent of contamination will be defined as the footprint of the fill area inside the CA fence. That is, it will be assumed that soil underneath the Former Staging Area is contaminated above the FAL.

4.2.4.5 SG5, Buried Debris

As agreed to in the DQO meeting with the CAU 413 stakeholders, it is assumed that the contaminated debris and soil buried in the GZ area exceeds the dose-based FAL. Thus, Decision I is resolved (i.e., COCs are present in the subsurface). Decision II will be resolved by conducting electromagnetic surveys in the GZ area. These data will be reviewed in conjunction with the geophysical survey data collected during the 1996 CAI (Section 2.5.5.4), to estimate the volume and extent of buried debris and soil.

4.2.4.6 SG6, PSM

The SG6 investigation will address PSM that is discovered during the CAI during visual surveys or other CAI activities and PSM that has already been identified through historical records or previous visual surveys (e.g., concrete and metal pieces of the test bunker [Section 2.4.6]). PSM identified during the CAI may include historical or recent spills (e.g., diesel spill from generator) or debris (e.g., lead bricks, drums). Sample locations for PSM will be determined based upon the likelihood of a contaminant release. These locations will be selected based on one or more of the biasing factors listed in Section A.8.6.

The Site Supervisor will determine whether a grab soil sample(s) will be collected (e.g., directly underneath a piece of debris) or a composite soil sample(s) of the impacted area (e.g., stained area) will be collected. If biasing factors are present in soils below locations where Decision I samples were removed, additional Decision I soil samples will be collected at depth intervals selected by the Site Supervisor based on biasing factors to a depth where the biasing factors are no longer present.

Decision II judgmental samples may be collected from locations based on where a COC was detected. In general, sample locations will be arranged in a triangular pattern around the area containing a COC at distances based on site conditions, process knowledge, and biasing factors. If a COC extends beyond the initial step-outs, Decision II samples will be collected from incremental step-outs. A sample collected in each step-out direction (lateral or vertical) that does not exceed the FALs, will define extent of contamination in that direction.

During the review of soil sample data collected at CAU 413 in 1992, an anomalous detection of Cs-137 was identified at a sample location southeast of the CA fence. The activity of Cs-137 at this sample location was five times that of all other samples collected at the time. Although the quality of the data could not be verified and Cs-137 is not a COPC for CAU 413, further investigation of this sample location is warranted to determine whether there are Cs-137 levels that would violate the CSM. A radiation survey using a PRM-470 instrument or similar gamma detector will be conducted in the area of the 1992 sample location. If the survey shows a gamma signature above background levels, a grab or composite sample will be collected at the location or area of maximum detection and analyzed for gamma spectroscopy. If the sample results suggest a violation of the CSM for CAU 413, the CSM will be reevaluated with the stakeholders to determine a path forward.

4.2.4.7 SG7, Soil Mounds

Decision I will be addressed by collecting one composite sample from the surface (0 to 5 cm [0 to 2 in.]) and subsurface (15 to 30 cm [6 to 12 in.]) of each mound. The composite samples from each mound will be composed of soil collected from six random locations. One TLD will be placed on each soil mound approximately 1 m (3.3 ft) from the top of the mound. The highest TED from either surface or subsurface samples will be used to resolve DQO decisions. If a subsurface sample results in a higher internal dose than a surface sample, a TLD-equivalent external dose will be calculated for the subsurface sample in accordance with the Soils RBCA document (NNSA/NFO, 2014).

If a COC is detected in a soil mound, the extent of contamination is assumed to be the physical extent of the mound above the ground surface. Thus, DQO decisions will be made for each individual soil mound.

Decision I and II for removable contamination will be assessed by collecting removable contamination samples from the surface of each soil mound. These data will be compared to the HCA criterion to determine whether corrective action is required.

4.2.5 Sample Collection

The CAU 413 sampling program will consist of the following activities:

- Collect soil samples from locations as described in Section 4.2.4.
- Collect required QC samples.
- Collect waste management samples as necessary.
- Collect external dose measurements by placing TLDs at the sample plots and drainage sample locations.
- Collect background dose measurements by placing TLDs at locations unaffected by the CSII test.
- Collect removable contamination samples from locations as described in Section 4.2.4.
- Record Global Positioning System (GPS) coordinates for each environmental sample location.

A probabilistic sampling approach will be implemented where sample plots are to be established (SG1). Each sample from a sample plot will consist of soil collected from the surface to a depth of 5 cm at nine randomly located subsample locations within the plot (see Section A.8.1.2). External dose will be determined at each sample plot from a TLD installed at the approximate center of the plot at a height of 1 m.

At locations where buried contamination may be present (SG2 and SG3), a judgmental sampling approach will be implemented. Subsurface soil samples will be collected from 5-cm depth intervals up to 30 cm or until native material is encountered. Each sample will be screened with an alpha/beta detector. The surface sample will be submitted for analysis. Additionally, if the field-screening result (FSR) for any depth sample exceeds the FSR of the surface sample by greater than 20 percent, the depth sample with the highest screening value at each sample location will be submitted for analysis.

If the field-screening level (FSL) is not exceeded in any depth sample, only the surface sample will be submitted for analysis.

A judgmental sampling approach will also be implemented at SG4, SG6, and SG7. Sample locations will be biased based on available data and/or historical documentation, as detailed in Section 4.2.4. A grab sample will be collected at each SG4, Former Staging Area, sample location from 0 to 5 cm below the fill material. The number and location of PSM samples will be determined based on the type of release and any biasing factors present. Section A.8.0 provides additional detail on sampling at study group locations. Composite soil samples will be collected, and one TLD will be placed, at each soil mound in SG7.

TLDs will be placed at background locations in the vicinity of CAU 413 to measure natural sources of radiation (e.g., cosmic, terrestrial). Three background TLDs will be placed at locations that are representative of the general area but beyond the influence of the CAU 413 release. The proposed background TLD locations are shown in Figure 4-1.

4.2.6 Sample Management

The laboratory requirements (i.e., minimum detectable concentrations [MDCs], precision, and accuracy) to be used when analyzing the COPCs are presented in the Soils Activity QAP (NNSA/NSO, 2012c). The analytical program for CAU 413 is presented in Table A.2-2. All sampling activities and QC requirements for field and laboratory environmental sampling will be conducted in compliance with the Soils Activity QAP.

4.3 Site Restoration

Upon completion of CAI and waste management activities, the following actions will be implemented before closure of the site Real Estate/Operations Permit (REOP):

- All equipment, wastes, debris, and materials associated with the CAI will be removed from the site.
- All CAI-related signage and fencing (unless part of a corrective action) will be removed from the site.
- Site will be inspected to ensure restoration activities have been completed.

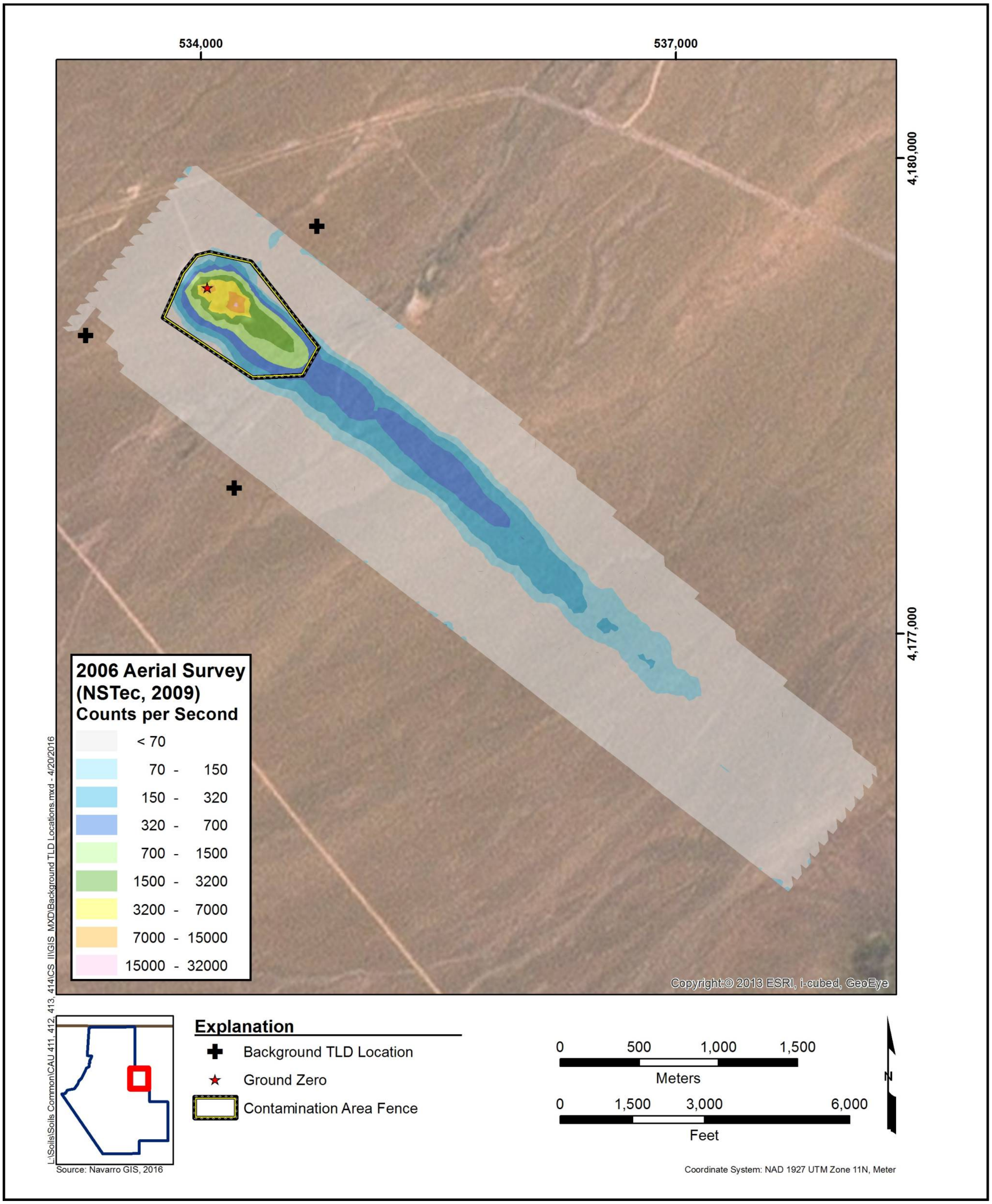


Figure 4-1
Proposed Background TLD Locations

5.0 Waste Management

Waste generated during the CAU 413 field investigation will be managed in accordance with all applicable DOE orders, federal and state regulations, and agreements and permits between DOE and NDEP. Wastes will be characterized based on these regulations using process knowledge, field measurements, and analytical results from investigation and waste samples. Waste types that may be generated during the CAI include industrial, hydrocarbon, and low-level radioactive waste. Hazardous, PCB, and mixed wastes are not anticipated to be generated during the CAI at the CSII site.

Disposable sampling equipment and personal protective equipment (PPE) are considered potentially contaminated waste only by virtue of contact with potentially contaminated media (e.g., soil) or potentially contaminated debris (e.g., metal and concrete). These wastes may be characterized based on CAI sample results of associated samples, process knowledge, or directly sampled. Chemicals were not known to be used or present at this CAU in a manner that would generate listed hazardous waste; therefore, wastes will be characterized based on their chemical characteristics.

Conservative estimates of total waste contaminant concentrations may be made based on the mass of the waste, the amount of contaminated media contained in the waste, and the maximum concentration of contamination found in the media.

5.1 Waste Minimization

The CAI will be conducted so as to minimize the generation of wastes using process knowledge, segregation, visual examination, and/or field screening (e.g., radiological survey and swipe results) to avoid cross-contaminating uncontaminated soil or uncontaminated investigation-derived waste (IDW) that would otherwise be characterized and disposed of as industrial waste. As appropriate, soil and debris will be returned to their original location. To limit unnecessary generation of hazardous or mixed waste, hazardous materials will not be used during the CAI unless approved before use. Other waste minimization practices will include, as appropriate, avoiding contact with contaminated materials, performing dry decontamination or wet decontamination over source locations, and carefully segregating waste streams.

5.2 Potential Waste Streams

The anticipated waste streams to be generated during the CAU 413 field investigation include industrial and low-level radioactive IDW. Hydrocarbon wastes may also be generated as a result of a spill or leak from onsite equipment. The waste streams may be in the form of disposable sampling equipment, PPE, debris (metal, concrete), and potentially small volumes of soil.

Known debris at the site includes small metal fragments and pieces of concrete. Debris that is removed during the CAI will be managed as IDW, unless it is eligible for recycling.

5.2.1 Industrial Waste

Industrial IDW will be collected, managed, and disposed of in accordance with the solid waste regulations and the permits for operation of the NNSS Solid Waste Disposal Sites. Industrial IDW generated at CAU 413 will be collected in plastic bags, sealed, labeled with the CAU number, and dated. The waste will then be placed in a roll-off box or similar storage container. The number of bags of industrial IDW placed in the container will be counted, noted in a log, and documented in the field activity daily log.

5.2.2 Hydrocarbon Waste

Suspected hydrocarbon solid waste, if generated, will be managed on site in a drum or other appropriate container until fully characterized and in accordance with the State of Nevada regulations (NDEP, 2006).

5.2.3 Low-Level Waste

Low-level radioactive wastes, if generated, will be managed in accordance with the contractor-specific waste certification program plan, DOE orders, and the requirements of the current version of the *Nevada National Security Site Waste Acceptance Criteria* (NNSA/NFO, 2015). Potential radioactive waste drums containing soil, PPE, and/or disposable sampling equipment may be staged and managed at a designated radioactive material area.

6.0 Quality Assurance/Quality Control

The overall objective of the characterization activities described in this CAIP is to collect accurate and defensible data to support the selection and implementation of a corrective action alternative for CAU 413. All characterization activities, including those related to TLD measurements, will be conducted in accordance with the Soils Activity QAP (NNSA/NSO, 2012b) and the Soils RBCA document (NNSA/NFO, 2014), which define rigorous data quality requirements.

6.1 QC Sampling Activities

Field QC samples will be collected in accordance with established procedures. Field QC samples are collected and analyzed to aid in determining the validity of environmental sample results. The number of required QC samples depends on the types and number of environmental samples collected. As determined in the DQO process, the minimum frequency of collecting and analyzing QC samples for this investigation is as follows:

- **Radiological samples**
  - FDs for grab samples (1 per 20 environmental samples)
- **Chemical samples (if collected)**
  - FDs for grab samples (1 per 20 environmental samples)
  - Trip blanks (1 per sample cooler containing VOC environmental samples)

Additional QC samples may be submitted based on site conditions at the discretion of the Task Manager or Site Supervisor. Field QC samples must be analyzed using the same analytical procedures implemented for associated environmental samples. Additional details regarding field QC samples are available in the Soils Activity QAP (NNSA/NSO, 2012b).

6.2 Laboratory/Analytical Quality Assurance

As stated in the DQOs (see Appendix A), and except where noted, laboratory analytical quality data will be used for making DQO decisions. The Soils Activity QAP (NNSA/NSO, 2012b) defines and establishes data quality criteria for analytical data. Rigorous QA/QC will be implemented for all laboratory samples, including documentation, data verification and validation of analytical results, and an assessment of DQIs as they relate to laboratory analysis.

Data verification and validation will be performed in accordance with the Soils Activity QAP, except where otherwise stipulated in this CAIP. All chemical and radiological laboratory data from samples that are collected and analyzed will be evaluated for data quality in accordance with company-specific procedures. The data will be reviewed to ensure that all required samples were appropriately collected and analyzed, and that the results met data validation criteria. Validated data, including estimated data (i.e., J-qualified), will be assessed to determine whether the data meet the DQO requirements of the investigation and the performance criteria for the DQIs. The results of this assessment will be documented in the investigation report. If the DQOs were not met, necessary mitigating actions will be evaluated, selected, and implemented (e.g., refine CSM or resample to fill data gaps).

7.0 Duration and Records Availability

7.1 Duration

Field and analytical activities will require approximately 160 days to complete.

7.2 Records Availability

Historical information and documents referenced in this plan are retained in the NNSA/NFO activity files in Las Vegas, Nevada, and can be obtained through written request to the NNSA/NFO Soils Activity Lead. This document is available in the DOE public reading facilities located in Las Vegas and Carson City, Nevada, or by contacting the appropriate DOE Soils Activity Lead.

8.0 References

AEC/NVOO, see Atomic Energy Commission, Nevada Operations Office.

ASTM, see ASTM International.

ASTM International. 1995 (reapproved 2015). *Standard Guide for Risk-Based Corrective Action Applied at Petroleum Release Sites*, ASTM E1739-95(2015). West Conshohocken, PA.

Atomic Energy Commission, Nevada Operations Office. 1964. *Project Manager's Report, Project Roller Coaster,* NVO-10. Prepared by Reynolds Electrical & Engineering Co., Inc. Las Vegas, NV.

BN, see Bechtel Nevada.

Bechtel Nevada. 1998. *Segmented Gate System Validation at Clean Slate 2,* Revision 0. Prepared for the U.S. Department of Energy, Nevada Operations Office. Las Vegas, NV.

Black, S.C, and Y.E. Townsend ed. 1999. *Nevada Test Site Annual Site Environmental Report for Calendar Year 1998*, DOE/NV/11718-361. Prepared for the U.S. Department of Energy, Nevada Operations Office. Las Vegas, NV: Bechtel Nevada.

Bowen, J.L. 1997. Written communication. Subject: *Analysis of Ambient Airborne Particulate Matter for Plutonium, Clean Slates Background Samples, Tonopah Test Range, February, 1996–January, 1997,* DRI Document No. 6357-683-7560.4D1. Prepared for the U.S. Department of Energy, Nevada Operations Office. Reno, NV: Desert Research Institute: Energy and Environmental Engineering Center.

Burnett, W.D., H.L. Rarrick, and G.E. Tucker, Jr. 1964. *Health Physics Aspects of Operation Roller Coaster,* SC-4973(RR). Albuquerque, NM: Sandia Corporation.

CFR, see *Code of Federal Regulations*.

Code of Federal Regulations. 2015. Title 10 CFR, Part 835, "Occupational Radiation Protection." Washington, DC: U.S. Government Printing Office.

Cornish, Col. B.R., U.S. Air Force, 99 ABW/CC. 2014. Letter to R. Boehlecke (NNSA/NFO) titled "Air Force Response to DOE Request to Close Five Radiological Sites on the NTTR," 2 May. Nellis AFB, NV.

Cornwall, H.R. 1972. *Geology and Mineral Deposits of Southern Nye County, Nevada,* Bulletin 77, scale 1:250,000. Reno, NV: Nevada Bureau of Mines and Geology, University of Nevada Mackay School of Mines.

Culp, T., and D. Howard. 1993. *1992 Environmental Monitoring Report, Tonopah Test Range, Tonopah, Nevada*, SAND 93-1449. Albuquerque, NM: Sandia National Laboratories.

Culp, T., W. Forston, D. Duncan, and R. Sanchez. 1998. *1997 Annual Site Environmental Report, Tonopah Test Range, Nevada*, SAND98-1832. Prepared for the U.S. Department of Energy, Nevada Operations Office. Las Vegas, NV: Sandia National Laboratories.

DASA, see Defense Atomic Support Agency.

DOE, see U.S. Department of Energy.

DOE/NV, see U.S. Department of Energy, Nevada Operations Office.

Defense Atomic Support Agency. 1963. "Radiological Safety Plan ROLLER COASTER FOLLOW-ON," 9 November. Albuquerque, NM: Sandia Base, Headquarters Field Command.

Dick, J.L., J.D. Shreve, and J.S. Iveson. 1963. *Operation Roller Coaster Interim Summary Report – Appendixes*, POIR-2500 (Volume 2). September. Prepared for the Defense Atomic Support Agency. (Appendixes B, C, D, E, F, G, H, I, J, K, and L declassified on 4 October 1994; Appendixes A and N [with deletions] declassified on 13 February 1997.)

EPA, see U.S. Environmental Protection Agency.

ERDA, see Energy Research and Development Administration.

Ekren, E.B., R.E. Anderson, C.L. Rogers, and D.C. Noble. 1971. *Geology of Northern Nellis Air Force Base Bombing and Gunnery Range, Nye County, Nevada*, Professional Paper 651. Washington, DC: U.S. Geological Survey.

Energy Research and Development Administration. 1975. *Environmental Assessment Tonopah Test Range, Tonopah, Nevada,* EIA/MA/76-2. Washington, DC.

Essington, E.H., E.B. Fowler, R.O. Gilbert, and L.L. Eberhardt. 1976. "Plutonium, Americium, and Uranium Concentrations in Nevada Test Soil Profiles." In Proceedings of a Symposium, *Transuranium Nuclides in the Environment*, IAEA-SM-199/76:157–173. 17–21 November, San Francisco, CA. Vienna, Austria: International Atomic Energy Agency.

FFACO, see *Federal Facility Agreement and Consent Order*.

Federal Facility Agreement and Consent Order. 1996 (as amended March 2010). Agreed to by the State of Nevada; U.S. Department of Energy, Environmental Management; U.S. Department of Defense; and U.S. Department of Energy, Legacy Management. Appendix VI, which contains the Soils Sites Strategy, was last modified June 2014, Revision No. 5.

French, R.H. 1983. "Precipitation in Southern Nevada." In *Journal of Hydraulic Engineering*, Vol. 109(7): pp. 1023–1036.

French, R.H. 1985. *Daily, Seasonal, and Annual Precipitation at the Nevada Test Site, Nevada* (Preliminary), DOE/NV/10384--01; Publication No. 45042. Las Vegas, NV: Desert Research Institute.

Friesen, H.N. 1992. *Summary of the Nevada Applied Ecology Group and Correlative Programs*, DOE/NV-357. Prepared for the U.S. Department of Energy, Nevada Operations Office. Las Vegas, NV.

Gilbert, R.O., Battelle Pacific Northwest Laboratories. 1993. Letter to L. Whitesides (IT Corporation) transmitting radionuclide concentration data for soil profile and vegetation samples collected at safety-shot areas on the Nevada Test Site, 29 November. Richland, WA.

Gilbert, R.O., L.L. Eberhardt, E.B. Fowler, E.M. Romney, E.H. Essington, and J.E. Kinnear. 1975. "Statistical Analysis of $^{239-240}$Pu and ^{241}Am Contamination of Soil and Vegetation on NAEG Study Sites." In *The Radioecology of Plutonium and Other Transuranics in Desert Environments*, NVO-153. pp. 339-394. June. Las Vegas, NV: U.S. Energy Research & Development Administration, Nevada Operations Office.

Glora, M.A., and I. Aoki. 1965. *Preliminary Report of 1965 Resurveys of Project Roller Coaster Sites*. Prepared for the Atomic Energy Commission. Mercury, NV: Reynolds Electrical & Engineering Co., Inc.

Glora, M.A., and I. Aoki. 1966. *Radiological Conditions at Project Roller Coaster Sites -1965,* NVO-162-19. Prepared for the Atomic Energy Commission. Mercury, NV: Reynolds Electrical & Engineering Co., Inc.

Glora, M.A., and B.L. Brown. 1964. *Project Roller Coaster Quarterly Resurvey, June 1964.* NVO-162-17. Prepared for the Atomic Energy Commission. Mercury, NV: Reynolds Electrical & Engineering Co., Inc.

Johnson, Sr., W.S. 1963. *Operation Roller Coaster Project Officers Report—Project 2.1, Soil Deposition,* POR-2501 (WT-2501). Prepared for the Defense Atomic Support Agency. Santa Fe, NM: Eberline Instrument Corp.

Leavitt, V.D. 1974. "Soil Surveys of Five Plutonium-Contaminated Areas on the Test Range Complex in Nevada." In *The Dynamics of Plutonium in Desert Environments*, NVO-142. pp. 21–27. July. P.B. Dunaway and M.G. White eds. Las Vegas, NV: Atomic Energy Commission, Nevada Operations Office.

Menker, H.E., J.C. Armstrong, J.D. Buchanan, E.J. Forslow, and B.H. Sorensen. 1966. *Operation Roller Coaster Project Officers Report–Project 5.2/5.3a, Radiochemical Analysis of Biological and Physical Samples*, POR-2515 (WT-2515). Palo Alto, CA: Hazleton-Nuclear Science Corp.

Mizell, S.A., V. Etyemezian, G. McCurdy, G. Nikolich, C. Shadel, and J. Miller. 2014. *Radiological and Environmental Monitoring at the Clean Slate I and III Sites, Tonopah Test Range, Nevada, With Emphasis on the Implications for Off-site Transport*, DOE/NV/0000939-19; Publication No. 45257. Las Vegas, NV: Desert Research Institute.

Moore, J., Science Applications International Corporation. 1999. Memorandum to M. Todd (SAIC) titled "Background Concentrations for NTS and TTR Soil Samples," 3 February. Las Vegas, NV: IT Corporation.

Myers, Maj. R.L.M., Defense Atomic Support Agency. 1963. Letter to Distribution titled "Locations, Instrumentation, Sampling Times, Samples Counted and Other Pertinent Information for the CLEAN SLATE II Event, Operation ROLLER COASTER," 14 June. Albuquerque, NM: Sandia Base, Headquarters Field Command.

NAC, see *Nevada Administrative Code*.

Navarro GIS, see Navarro Geographic Information Systems.

NBMG, see Nevada Bureau of Mines and Geology.

NDEP, see Nevada Division of Environmental Protection.

N-I, see Navarro-Intera, LLC.

NNSA/NFO, see U.S. Department of Energy, National Nuclear Security Administration Nevada Field Office.

NNSA/NSO, see U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office.

NSTec, see National Security Technologies, LLC.

National Security Technologies, LLC. 2009. GIS Data Transmittal to U.S. Air Force, Product ID 20091029-01-P012-R04, 15 December. Las Vegas, NV.

National Security Technologies, LLC. 2011. *Nevada Test and Training Range Results of the 10 CFR 835 Posting Compliance Field Investigation, Clean Slates I, II, and III and Double Tracks, Tonopah Test Range, Nevada*. April. Las Vegas, NV.

Navarro Geographic Information Systems. 2015. ESRI ArcGIS Software.

Navarro-Intera, LLC. 2013a. *Preliminary Investigation Results and Recommendations for CAUs 411, 412, 413, and 414, Nevada Test and Training Range and Tonopah Test Range, Nevada*, Rev. 0, N-I/28091--052. Las Vegas, NV.

Navarro-Intera, LLC. 2013b. *Water and Solute Travel Time Analysis for Soils Corrective Action Units 375, 413, 412, 413, 414, and 415,* N-I/28091--076. Las Vegas, NV.

Nevada Administrative Code. 2014a. NAC 445A.227, "Contamination of Soil: Order by Director for Corrective Action; Factors To Be Considered in Determining Whether Corrective Action Required." Carson City, NV. As accessed at http://www.leg.state.nv.us/nac on 24 August 2015.

Nevada Administrative Code. 2014b. NAC 445A.22705, "Contamination of Soil: Evaluation of Site by Owner or Operator; Review of Evaluation by Division." Carson City, NV. As accessed at http://www.leg.state.nv.us/nac on 24 August 2015.

Nevada Bureau of Mines and Geology. 1998. *Mineral and Energy Resource Assessment of the Nellis Air Force Range*, Open-File Report 98-1. Reno, NV.

Nevada Division of Environmental Protection. 2006 (as amended August 2000). *Class III Solid Waste Disposal Site for Hydrocarbon Burdened Soils, Area 6 of the NTS*, Permit SW 13-097-02, Rev. 7. Carson City, NV.

REECo, see Reynolds Electrical & Engineering Co., Inc.

Reynolds Electrical & Engineering Co., Inc. 1966. *Radiological Conditions at Project Roller Coaster 1966.* NVO-162-28. Prepared for the Atomic Energy Commission. Mercury, NV.

Reynolds Electrical & Engineering Co., Inc. 1968. *1968 Annual Radiological Survey of Project Roller Coaster,* RRS-68-16. Mercury, NV.

Reynolds Electrical & Engineering Co., Inc. 1969. *1969 Annual Radiological Survey of Project Roller Coaster*, RRS-70-2. Mercury, NV.

Schaeffer, J.R. 1968. *Climatology of Tonopah Test Range, 1967*, SC-M-68-522. Albuquerque, NM: Sandia Corporation.

Shreve, J.D. 1965. *Operation Roller Coaster Scientific Director's Summary Report,* DASA 1644. Albuquerque, NM: Sandia Corporation.

Townsend, Y.E., and R.F. Grossman ed. 2000. *Nevada Test Site Annual Site Environmental Report for Calendar Year 1999*, DOE/NV/11718-463. Prepared for the U.S. Department of Energy, Nevada Operations Office. Las Vegas, NV: Bechtel Nevada.

Townsend, Y.E., and R.F. Grossman ed. 2001. *Nevada Test Site Annual Site Environmental Report for Calendar Year 2000*, DOE/NV/11718-605. Prepared for the U.S. Department of Energy, National Nuclear Security Administration Nevada Operations Office. Las Vegas, NV: Bechtel Nevada.

U.S. Department of Energy. 2013. *Radiation Protection of the Public and the Environment*, DOE Order 458.1, Change 3. Washington, DC: Office of Health, Safety and Security.

U.S. Department of Energy, National Nuclear Security Administration Nevada Field Office. 2014. *Soils Risk-Based Corrective Action Evaluation Process*, Rev. 1, DOE/NV--1475-Rev. 1. Las Vegas, NV.

U.S. Department of Energy, National Nuclear Security Administration Nevada Field Office. 2015a. *Nevada National Security Site Waste Acceptance Criteria*, DOE/NV-325-Rev. 9. Las Vegas, NV.

U.S. Department of Energy, National Nuclear Security Administration Nevada Field Office. 2015b. *United States Nuclear Tests, July 1945 through September 1992*, DOE/NV--209-Rev 16. Las Vegas, NV.

U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office. 2004. *Corrective Action Decision Document for Corrective Action Unit 413: Clean Slate II Plutonium Dispersion (TTR)*, DOE/NV--895-Rev. 1. Las Vegas, NV.

U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office. 2012a. *Nevada National Security Site Radiological Control Manual*, DOE/NV/25946--801, Rev. 2. Prepared by Radiological Control Managers' Council. Las Vegas, NV.

U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office. 2012b. *Soils Activity Quality Assurance Plan,* Rev. 0, DOE/NV--1478. Las Vegas, NV.

U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office. 2013. *Final Site-Wide Environmental Impact Statement for the Continued Operation of the Department of Energy/National Nuclear Security Administration Nevada National Security Site and Off-Site Locations in the State of Nevada*, DOE/EIS-0426. Las Vegas, NV.

U.S. Department of Energy, Nevada Operations Office. 1995. *Cost/Risk/Benefit Analysis of Alternative Cleanup Requirements for Plutonium-Contaminated Soils On and Near the Nevada Test Site*, DOE/NV-399. May. Las Vegas, NV.

U.S. Department of Energy, Nevada Operations Office. 1996. *Clean Slate Corrective Action Investigation Plan*, Rev. 0, DOE/NV--456. Las Vegas, NV.

U.S. Department of Energy, Nevada Operations Office. 1997a. *Clean Slate Soils Disposal Options Cost Analysis, Corrective Action Units 412, 413, and 414*. Las Vegas, NV.

U.S. Department of Energy, Nevada Operations Office. 1997b. *Clean Slate Transportation and Human Health Risk Assessment*, DOE/NV--463. Las Vegas, NV.

U.S. Department of Energy, Nevada Operations Office. 1997c. *Radiological Dose Assessment for Residual Radioactive Material in Soil at the Clean Slate Sites 1, 2, and 3, Tonopah Test Range*, DOE/NV--482. Las Vegas, NV.

U.S. Department of Energy, Nevada Operations Office. 1998. *Clean Slate 2 Revegetation and Monitoring Plan*, DOE/NV/11718-150. Las Vegas, NV.

U.S. Environmental Protection Agency. 2015. *Pacific Southwest, Region 9: Regional Screening Levels (Formerly PRGs), Screening Levels for Chemical Contaminants*. Prepared by EPA Office of Superfund and Oak Ridge National Laboratory. As accessed at http://www.epa.gov/region9/superfund/prg on 24 August.

Yu, C., A.J. Zielen, J.-J. Cheng, D.J. LePoire, E. Gnanapragasam, S. Kamboj, J. Arnish, A. Wallo III, W.A. Williams, and H. Peterson. 2001. *User's Manual for RESRAD Version 6*, ANL/EAD-4. Argonne, IL: Argonne National Laboratory, Environmental Assessment Division. (Version 7.0 released in April 2014.)

Appendix A

Data Quality Objectives

A.1.0 Introduction

The DQO process described in this appendix is a seven-step strategic systematic planning method used to plan data collection activities and define performance criteria for the CAU 413 CAI. The DQOs are designed to ensure that the data collected will provide sufficient and reliable information to determine the appropriate corrective actions, to verify the adequacy of existing information, to provide sufficient data to implement the corrective actions, and to verify that closure was achieved. The CAU 413 CAI will be based on the DQOs presented in this appendix as developed by representatives of USAF, NDEP, and NNSA/NFO. The seven steps of the DQO process presented in Section A.2.0 through A.8.0 were developed in accordance with EPA *Guidance on Systematic Planning Using the Data Quality Objectives Process* (EPA, 2006).

In general, the procedures used in the DQO process provide the following:

- A method to establish performance or acceptance criteria, which serve as the basis for designing a plan for collecting data of sufficient quality and quantity to support the goals of a study.
- Criteria that will be used to establish the final data collection design such as
  - the nature of the problem that has initiated the study and a conceptual model of the environmental hazard to be investigated,
  - the decisions or estimates that need to be made and the order of priority for resolving them,
  - the type of data needed, and
  - an analytic approach or decision rule that defines the logic for how the data will be used to draw conclusions from the study findings.
- Acceptable quantitative criteria on the quality and quantity of the data to be collected, relative to the ultimate use of the data.
- A data collection design that will generate data meeting the quantitative and qualitative criteria specified. A data collection design specifies the type, number, location, and physical quantity of samples and data, as well as the QA and QC activities that will ensure that sampling design and measurement errors are managed sufficiently to meet the performance or acceptance criteria specified in the DQOs.

A.2.0 Step 1 - State the Problem

Step 1 of the DQO process defines the problem that requires study, identifies the planning team, and develops a conceptual model of the environmental hazard to be investigated.

The problem statement for CAU 413 is as follows: "Existing information on the nature and extent of contamination is insufficient to evaluate CAAs for CAU 413."

A.2.1 Planning Team Members

The DQO planning team consists of representatives from NDEP, USAF, and NNSA/NFO. The DQO planning team met on June 17, 2015, for the DQO meeting.

A.2.2 Conceptual Site Model

The CSM is used to organize and communicate information about site characteristics. It reflects the best interpretation of available information at a point in time. The CSM is a primary vehicle for communicating assumptions about release mechanisms, potential migration pathways, or specific constraints. It provides a summary of how and where contaminants are expected to move and what impacts such movement may have. It is the basis for assessing how contaminants could reach receptors both in the present and future. The CSM describes the most probable scenario for current conditions at the site and defines the assumptions that are the basis for identifying appropriate sampling strategy and data collection methods. An accurate CSM is important as it serves as the basis for all subsequent inputs and decisions throughout the DQO process.

The CSM was developed for CAU 413 using information from the physical setting, potential contaminant sources, release information, historical background information, knowledge from similar sites, and physical and chemical properties of the potentially affected media and COPCs.

The CSM consists of the following:

- Potential contaminant releases, including media subsequently affected
- Release mechanisms (the conditions associated with the release)

- Potential contaminant source characteristics, including contaminants suspected to be present and contaminant-specific properties
- Site characteristics, including physical, topographical, and meteorological information
- Migration pathways and transport mechanisms that describe the potential for migration and where the contamination may be transported
- The locations of points of exposure where individuals or populations may come in contact with a COC associated with the CAU
- Routes of exposure where contaminants may enter the receptor

If additional elements are identified during the CAI that are outside the scope of the CSM, the situation will be reviewed and a recommendation will be made as to how to proceed. In such cases, NDEP will be notified and given the opportunity to comment on, or concur with, the recommendation.

Table A.2-1 provides information on CSM elements that will be used throughout the remaining steps of the DQO process. Figure A.2-1 depicts a representation of the conceptual pathways to receptors from CAU 413 sources. Figure A.2-2 depicts a graphical representation of the CSM.

A.2.2.1 Contaminant Sources

The contaminant source for CAU 413 is the CSII test conducted in 1963. The test dispersed nuclear material to soil on the ground surface and to contaminated pieces of the bunker and test device (concrete and metal debris).

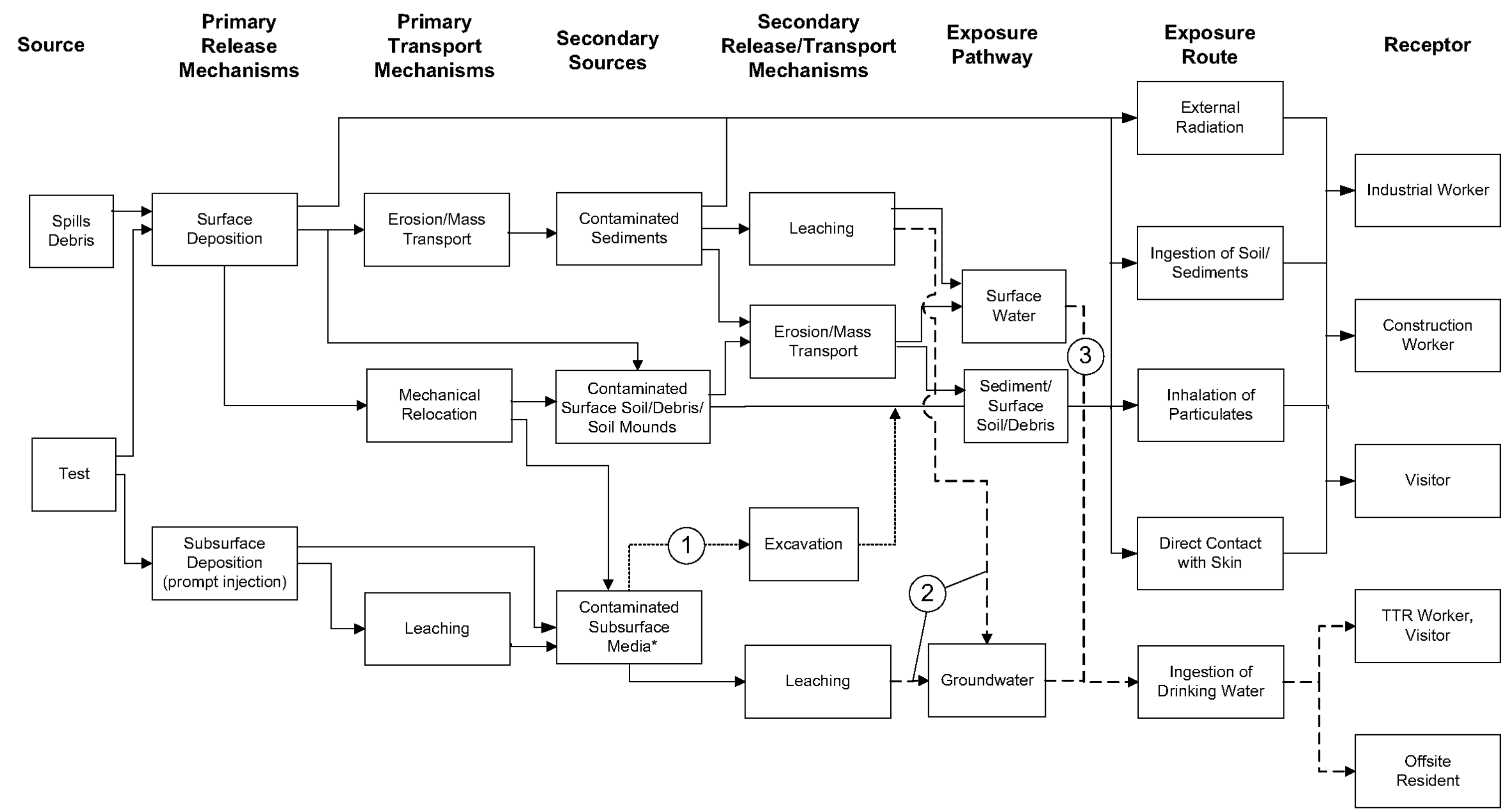
The most likely locations of the contamination and releases to the environment are surface and shallow subsurface soils to which radionuclides were dispersed by the test; debris ejected from the bunker structure to the ground surface; soils and debris buried at the GZ area after the test; and soil mounds.

Table A.2-1
CSM Description of Elements for Each SG in CAU 413
(Page 1 of 2)

SG Number	1	2	3	4	5	6	7
SG Description	Undisturbed Areas	Disturbed Areas	Sedimentation Areas	Former Staging Area	Buried Debris	PSM	Soil Mounds
Site Status	Inactive and/or abandoned						
Exposure Scenario	Construction Worker						
Sources of Potential Contamination	Radionuclides from CSII storage–transportation test						
Location of Contamination/ Release Point	Surface soil surrounding and downwind of GZ				Subsurface soil at GZ	Surface soil	Surface soil in the vicinity of GZ
Amount Released	Classified						
Affected Media	Surface and shallow subsurface soil		Surface and shallow subsurface soil; sediments	Soil underneath fill material	Subsurface soil and debris in GZ burial mound	Surface and subsurface soil and debris	Soil in mounds and surface soil underneath mounds
Potential Contaminants	Pu-238, Pu-239/240, Pu-241, Am-241, U-234,U-235, U-238						
Transport Mechanisms	Lateral transport of contamination through drainage channels and overland flow is a major driving force for migration of surface contaminants. Wind may also contribute to lateral transport through resuspension and redistribution of windborne contaminants. Mechanical disturbance during post-test operations may also serve to displace or redistribute contaminants. Percolation/infiltration of precipitation through soil is a minor force for contaminant migration.						

Table A.2-1
CSM Description of Elements for Each SG in CAU 413
(Page 2 of 2)

<table>
<tr><th>SG Number</th><th>1</th><th>2</th><th>3</th><th>4</th><th>5</th><th>6</th><th>7</th></tr>
<tr><th>SG Description</th><th>Undisturbed Areas</th><th>Disturbed Areas</th><th>Sedimentation Areas</th><th>Former Staging Area</th><th>Buried Debris</th><th>PSM</th><th>Soil Mounds</th></tr>
<tr><td>Migration Pathways</td><td colspan="7">Lateral migration of potential contaminants across surface soils/sediments and vertical migration of potential contaminants through subsurface soils.</td></tr>
<tr><td>Lateral and Vertical Extent of Contamination</td><td colspan="7">Contamination is expected to have been initially contiguous to the release points. Concentrations are expected to generally decrease with distance and depth from the source. Lateral and vertical extent of contamination exceeding the FAL is assumed to be within the spatial boundaries. Groundwater contamination is not expected.</td></tr>
<tr><td>Exposure Pathways</td><td colspan="7">The potential for contamination exposure is limited to personnel conducting periodic inspections or radiological surveys, UXO retrieval operations, and construction activities. These human receptors may be exposed to COCs through oral ingestion or inhalation of, or dermal contact (absorption) with soil and/or debris due to inadvertent or intended disturbance of these materials, or irradiation by radioactive materials.</td></tr>
</table>



1. Potential Pathway - This pathway would exist only if the subsurface media were excavated.
2. Incomplete Pathway - Characterization of regional hydrogeology and environmental data have shown that leaching of contaminants is limited.
3. Incomplete Pathway - There are no surface waters that are used as a source for drinking water.

*Includes contaminated soil and debris buried near GZ.

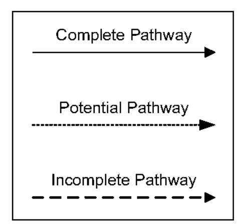


Figure A.2-1
CSM Flowchart for CAU 413

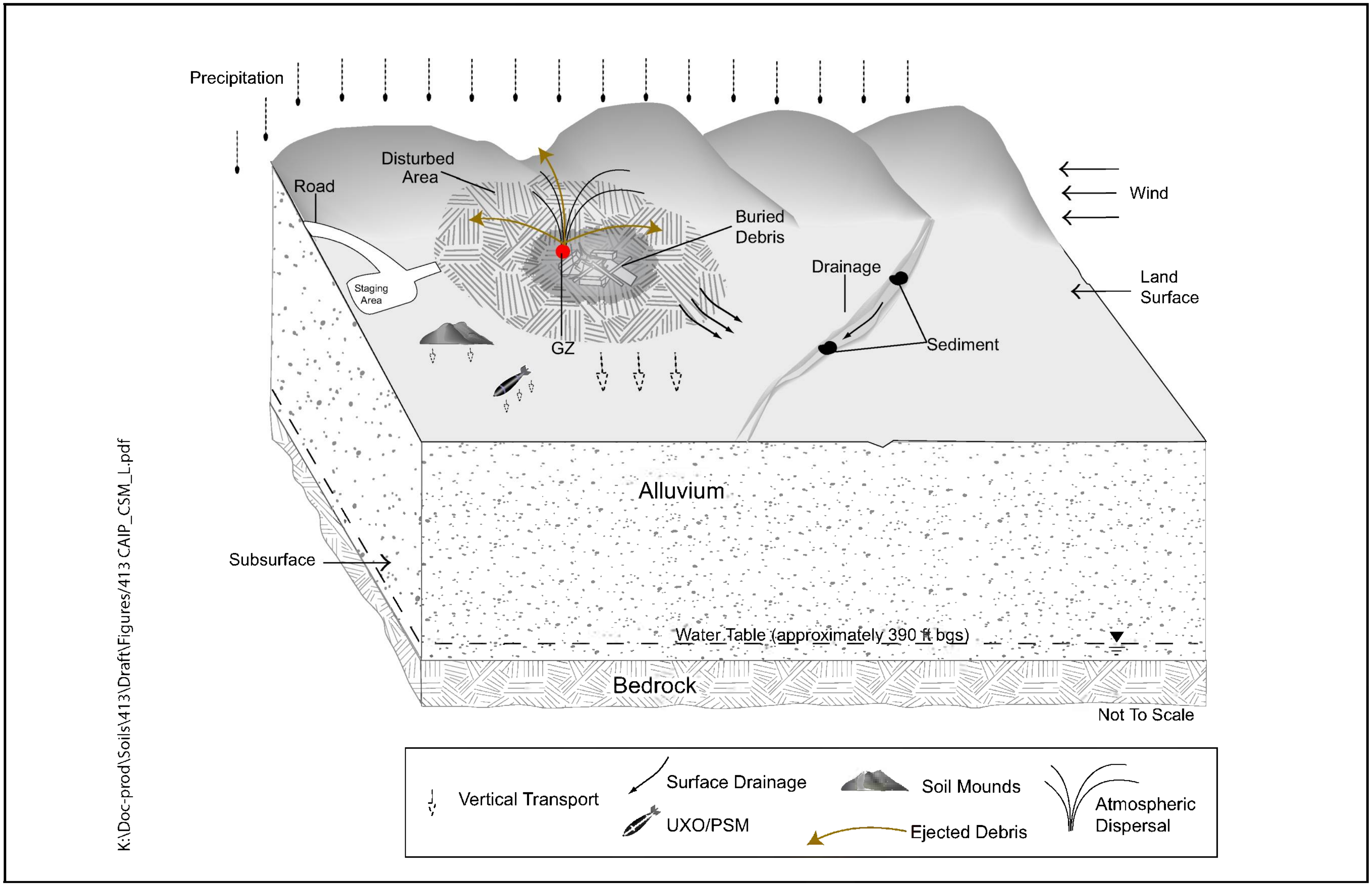


Figure A.2-2
CSM for CAU 413

A.2.2.2 Release Mechanisms

The CSM assumes two primary release mechanisms for the dispersal of contaminants from the CSII test: (1) the test explosion and (2) post-test disturbance of contaminated soil and debris.

Based on post-test observations of contaminant distribution, it is thought that the radionuclide test material (Pu and DU) separated into three phases during the explosion that resulted in the following: (1) solid particles that were thrown from the blast and landed relatively close to GZ; (2) liquid metal that coated concrete and metal surfaces, which were subsequently thrown from the blast; and (3) gaseous particles that became airborne and followed the predominant wind direction at the time. The majority of radioactive material, in the form of solid particles deposited close to GZ, was most likely scraped from the ground surface, and was buried with the test debris and contaminated soil after the test.

The solid and liquid phases of the release were thrown out in all directions with bunker and other test materials as a result of the CSII test. However, a preferential path for this ejecta was to the east associated with the initial failure of the bunker door structure (Burnett et al., 1964; Myers, 1963). Some pieces of the highly contaminated debris have a faded black substance on one side of the debris. Based on field readings of this surface, it is likely that this black substance contains Pu and DU that were fused to the bunker concrete as the liquid portion of the contaminant release. Recent field observations suggest that radiological contamination is not distributed evenly on individual debris pieces, or among the collection of debris identified to date (i.e., some pieces are contaminated, other are not). It is assumed that the more highly contaminated debris surfaces represent pieces of the bunker interior that may have been exposed to molten metal from the test device during detonation.

The gaseous portion of the contaminant plume generally followed the prevailing southeasterly wind direction at the time of the test. This contamination plume generally decreases in activity with increased distance from GZ, except in areas near GZ that were disturbed by post-test activities. A non-contiguous pattern may be seen in both the ground-based KIWI survey (Figure 2-8) and the 2006 aerial survey (Figure 2-12). As discussed in Sections 2.4.2 and 2.4.5, soil and debris in the area around GZ was scraped and buried after the test. In addition, the burial area was excavated in late 1963 to collect contaminated metal debris for further study (Section 2.2). Thus, it is highly probable that the non-contiguous contamination observed in the radiation surveys is attributable to the redistribution of contaminated soil during post-test activities.

Post-test activities included the consolidation and burial of contaminated soil and debris near GZ shortly after the test (Sections 2.4.2 and 2.4.5), the recovery of metal debris from the burial location some months later (Section 2.4.5), the scraping of surface soil during construction of an equipment staging area (Section 2.4.4), and the scraping of the ground surface at select areas to support a technology demonstration project (Section 2.4.2). Each of these activities redistributed, or had the potential to redistribute, contamination originally deposited on the ground surface by the CSII test. The location near GZ where contaminated soil and debris were buried shortly after the test was reportedly covered with clean soil. However, it is not known whether the area was re-covered with clean soil after the metal debris was removed some months later. As a result, it is possible that contaminated soil and/or debris is present on the surface at the burial location. This burial location (SG5) is the only known area at the CSII site at which contaminated material was buried in the subsurface (possibly to a depth of 5 ft or more). The CSM assumes that subsurface contamination is not present at any of the disturbed areas within SG2 with activities higher than that of the surface. This assumption is based on the premise that the objective of these activities was not to bury contamination, but to remove it from the ground surface (i.e., to clear an area for construction or to obtain contaminated soil to study). Therefore the contamination initially deposited on the surface would have been mixed with less contaminated soil in the shallow subsurface, forming a deeper and less concentrated layer of contamination from the surface to the depth of disturbance.

A.2.2.3 Potential Contaminants

Release-specific COPCs were identified during the planning process through the review of site history, process knowledge, personnel interviews, past investigation efforts, and inferred activities associated with the CAU. The list of COPCs is intended to encompass all contaminants reasonably expected at the site that could contribute to a dose or risk exceeding action levels.

Based on the nature of the releases identified in Section 2.4 and the previous investigation results discussed in Section 2.5, the COPCs for CAU 413 are as follows:

- Pu-238
- Pu-239/240
- Pu-241
- Am-241
- U-234
- U-235
- U-238

Historical records indicate that the CSII test device contained Pu, DU, and Am-241 (AEC/NVOO, 1964; Menker et al., 1966). There are no historical records indicating that RCRA constituents were either present or released at the CSII site (DOE/NV, 1996). Thus, no chemical COPCs are identified for CAU 413.

Table A.2-2 details the analytical program for CAU 413 samples. Table A.2-3 presents the analytes that are reported by the laboratory for each of these analytical methods.

A.2.2.4 Site Characteristics

The CSII site is located within the high desert region of south-central Nevada in a broad valley known as Cactus Flat with an approximate elevation of 1,620 m (5,300 ft) amsl. The gravelly sandy loam and sandy loam soils at CAU 413 (Leavitt, 1974) show moderate permeability, porosity, and water-holding capacity; low organic content; and relatively high adsorption potential. Annual precipitation at the TTR is 13 to 15 cm (5 to 6 in.) in Cactus Flat, and the PET ranges from 58 to 69 in. (French, 1983 and 1985). Average temperatures for the warmest and coldest hours in January from the TTR weather station are 44 °F and 18 °F, respectively. Corresponding temperatures in July are 90 °F and 58 °F (Schaeffer, 1968).

The depth to groundwater in the vicinity of Cactus Flat varies from ground surface at springs located in the Cactus and Kawich mountains bordering Cactus Flat, to more than 120 m (393 ft) on the valley floor (Ekren et al., 1971). The average depth to groundwater estimated from the three closest wells to the CSII site is 390 ft bgs (N-I, 2013).

Table A.2-2
Analytical Program

Analyses	SG1, SG2, SG3, and SG4	SG5[a] and SG6[b]	SG7
Inorganic COPCs			
RCRA Metals	--	TBD	--
Hexavalent Chromium	--	TBD	--
Organic COPCs			
VOCs	--	TBD	--
SVOCs	--	TBD	--
Radionuclide COPCs			
Gamma Spectroscopy	X	TBD	X
Isotopic U	X	TBD	X
Isotopic Pu	X	TBD	X
Isotopic Am	X	TBD	X
Pu-241	X	TBD	X

[a]The collection and analyses of samples of the Buried Debris release is not anticipated.
[b]Analyses for PSM will be determined on a case-by-case basis considering any biasing factors present (e.g., elevated radioactivity, associated waste) and professional judgment.

TBD = To be determined

X = Required analytical method as described in Soils Activity QAP (NNSA/NSO, 2012b)
-- = Not required

No permanent surface water streams or lakes are present at the CSII site. Several dry lake beds (playas) exist at the TTR, most notably Main and Antelope Lakes on Cactus Flat. Surface water flows to the southwest in the direction of Antelope Lake through drainage channels that transect the CSII site (Figure 2-1). The lake beds retain surface water after heavy rains but are normally dry again within a few days due to evaporation. Numerous stream channels that remain dry most of the year and only discharge water after rain are present on Cactus Flat. Three such drainage channels were identified at the CSII site during previous investigations (Section 2.4.3).

Additional information on the environmental setting of the CSII site may be found in Section 2.1 and in the *Clean Slate Corrective Action Investigation Plan*, Rev. 0 (DOE/NV, 1996).

Table A.2-3
Analytes Reported Per Method

Organic COPCs

Method 8260[a] VOCs	
1,1,1,2-Tetrachloroethane	Carbon tetrachloride
1,1,1-Trichloroethane	Chlorobenzene
1,1,2,2-Tetrachloroethane	Chloroethane
1,1,2-Trichloroethane	Chloroform
1,1-Dichloroethane	Chloromethane
1,1-Dichloroethene	Chloroprene
1,2,4-Trichlorobenzene	cis-1,2-Dichloroethene
1,2,4-Trimethylbenzene	Dibromochloromethane
1,2-Dibromo-3-chloropropane	Dichlorodifluoromethane
1,2-Dichlorobenzene	Ethyl methacrylate
1,2-Dichloroethane	Ethylbenzene
1,2-Dichloropropane	Isobutyl alcohol
1,3,5-Trimethylbenzene	Isopropylbenzene
1,3-Dichlorobenzene	Methacrylonitrile
1,4-Dichlorobenzene	Methyl methacrylate
2-Butanone	Methylene chloride
2-Chlorotoluene	n-Butylbenzene
2-Hexanone	n-Propylbenzene
4-Isopropyltoluene	sec-Butylbenzene
4-Methyl-2-pentanone	Styrene
Acetone	tert-Butylbenzene
Acetonitrile	Tetrachloroethene
Allyl chloride	Toluene
Benzene	Total xylenes
Bromodichloromethane	Trichloroethene
Bromoform	Trichlorofluoromethane
Bromomethane	Vinyl acetate
Carbon disulfide	Vinyl chloride

Method 8270[a] SVOCs	
1,4-Dioxane	Bis(2-ethylhexyl)phthalate
2,3,4,6-Tetrachlorophenol	Butyl benzyl phthalate
2,4,5-Trichlorophenol	Carbazole
2,4,6-Trichlorophenol	Chrysene
2,4-Dimethylphenol	Di-n-butyl phthalate
2,4-Dinitrotoluene	Di-n-octyl phthalate
2-Chlorophenol	Dibenzo(a,h)anthracene
2-Methylnaphthalene	Dibenzofuran
2-Methylphenol	Dimethyl phthalate
2-Nitrophenol	Fluoranthene
3-Methylphenolc (m-cresol)	Fluorene
4-Methylphenolc (p-cresol)	Hexachlorobenzene
4-Chloroaniline	Hexachlorobutadiene
4-Nitrophenol	Hexachloroethane
Acenaphthene	Indeno(1,2,3-cd)pyrene
Acenaphthylene	n-Nitroso-di-n-propylamine
Aniline	Naphthalene
Anthracene	Nitrobenzene
Benzo(a)anthracene	Pentachlorophenol
Benzo(a)pyrene	Phenanthrene
Benzo(b)fluoranthene	Phenol
Benzo(g,h,i)perylene	Pyrene
Benzo(k)fluoranthene	Pyridine
Benzoic acid	Diethyl phthalate
Benzyl alcohol	

Inorganic COPCs

Method 6010[a] RCRA Metals
Arsenic
Barium
Beryllium
Cadmium
Chromium
Lead
Selenium
Silver

Method 7196[a]
Chromium VI

Radionuclide COPCs

Method Ga-01[b] Gamma Spec
Ac-228
Ag-108m
Al-26
Am-241
Cm-243
Co-60
Cs-137
Eu-152
Eu-154
Eu-155
K-40
Nb-94
Pa-233
Pb-212
Pb-214
Th-229
Th-234
Tl-208
U-235

Method U-02[b] Isotopic U
U-234
U-235
U-238

Method Pu-02[b] Isotopic Pu
Pu-238
Pu-239/240

Method Am-01[b] Isotopic Am
Am-241
Am-243

Lab-Specific Methods[c]
Pu-241

[a] *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods* (EPA, 2015b)
[b] *The Procedures Manual of the Environmental Measurements Laboratory*, which includes HASL-300 Methods (DOE, 1997)
[c] The most current EPA, DOE, or equivalent accepted analytical method may be used, including laboratory standard operating procedures approved by the contractor in accordance with industry standards and the contractor's statement of work requirements.

HASL = Health and Safety Laboratory
Ac = Actinium
Ag = Silver
Al = Aluminum
Cm = Curium
Co = Cobalt
Eu = Europium
K = Potassium
Nb = Niobium
Pa = Proactinium
Pb = Lead
Th = Thorium
Tl = Thallium

A.2.2.5 Contaminant Characteristics

The characteristics of the major contaminants that contribute to dose at CAU 413 (Pu and Am) are very low solubility and very high adsorption potential. In general, contaminants with low solubility and high affinity for media are expected to be found relatively close to release points. This is demonstrated by the high distribution coefficient (K_d) values reported in many studies for Pu and Am. Studies reported by the EPA, RESRAD, and Sheppard and Thibault clearly show that K_d values for Pu and Am are related to soil texture, pH, and organic matter (EPA, 2004; Yu et al., 2001; Sheppard and Thibault, 1990; NNSA/NSO, 2004). In general, K_d values increase with decreasing particle size. For both Pu and Am, K_d values strongly increase with higher pH values within the common pH range for agricultural soils. In general, lower levels of organic matter are associated with higher K_d values. For the site-specific conditions present at the CSII site with relatively high pH and low organic content (Leavitt, 1974), K_d values for Pu and Am would be expected to be even higher than those reported in the studies. However, the more conservative default K_d values for Pu and Am were used in the RESRAD modeling to establish the CAU 413 RRMGs.

Based on the conclusions of a travel-time analysis conducted for the CSII site, the radionuclide contaminants at CAU 413 are highly adsorbed on the valley-fill alluvial materials and generally do not move with the groundwater (N-I, 2013). As a result, it is predicted that CAU 413 contaminants will not reach the shallow groundwater table below the site for thousands of years. The travel-time analysis was based primarily on regional groundwater models using conservative input parameters.

A.2.2.6 Migration Pathways

Migration pathways include the lateral migration of potential contaminants as a result of airborne (wind) dispersion, surface water runoff, and mechanical disturbance of soils. Vertical migration pathways for contaminants include infiltration of surface water and precipitation, and mechanical disturbance of surface and subsurface soils. The migration of Pu in all pathways is primarily due to the migration of soil particles upon which they are adsorbed (see Section A.2.2.5). This, coupled with the high PET rate of the TTR (see Section A.2.2.4), indicates that the lateral pathway will dominate over the vertical at CAU 413.

The CSII test resulted in the airborne dispersal and deposition of contaminants on the surface soil around CSII. Wind events (including dust devils) entrain, mix, and disperse soil particles within their path. As the areas affected by these events are much larger than the area impacted by CSII releases, soil from the entire affected area (both uncontaminated and contaminated) is mixed and dispersed. This results in slightly lower contaminant concentrations across the contaminated area and slightly higher contaminant concentrations in the uncontaminated areas. The net effect of this phenomenon is that the area where contamination exceeds the FAL could become slightly smaller. This CSM element assumption is supported by several studies monitoring airborne particles in the vicinity of the CS release sites (Section 2.5.10). These studies have not detected any significant concentrations of contaminants originating from the release sites.

Contaminants present in drainage systems are subject to much higher transport rates than contaminants present in other surface areas. The drainage channels/ephemeral washes at the CSII site are generally dry but are subject to infrequent stormwater flows. These stormwater flow events provide an intermittent mechanism for both lateral and vertical transport of contaminants. Contaminated sediments entrained by these stormwater events would be carried by the drainage channel flow to locations where the flowing water loses energy and the sediments drop out. These locations are readily identifiable as sedimentation areas. Surface water flows to the southwest in the direction of Antelope Lake through drainage channels that transect the CSII site (Figure 2-1).

Percolation of infiltrated precipitation serves as a driving force for downward migration of contaminants. However, very little of the infiltrated precipitation is available for percolation due to the high evaporative demand (PET of 58 to 69 inches per year [in./yr]) and the limited amount of annual precipitation for this region (6 in./yr) (French, 1983 and 1985). Therefore, percolation of infiltrated precipitation at the CSII site does not provide a significant mechanism for vertical migration of any contaminant to groundwater. In addition, as the major contaminants at the CSII site (Pu and Am) are highly adsorptive to the soil (Section A.2.2.5) and have been shown not to have migrated more than a few inches in the last 50 years (Section 2.5), there is no potential for groundwater to be impacted by CSII releases. Therefore, migration to groundwater is not considered to be a viable pathway in the CSM.

Mechanical disturbance and redistribution of contaminated surface and/or subsurface soil is another likely migration pathway/transport mechanism at the site. Documented post-test operations involved the collection and burial of surface soil and debris immediately following the CSII test, excavation of metal debris months after burial, removal of topsoil for construction of an equipment and material staging area, and scraping of contaminated surface soil in support of a technology demonstration project. These post-test activities are further discussed in Sections 2.4.2, 2.4.4, 2.4.5, and 2.4.7.

Migration is influenced by the chemical characteristics of the contaminants and the physical characteristics of the vadose zone material. The contaminant characteristics of the major contaminants that contribute to dose (Pu and Am) are very low solubility and very high adsorption potential. In general, these contaminants with low solubility and high affinity for media, are expected to be found relatively close (horizontally and vertically) to release points. That is, these contaminants tend to adhere to soil and do not readily move. Based on historical soil profile data collected in the 1970s (Essington et al., 1976; Gilbert et al., 1975) and 1990s (NNSA/NSO, 2004), it is estimated that 90 percent of the Pu activity is present in the top 5 cm of soil at CAU 413.

A.2.2.7 Exposure Scenario

In consultation with stakeholders, a CW land use scenario was determined applicable to the CAU 413 site (Cornish, 2014). This scenario assumes primarily outdoor construction activities that may include road construction/maintenance, underground utilities excavation, and/or target or other structure placement in the vicinity of CAU 413. The most exposed individual in this scenario is defined as an adult construction worker who works at the site for 120 day/yr, 8 hr/day, for a total of 960 hr/yr. The construction worker spends an average of 6 hr/day outdoors, and 2 hr/day indoors during the work day. The worker is exposed to surface soil, and subsurface soil to 0.45 m bgs to account for the placement of structure footers and/or building foundations. The worker receives an internal dose through incidental ingestion of surface and subsurface soil and inhalation of soil particulates and an external dose through dermal contact (absorption) with soil and debris or by external irradiation. Dermal exposure to soil and debris is limited to the face, hands, and forearms. It is assumed the construction worker does not obtain drinking water from the site.

A.3.0 Step 2 - Identify the Goal of the Study

Step 2 of the DQO process states how environmental data will be used in meeting objectives and solving the problem, identifies study questions or decision statement(s), and considers alternative outcomes or actions that can occur upon answering the question(s).

A.3.1 Decision Statements

The Decision I statement is as follows: "Does any location exceed the FALs?" For a judgmental sampling design (i.e., biased sampling), any analytical result for a COPC above the FAL will result in that COPC being designated as a COC. For a probabilistic sampling design (i.e., unbiased sampling), any COPC that has a 95 percent UCL of the average concentration above the FAL will result in that COPC being designated as a COC. A COC may also be defined as a contaminant that, in combination with other like contaminants, is determined to jointly pose an unacceptable risk based on a multiple contaminant analysis (NNSA/NFO, 2014). If a COC is detected, then Decision II must be resolved.

The Decision II statement is as follows: "Is there sufficient information to evaluate potential CAAs?" Sufficient information is defined to include the following:

- The lateral and vertical extent of contamination at levels exceeding the FAL
- The information needed to estimate potential remediation waste types and volumes

For radiological contaminants, the presence of contamination at levels exceeding the FAL is defined as the condition where the most exposed worker has the potential to receive a TED of at least 25 mrem/yr.

For SG1, Undisturbed Areas, the DQO process resulted in an assumption that TED within the CA fence exceeds the FAL. It was also assumed for SG5, Buried Debris, and SG6, Ejected Debris, that the contaminated debris and associated soil exceeds the FALs. Thus, Decision I for these releases is resolved, and Decision II must be evaluated for each.

If sufficient information is not available to evaluate potential CAAs, then site conditions will be reevaluated and additional samples will be collected (as long as the scope of the investigation is not exceeded and any CSM assumption has not been shown to be incorrect).

A.3.2 Alternative Actions to the Decisions

The following subsections identify actions that may be taken to resolve the DQO decisions depending on the possible outcomes of the investigation.

A.3.2.1 Alternative Actions to Decision I

If the FALs are not exceeded at any study group, then further assessment of the study group is not required. If the FALs are exceeded at any study group, then the extent of COC contamination will be defined according to the criteria established in Section A.4.1, and potential remediation waste types will be identified for that study group.

A.3.2.2 Alternative Actions to Decision II

If the lateral and vertical extent of COC contamination have not been defined for radiological contamination, then additional samples will be collected until a coefficient of determination (or r^2) greater than 0.8 can be established between TED values and radiation survey values. If a valid correlation cannot be established using this criterion, the lateral and vertical extent of COC contamination will be defined by bounding locations where the TED is less than the FAL. If sample analytical results are not sufficient to predict potential remediation waste types, then additional waste characterization samples will be collected. If available information is not sufficient to evaluate the potential for migration of COC contamination beyond the corrective action boundary or to evaluate potential CAAs, then additional information will be collected. Otherwise, collection of additional information is not required.

A.4.0 Step 3 - Identify Information Inputs

Step 3 of the DQO process identifies the information needed, determines sources for information, and identifies sampling and analysis methods that will allow reliable comparisons with FALs.

A.4.1 Information Needs

To resolve Decision I, samples will be collected and analyzed in accordance with the following criteria:

- Samples must be collected in areas most likely to contain a COC.
- Samples must properly represent contamination at the sampled location.
- The analytical suite selected must be sufficient to identify any COCs present in the samples.

The extent of COC contamination (Decision II) will be determined using one of the following methods:

- **Method 1.** TED rates need to be established at locations where the TED values bound the FAL dose rate and provide sufficient information to establish a coefficient of determination (or r^2) greater than 0.8 between TED values and radiation survey values. A boundary will then be determined around the radiation survey isopleth that correlates to the 25-mrem/yr FAL.

- **Method 2.** The lateral and vertical extent of COC contamination will be defined by sample results from locations contiguous to the contamination where TED or COC concentrations are less than the FAL.

- **Method 3.** The lateral and vertical extent of COC contamination will be defined by the entire lateral and vertical extent of a material with clearly identifiable physical properties that is assumed to be entirely contaminated at levels exceeding the FAL.

If additional information is needed to complete corrective actions, additional samples will be collected and analyzed.

A.4.2 Sources of Information

Information to satisfy Decision I and Decision II will be generated by collecting environmental samples. These samples will be submitted to analytical laboratories meeting the quality criteria stipulated in the Soils Activity QAP (NNSA/NSO, 2012b). TLDs will be submitted to the

Environmental Technical Services group at the NNSS, which is certified by the DOE Laboratory Accreditation Program for dosimetry. Only validated data from analytical laboratories will be used to make DQO decisions. Sample collection and handling activities will follow standard procedures.

A.4.2.1 Sample Locations

Design of the sampling approaches for the CAU 413 releases must ensure that the data collected are sufficient for selection of the CAAs (EPA, 2002). Samples collected should either be from locations that most likely contain a COC, if present (judgmental), or from locations that properly represent overall contamination at the study group (probabilistic). These sample locations, therefore, can be selected by means of either biasing factors used in judgmental sampling or randomly using a probabilistic sampling design. The implementation of a judgmental approach for sample location selection, and of a probabilistic sampling approach for CAU 413 are discussed in Section A.7.2.

A.4.2.2 Analytical Methods

Analytical methods are available to provide the data needed to resolve the decision statements. The analytical methods and laboratory requirements (e.g., precision, and accuracy) for soil samples are provided in the Soils Activity QAP (NNSA/NSO, 2012b).

A.5.0 Step 4 - Define the Boundaries of the Study

Step 4 of the DQO process defines the target population of interest and its relevant spatial boundaries, specifies temporal and other practical constraints associated with sample/data collection, and defines the sampling units on which decisions or estimates will be made.

A.5.1 Target Populations of Interest

The population of interest to resolve Decision I is contaminant concentrations exceeding a FAL at any location or area within the CAU. The populations of interest to resolve Decision II are as follows:

- For radiological contamination, TED and corresponding radiation survey values from locations where TED varies from above the FAL to below the FAL
- For chemical contamination, COC concentrations for each one of a set of locations bounding contamination in lateral and vertical directions
- Investigation waste and potential remediation waste characteristics

A.5.2 Spatial Boundaries

Spatial boundaries are the maximum lateral and vertical extent of expected contamination that can be supported by the CSM. These boundaries were agreed to in the DQO meeting with the CAU 413 stakeholders. The spatial boundaries for the three types of releases at the site are as follows:

- **SG1, Undisturbed Areas.** 4 in. (vertical), 4 mi (lateral)
- **SG2, Disturbed Areas.** 6 in. (vertical), 2 mi (lateral)
- **SG3, Sedimentation Areas.** Visual depth of sedimentation (vertical), 4 mi (lateral)
- **SG4, Former Staging Area.** 4 in. beneath fill material (vertical), 2 mi (lateral)
- **SG5, Buried Debris.** 10 ft (vertical), 400-ft radius from GZ (lateral)
- **SG6, PSM.** 4 in. (vertical), 1.5 mi (lateral)
- **SG7, Soil Mounds.** Visual extent above ground surface (vertical), visual extent of mound on surface (lateral)

Contamination identified beyond these boundaries may indicate a flaw in the CSM and may require reevaluation of the CSM before the investigation can continue.

A.5.3 Practical Constraints

No practical constraints that would prevent completion of CAI activities were identified at the CSII site. However, activities or site conditions that may delay investigation at the site include military activities at the TTR; weather (i.e., high winds, rain, lightning, extreme heat); and/or access restrictions.

A.5.4 Define the Sampling Units

The scale of decision making refers to the smallest, most appropriate area or volume for which decisions will be made. The scale of decision making for Decision I is defined as the release. A COC detected at any release site will cause the determination that the site is contaminated and needs further evaluation. The scale of decision making for Decision II is defined as a contiguous area contaminated with any COC originating from the release. Resolution of Decision II requires this contiguous area to be bounded laterally and vertically.

A.6.0 Step 5 - Develop the Analytic Approach

Step 5 of the DQO process specifies appropriate population parameters for making decisions, defines action levels, and generates a decision rule.

A.6.1 Population Parameters

Population parameters are defined for judgmental and probabilistic sampling designs in the following subsections. Population parameters are the parameters compared to action levels.

A.6.1.1 Judgmental Sampling Design

The judgmental design will be implemented as described in the Soils RBCA document (NNSA/NFO, 2014). For radiological contaminants, the population parameter is the calculated TED from each location. For chemical contaminants, the population parameter is the observed concentration of each contaminant from each individual analytical sample. Each sample result will be compared to the FALs to determine the appropriate resolution to Decision I and Decision II. A single sample result for any contaminant exceeding a FAL would cause a determination that a corrective action is required (for Decision I), or that the extent of COC contamination is not bounded (for Decision II).

A.6.1.2 Probabilistic Sampling Design

For probabilistic sampling results, the population parameter is the true TED over the area of the sample plot. Resolution of DQO decisions associated with the probabilistic sampling design requires determining, with a specified degree of confidence, whether the true TED at the site in question exceeds the FAL. Because a calculated TED is an estimate of the true (unknown) TED, it is uncertain how well the calculated TED represents the true TED. If the calculated TED were significantly different than the true TED, a decision based on the calculated TED could result in a decision error. To reduce the probability of making a false-negative decision error, a conservative estimate of the true TED is used to compare to the FAL instead of the calculated TED. This conservative estimate (overestimation) of the true TED will be calculated as the 95 percent UCL of the average TED values (Section 4.1). By definition, there will be a 95 percent probability that the true TED is less than the 95 percent UCL of the calculated TED.

For Decision I, the 95 percent UCL will be used to compare with the FAL. For Decision II, the 95 percent LCL of the regression will be used to determine the radiological survey value that corresponds to 25 mrem/yr of TED. The computation of appropriate confidence limits will be accomplished as described in the Soils RBCA document (NNSA/NFO, 2014).

A.6.2 Action Levels

The PALs presented in this section are to be used for site screening purposes. They are not necessarily intended to be used as cleanup action levels or FALs. However, they are useful in screening out contaminants that are not present in sufficient concentrations to warrant further evaluation, thereby streamlining the consideration of remedial alternatives.

The FALs will be established using the RBCA process described in the Soils RBCA document (NNSA/NFO, 2014). This process conforms with NAC 445A.227, which lists the requirements for sites with soil contamination (NAC, 2014a). For the evaluation of corrective actions, NAC 445A.22705 (NAC, 2014b) requires the use of ASTM Method E1739 (ASTM, 1995) to "conduct an evaluation of the site, based on the risk it poses to public health and the environment, to determine the necessary remediation standards or to establish that corrective action is not necessary." For the evaluation of corrective actions, the FALs are established as the necessary remedial standard. The definition of the FALs, the comparison of laboratory results to the FALs, and the evaluation of potential corrective actions will be included in the CAU 413 CADD.

A.6.2.1 Chemical PALs

Except as noted herein, the chemical PALs are defined as the Region 9 Regional Screening Levels for chemical contaminants in industrial soils (EPA, 2015a). Background concentrations for RCRA metals will be used instead of screening levels when natural background concentrations exceed the screening level. Background is considered the average concentration plus two standard deviations of the average concentration for sediment samples collected by the Nevada Bureau of Mines and Geology throughout the NTTR (formerly the Nellis Air Force Range) (NBMG, 1998; Moore, 1999). For detected chemical COPCs without established screening levels, the protocol used by EPA Region 9 in establishing screening levels (or similar) will be used to establish PALs. If used, this process will be documented in the investigation report.

A.6.2.2 Radiological PAL

The radiological PAL is based on the guidelines for residual concentration of radionuclides in DOE Order 458.1 (DOE, 2013) and the exposure scenario developed by DOE, NDEP, and USAF. The PAL for the CSII site is a TED of 25 mrem/yr, based upon the CW exposure scenario, which is summarized in Section A.2.2.7. The TED is calculated as the sum of external dose and internal dose. External dose is calculated from TLD measurements; internal dose is determined by converting analytical results from soil samples using RRMGs that were established using the RESRAD computer code (Yu et al., 2001). Internal dose estimates could be further refined through the use of air sampling to estimate inhalation dose. The RRMG is the value, in picocuries per gram of surface soil, for a particular radionuclide that would result in an internal dose of 25 mrem/yr to a receptor (under the appropriate exposure scenario) independent of any other radionuclide (assuming that no other radionuclides contribute dose). The input parameters used in the RESRAD calculation of RRMGs for the CW exposure scenario are presented in Appendix C. The calculated RRMGs for the CW scenario are presented in Appendix D.

The nature of the CSII test resulted in the dispersion of radionuclides, a portion of which are in the form of “removable contamination.” Removable contamination is defined as radioactive material that can be removed from surfaces by nondestructive means, such as casual contact, wiping, brushing, or washing (NNSA/NSO, 2012a). The RBCA dose evaluation process does not address the potential for removable contamination under different exposure scenarios to be transported to other areas. In order to ensure that removable contamination is accounted for during FFACO site closure, removable contamination levels will be compared to the HCA criterion of 2,000 dpm/100 cm^2 alpha contamination. The HCA criterion is a numeric threshold for removable alpha contamination that is used in the DOE Occupational Radiation Protection Program (CFR, 2015) to determine area posting requirements. For removable contamination, it is assumed that if this threshold is exceeded, the dose-based FAL is also exceeded and corrective action is required. Thus, in order to determine whether corrective action is necessary at CAU 413, radiological dose as well as removable contamination levels must be considered. A discussion on the risks associated with removable radioactive contamination is presented in the Soils RBCA document (NNSA/NFO, 2014).

A.6.3 Decision Rules

The decision rule applicable to both Decision I and Decision II is as follows:

- If contamination levels are inconsistent with the CSM or extends beyond the spatial boundaries identified in Section A.5.2, then work will be suspended and the investigation strategy will be reconsidered, else the decision will be to continue sampling.

The decision rules for Decision I are as follows:

- If the population parameter of any COPC in the Decision I population of interest (defined in Step 4) exceeds the corresponding FAL, then Decision II will be resolved and a corrective action will be determined, else no further action will be necessary for that COPC in that population.
- If a waste is present that, if released, has the potential to cause future soil contamination at levels exceeding a FAL, then a corrective action will be determined, else no further action will be necessary.

The decision rule for Decision II is as follows:

- If the spatial extent of any COC has not been defined, then additional samples will be collected, else no further investigation will be necessary. If sufficient information is not available to determine potential remediation waste types and evaluate the feasibility of remediation alternatives, additional waste characterization samples will be collected, else no further investigation will be necessary.

A.7.0 Step 6 - Specify Performance or Acceptance Criteria

Step 6 of the DQO process defines the decision hypotheses, specifies controls against false rejection and false acceptance decision errors, examines consequences of making incorrect decisions from the test, and places acceptable limits on the likelihood of making decision errors.

The sampling design for the sample plots includes elements of both judgmental and probabilistic sampling. Each sample plot location is selected based on biasing factors (i.e., results of aerial and ground-based radiological surveys) which is typical of a judgmental sampling approach. The sample design within the sample plot is probabilistic in nature because the sample locations within the plot are free from bias, and the objective is to characterize the 100-m^2 area of the sample plot (as opposed to a single sample location). This combination of judgmental and probabilistic approaches results in data upon which the DQO decisions for the sample plot as a whole are based.

A.7.1 Decision Hypotheses

The baseline condition (i.e., null hypothesis) and alternative condition for Decision I are as follows:

- **Baseline condition.** A COC is present.
- **Alternative condition.** A COC is not present.

The baseline condition (i.e., null hypothesis) and alternative condition for Decision II are as follows:

- **Baseline condition.** The extent of a COC has not been defined.
- **Alternative condition.** The extent of a COC has been defined.

Decisions and/or criteria have false-negative or false-positive errors associated with their determination. The impact of these decision errors and the methods that will be used to control these errors are discussed in the following subsections. In general terms, confidence in DQO decisions based on judgmental sampling results will be established qualitatively by the following:

- Developing a CSM that is agreed to by decision maker participants during the DQO process.
- Testing the validity of the CSM based on investigation results.
- Evaluating the quality of data based on DQI parameters.

A.7.2 False-Negative Decision Error

The false-negative decision error would mean deciding that a COC is not present when it actually is (Decision I), or deciding that the extent of a COC has been defined when it has not (Decision II). In both cases, the potential consequence is an increased risk to human health and environment.

For the CSII CAI, the sampling design includes elements of both judgmental and probabilistic sampling. Each sample plot location is selected based on radiological biasing factors (i.e., results of aerial and ground-based radiological surveys), which is typical of a judgmental sampling approach. The sample design of the sample plot itself is probabilistic in nature because the sample locations within the plot are random (i.e., non-biased) and the objective is to characterize the 100-m^2 area of the sample plot (as opposed to a single sample location). This combination of judgmental and probabilistic approaches results in data upon which the DQO decisions for the site as a whole are based.

A.7.2.1 False-Negative Decision Error for Judgmental Sampling

In judgmental sampling, the selection of the number and location of samples is based on knowledge of the feature or condition under investigation and on professional judgment (EPA, 2002). Judgmental sampling conclusions about the target population depend upon the validity and accuracy of professional judgment.

The false-negative decision error (where consequences are more severe) for judgmental sampling designs is controlled by meeting these criteria:

- For Decision I, having a high degree of confidence that the sample locations selected will identify a COC if present anywhere within the release. For Decision II, having a high degree of confidence that the sample locations selected will identify the extent of a COC.
- Having a high degree of confidence that analyses conducted will be sufficient to detect any COC present in the samples.
- Having a high degree of confidence that the dataset is of sufficient quality and completeness.

To satisfy the first criterion, Decision I samples must be collected in areas most likely to be contaminated by a COC (supplemented by unbiased samples where appropriate). A biased sampling strategy will be used to target areas with the highest potential to contain a COC, if it is present anywhere in the release. Sample locations will be determined based on process knowledge, previously acquired data, or the field-screening and biasing factors listed in Section A.4.2.1.

Decision II samples must be collected in areas that represent the lateral and vertical extent of contamination. The following characteristics must be considered to control decision errors for the first criterion:

- Source and location of release
- Chemical nature and fate properties
- Physical transport pathways and properties
- Hydrologic drivers

These characteristics were considered during the development of the CSM and selection of sampling locations.

For grab sample locations, individual sample results, rather than an average concentration, will be used to compare to FALs. Adequate representativeness of the entire target population may not be a requirement in developing a sampling design. If good prior information about the target site of interest is available, then the sampling may be designed to collect samples only from areas known to have the highest concentration levels on the target site. If the observed concentrations from these samples are below the action level, then a decision can be made that the site contains safe levels of the contaminant without the samples being truly representative of the entire area (EPA, 2006).

The field-screening methods and biasing factors (see Section A.8.6) will be used to further ensure that appropriate sampling locations are selected to meet these criteria. The investigation report will present an assessment on the DQI of representativeness that samples were collected from those locations that best represent the populations of interest as defined in Section A.5.1.

To satisfy the second criterion, Decision I soil samples will be analyzed for the radiological parameters listed in Section 3.2. Decision II soil samples will be analyzed for unbounded COCs. The DQI of sensitivity will be assessed for all analytical results to ensure that all sample analyses had measurement sensitivities (detection limits) that were less than or equal to the corresponding FALs. If this criterion is not achieved, the affected data will be assessed (for usability and potential impacts on meeting site characterization objectives) in the investigation report.

To satisfy the third criterion, the entire dataset of soil sample results, as well as individual soil sample results, will be assessed against the DQIs of precision, accuracy, comparability, and completeness as defined in the Soils Activity QAP (NNSA/NSO, 2012b). The DQIs of precision and accuracy will be used to assess overall analytical method performance as well as to assess the need to potentially qualify individual contaminant results when corresponding QC sample results are not within the established control limits for precision and accuracy. Data qualified as estimated for reasons of precision or accuracy may be considered to meet the analyte performance criteria based on an assessment of the data. The DQI for completeness will be assessed to ensure that all data needs identified in the DQO have been met. The DQI of comparability will be assessed to ensure that all analytical methods used are equivalent to standard EPA methods so that results will be comparable to regulatory action levels that have been established using those procedures. Strict adherence to established procedures and QA/QC protocol protects against false negatives.

To provide information for the assessment of the DQIs of precision and accuracy, the following QC samples will be collected:

- FDs (1 per 20 grab [judgmental] environmental samples, or 1 per CAU if less than 20 collected)

A.7.2.2 False-Negative Decision Error for Probabilistic Sampling

The false-negative decision error rate goal was established by the DQO meeting participants at 5 percent. Upon validation of the analytical results, statistical parameters will be calculated for each significant COPC identified at each site. Protection against a false-negative decision error is contingent upon the following:

- Population distribution
- Sample size
- Actual variability
- Measurement error

Control of the false-negative decision error for probabilistic sampling designs is accomplished by ensuring that the following requirements are met for each of the significant COPCs:

- A sufficient sample size was collected.
- The actual standard deviation is calculated.
- Analyses conducted were sufficient to detect contamination exceeding FALs.

A.7.3 False-Positive Decision Error

The false-positive decision error would mean deciding that a COC is present when it is not, or a COC is unbounded when it is not, resulting in increased costs for unnecessary sampling and analysis.

False-positive results are typically attributed to laboratory and/or sampling/handling errors that could cause cross contamination. To control against cross contamination, decontamination of sampling equipment will be conducted in accordance with established and approved procedures, and only clean sample containers will be used. To determine whether a false-positive analytical result may have occurred, the following QC samples will be collected:

- Trip blanks (1 per sample cooler containing VOC environmental samples)
- Equipment blanks (1 per VOC sampling event)
- Source blanks (1 per uncharacterized source lot per lot)

For probabilistic sampling, false-positive decision error rate goal was established by the DQO meeting participants at 0.20 (or 20 percent probability). Protection against this decision error is also afforded by the controls listed in Section A.7.2 for probabilistic sampling designs.

A.8.0 Step 7 - Develop the Plan for Obtaining Data

Step 7 of the DQO process selects and documents a design that will produce data that exceeds performance or acceptance criteria. The sampling design for the CSII CAI site includes collection of soil, TLD, and removable radioactive contamination samples. The location of samples will be selected and evaluated judgmentally, and the soil samples collected within the sample plots will be collected and evaluated probabilistically. Samples of PSM or soil potentially impacted by PSM will be collected judgmentally, based on visual and/or radiological biasing factors. Investigation results will be compared to FALs to determine the need for corrective action.

To facilitate site investigation and the evaluation of DQO decisions, the releases at CAU 413 have been divided into seven study groups presented in Table 1-1. The study groups are summarized in the following subsections and described in detail in Section 2.4.

A.8.1 SG1, Undisturbed Areas

SG1 includes those areas not impacted by post-test operations. It is assumed that contamination from the CSII test deposited on the ground surface at these locations has not been mechanically disturbed since the time of the test.

A.8.1.1 Decision I

As agreed to in the DQO meeting with the CAU 413 stakeholders, it is assumed that the dose-based FAL is exceeded in SG1. Thus, Decision I is resolved (i.e., COCs are present at the site), and Decision II must be addressed.

Removable contamination data will be collected during the CAI from random locations at the soil sample plots located inside the CA fence. These data, combined with removable contamination data from previous investigations, will be compared to the HCA criterion to determine whether corrective action is necessary.

A.8.1.2 Decision II

Soil sample plots and TLDs will be placed to determine the extent of COCs that exceed the FAL of 25 mrem/yr using the CW exposure scenario. Sample locations were selected using the 1996 KIWI survey results and available FIDLER data. These radiation survey data were reviewed to identify sample locations that present varying dose levels. Using a range of dose levels is recommended to establish a correlation of dose to radiation survey values, as explained in the Soils RBCA document (NNSA/NSO, 2014). A minimum of nine soil sample plots will be established in areas of varying contamination levels identified by the KIWI and FIDLER surveys. Where possible, locations were selected outside drainage channels (SG3), away from the burial area near GZ (SG5), and outside disturbed areas (SG2). The proposed sample location closest to GZ, however, is located within the 800-ft diameter area that is presumed to have been disturbed after the CSII test. The proposed sample locations are presented in Figure A.8-1.

Sample Plots. The probabilistic sampling scheme will be implemented to select sample locations within each sample plot. Randomly selected subsample locations will be based on a random start, triangular pattern (NNSA/NFO, 2014). If sufficient sample material cannot be collected at a specified location, the Site Supervisor will establish the location at the nearest place that a surface sample can be obtained. Composite samples will be collected at each sample plot in the following manner:

- Four composite samples will be collected from each sample plot.
- Each composite sample will be composed of nine subsamples taken from randomly selected locations within each plot. These locations will be predetermined using a random start with a triangular grid pattern (Figure A.8-2).
- The entire volume of the composited material collected will be submitted to the laboratory for analysis. Soil samples will be analyzed for isotopic Pu, isotopic Am, isotopic U, Pu-241 and gamma spectroscopy.

TLDs. One TLD will be placed at the approximate center of each sample plot at a height of approximately 1 m (3.3 ft). TLD processing will follow the protocols established in *Nevada Test Site Routine Radiological Environmental Monitoring Plan* (BN, 2003). TLDs will be left in place for a targeted total exposure time of 2,000 hours, or the resulting data will be adjusted to be equivalent to an exposure time of 2,000 hours.

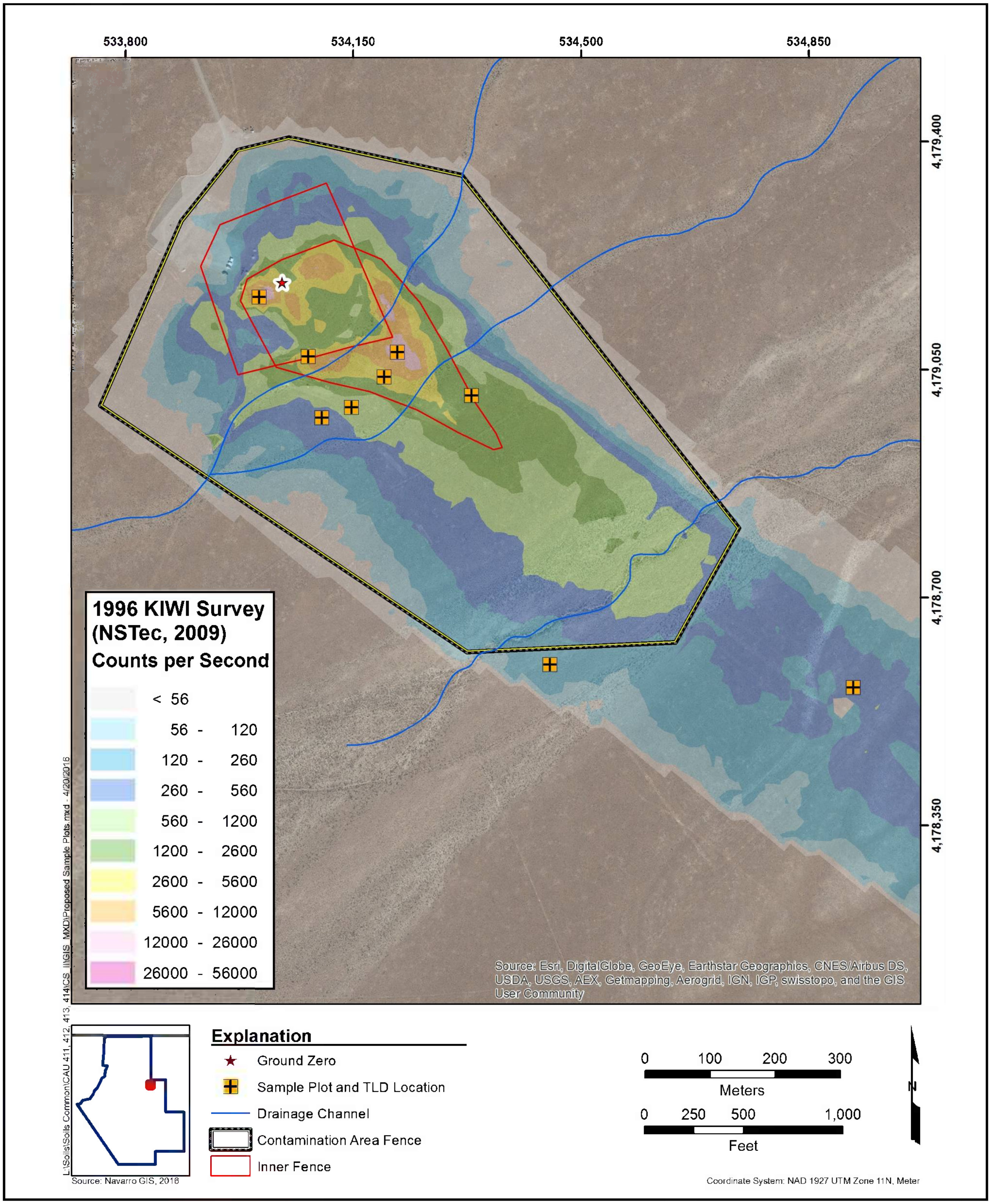


Figure A.8-1
Sample Plot and TLD Locations for SG1, Undisturbed Areas

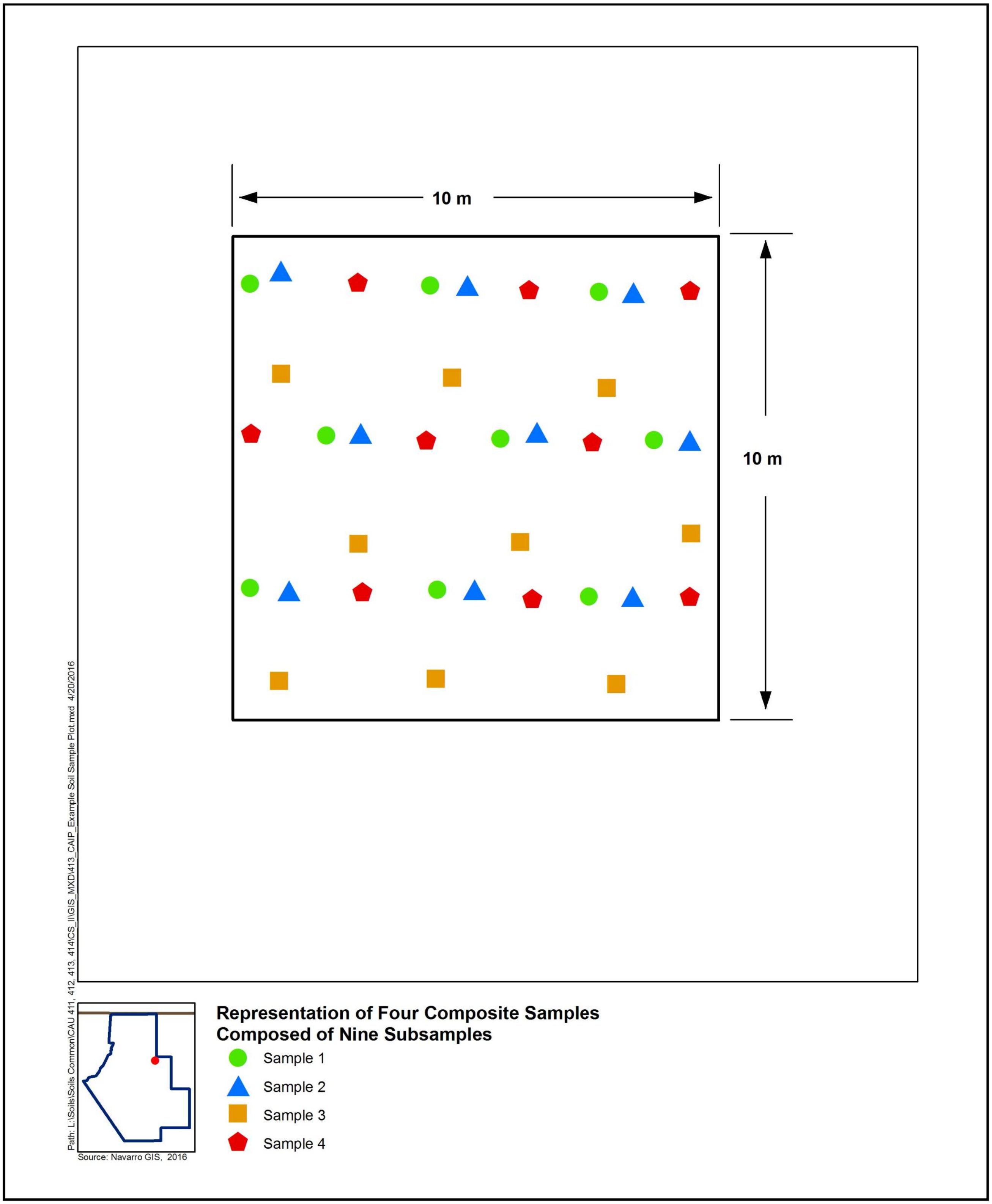


Figure A.8-2
Sample Plot Subsample Locations

A.8.2 SG2, Disturbed Areas

SG2 includes those locations where it is likely that contamination originally deposited by the test was redistributed by activities that occurred immediately after, and in the years following, the test (e.g., post-test cleanup, technology demonstration project). Five such areas were identified at CAU 413 using historical information and aerial photographs.

A.8.2.1 Decision I

The presence and nature of contamination decision (Decision I) will be a judgmental decision determined using sample results from biased locations under a judgmental sampling design. individual sample results, rather than an average concentration, will be used to compare to FALs. Therefore, statistical methods to generate site characteristics will not be needed.

The primary concern at SG2 is whether mechanical movement of contaminated soil resulted in the vertical redistribution of contamination at the site (i.e., surface contamination was mixed into the subsurface). To determine whether COCs are present below the ground surface (0 to 5 cm), one sample location will be evaluated within each of the five areas (Figure A.8-3). It is assumed that the mechanical disturbance in each of the areas (e.g., scraping or grading) was relatively uniform, so that the redistribution of contamination would not be preferential. The 1996 KIWI survey was used to bias the sample location within the 800-ft-diameter circular area surrounding GZ to the location of highest surface radiation. This location coincides with one of the proposed sample plot/TLD locations discussed in Section A.8.1.2. Sample locations at the other four areas were selected using the 2012 FIDLER survey results, as it is likely these four areas were disturbed in 1998 (i.e., two years after completion of the KIWI survey). The 2012 FIDLER data are limited, so where no survey data were available, the sample location was placed in the approximate center of the area. The judgmental sample locations may need to be modified during the CAI based on field conditions, but only if the modified locations meet the decision needs and criteria stipulated in these DQOs.

In order to determine whether buried contamination exists, samples will be screened and submitted for analysis as follows:

- At each sample location, a sample will be collected from each 5-cm depth interval up to 30 cm bgs or until native material is encountered.

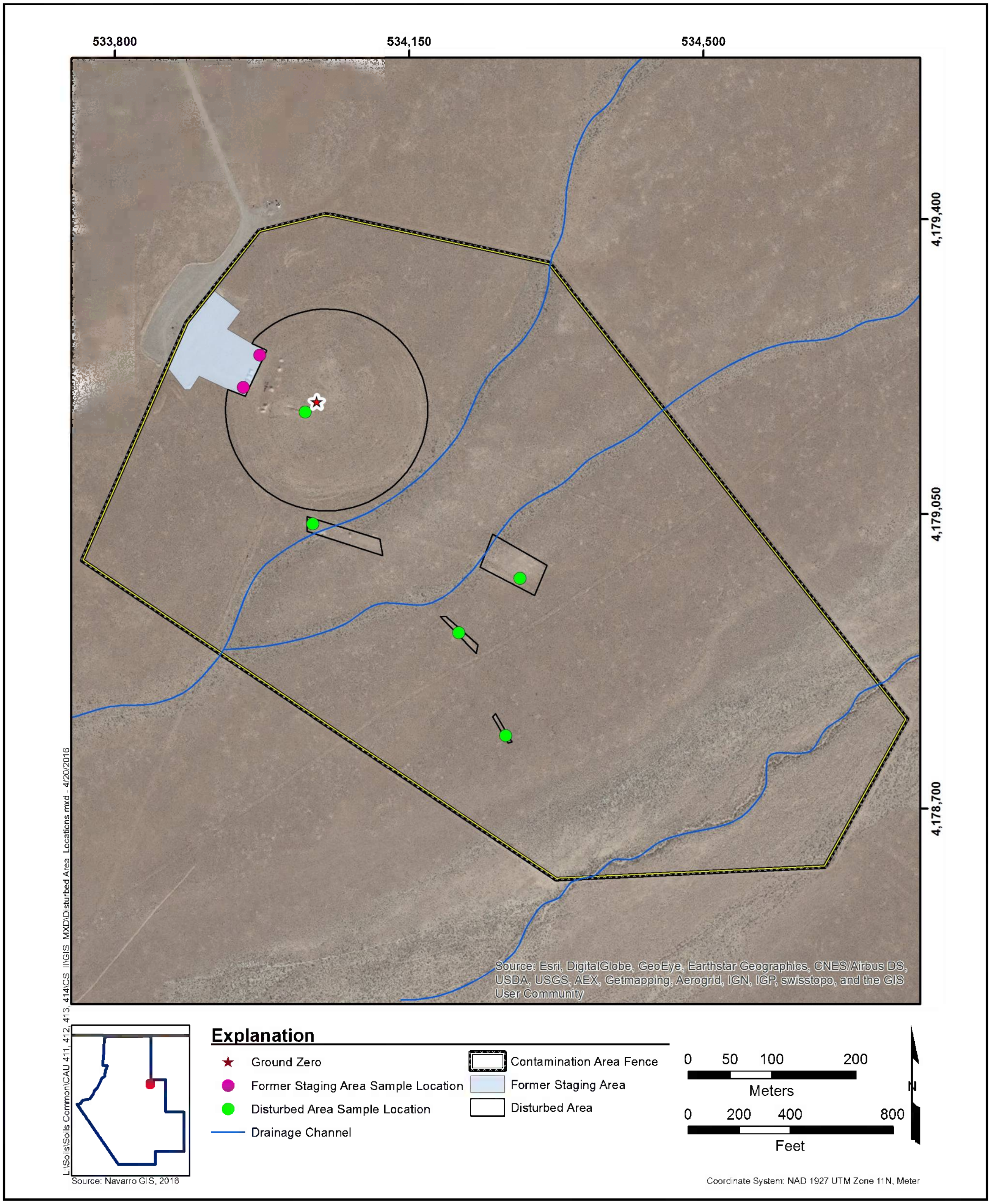


Figure A.8-3
Sample Locations for SG2, Disturbed Areas; and SG4, Former Staging Area

- Each sample will be field screened with an alpha/beta detection instrument and compared to the established background FSL for the site.
- If the depth sample with the highest FSR is greater than the FSL, but not significantly different (at least 20 percent difference) than the FSR of the surface sample, then only the surface sample will be submitted for analysis. If the FSR is greater than the FSL and greater than 20 percent higher than the surface sample, then both the surface sample and the depth sample with the highest FSR will be submitted for analysis.
- If the FSL is not exceeded in any depth sample, then only the surface sample will be submitted for analysis.

Soil samples from SG2 will be analyzed for gamma spectroscopy, isotopic Pu, isotopic Am, isotopic U, and Pu-241.

If buried contamination is encountered, a TLD-equivalent external dose will be calculated for the subsurface sample by establishing a correlation between RESRAD-calculated external dose from surface samples and the RESRAD-calculated external dose from the subsurface samples. The surface TLD reading will be adjusted by this proportion to estimate a TLD-equivalent external dose for the subsurface soil as described in the Soils RBCA document (NNSA/NFO, 2014). The highest TED from either surface or subsurface samples will be used to resolve DQO decisions for this study group.

A.8.2.2 Decision II

If buried contamination in excess of the FALs is present at any of the disturbed areas, it will be assumed that the entire visibly disturbed area contains buried contamination in excess of the FALs.

A.8.3 SG3, Sedimentation Areas

SG3 consists of sedimentation areas within drainage channels or surface water conveyances where sediment has visibly accumulated. These channels may serve as transport mechanisms for contamination originally deposited on the ground surface during the CSII test. The potential also exists for contamination in these accumulation areas to have been buried over time by subsequent erosion events.

A.8.3.1 Decision I

The presence and nature of contamination decision (Decision I) will be determined using sample results from biased locations under a judgmental sampling design. Aerial photographs and visual surveys at the site were used to identify three major drainage channels that transect the CA fence at CAU 413. Two of the channels flow south of GZ and converge at the CA fence line; the third channel is just north of the southern extent of the CA fence (Figure 2-2).

The three drainage channels will be visually surveyed to locate sedimentation areas within and outside the CA fence. A minimum of two areas in each drainage channel within the CA fence and two areas in each drainage channel outside the fence will be sampled. The drainage sample locations inside the CA fence will be selected outside and downgradient of the 25-mrem/CW-yr boundary established using the soil sample and TLD data. The first and second visible accumulation areas downgradient of the boundary will be sampled. The two locations in each drainage channel located outside the CA fence will be the two closest sediment accumulation areas to the fence. The purpose of sampling at these locations is to determine whether contaminants are migrating outside the radiologically controlled area (i.e., the CA fence). Within each sedimentation area, a FIDLER survey will be conducted and the sample location selected at the highest radiological reading. The sample location at each sedimentation area will be the center of the area. Samples from SG3 will be analyzed for gamma spectroscopy, isotopic Pu, isotopic Am, isotopic U, and Pu-241. One TLD will also be placed at each drainage sample location.

At each sample location, samples will be screened for buried contamination using the method described in Section A.8.2.1. If buried contamination is encountered, a TLD-equivalent external dose will be calculated for the subsurface sample by establishing a correlation between RESRAD-calculated external dose from surface samples and the RESRAD-calculated external dose from the subsurface samples. The surface TLD reading will be adjusted by this proportion to estimate a TLD-equivalent external dose for the subsurface soil as described in the Soils RBCA document (NNSA/NFO, 2014). The highest TED from either surface or subsurface samples will be used to resolve DQO decisions for this study group.

A.8.3.2 Decision II

If a COC is found in a sediment accumulation area, additional sedimentation areas will be sampled until at least two consecutive, downgradient sedimentation areas are found that do not contain a COC. Decision II will be resolved by the assumption that the entire volume of sediment where a COC was identified is contaminated above the FAL.

A.8.4 SG4, Former Staging Area

SG4 consists of a Former Staging Area located northwest of GZ (Figure 2-2), which is a visibly distinct area of fill material. Before construction of this area in the 1990s, the upper layer of native soil was removed, and the pad was then covered with gravel and compacted (NNSA/NSO, 2004). The Former Staging Area is defined as the area of fill located inside the CA fence; the area of fill material outside the CA fence is not part of the study group (Section 2.4.4).

A.8.4.1 Decision I

In order to confirm that radioactive contamination is no longer present beneath the pad, soil samples will be collected at two locations within the pad footprint inside the CA fence. The two locations were selected on the edge of the pad, closest to the GZ area (Figure A.8-3). At each location, fill material will be removed until native soil is encountered and a grab sample will be collected of the native soil from 0 to 5 cm. The soil samples from the Former Staging Area will be analyzed for gamma spectroscopy, isotopic Pu, isotopic Am, isotopic U, and Pu-241.

A.8.4.2 Decision II

If COCs are detected at either of the Former Staging Area sample locations, the extent of contamination will be defined as the footprint of the fill area inside the CA fence. That is, it will be assumed that soil underneath the Former Staging Area is contaminated above the FAL.

A.8.5 SG5, Buried Debris

This study group includes the contaminated debris and soil that were buried at GZ after the CSII test. Historical documents indicate that after the detonation, contaminated debris (e.g., concrete, metal) and fragments scattered out to a radius of 1,500 to 2,500 ft were collected and buried at GZ

(AEC/NVOO, 1964; Burnett et al., 1964). In addition, several inches of contaminated soil was scraped from the GZ area and buried. The approximate lateral extent of the buried debris area is shown on Figure 2-3.

A.8.5.1 Decision I

As agreed to in the DQO meeting with the CAU 413 stakeholders, it is assumed that the contaminated debris and soil buried in the GZ area exceeds the dose-based FAL. Thus, Decision I is resolved (i.e., COCs are present at the site), and Decision II must be addressed.

A.8.5.2 Decision II

To define the vertical and lateral extent of the buried debris release, electromagnetic surveys will be conducted in the GZ area at the suspected location of the burial mound. These data will be reviewed in conjunction with the geophysical survey data collected during 1996 site characterization activities (Section 2.5.5.4) to estimate the volume and extent of buried debris and soil.

A.8.6 SG6, PSM

PSM is defined as a material present at a site that contains radiological or chemical contaminants that, if released, could cause the surrounding environmental media to contain a COC (NNSA/NFO, 2014). This study group includes existing PSM identified through historical documents and verified in previous site visits (see Section 2.4.6) and PSM not yet identified (e.g., historic spills, drums) that may be discovered during the CAI.

Sample locations for PSM will be determined based upon the likelihood of a contaminant release and the presence of the following biasing factors:

- *Stains.* Any spot or area on the soil surface that may indicate the presence of a potentially hazardous liquid.
- *Radiological survey anomalies.* Radiological survey results that are significantly higher than the surrounding area.
- *Drums, containers, equipment, or debris.* Materials that contain or may have contained hazardous or radioactive substances.

- *Lithology*. Locations where variations in lithology (soil or rock) indicate that different conditions or materials exist.
- *Preselected areas based on process knowledge of the site*. Locations for which evidence such as historical photographs, experience from previous investigations, or input from interviewee(s) suggests that a release of hazardous or radioactive substances may have occurred.
- Visual indicators such as discoloration, textural discontinuities, disturbance of native soils, or any other indication of potential contamination.
- *Other biasing factors*. Factors not previously defined that become evident during the CAI.

PSM sample results will be evaluated against the criteria listed in the Soils RBCA document (NNSA/NFO, 2014) to determine the need for corrective action.

A.8.6.1 Decision I

Samples of PSM or soil potentially impacted by PSM may be collected based on visual and/or radiological biasing factors. Sample locations will be determined based on process knowledge, previously acquired data, or the field-screening and biasing factors listed in this section. If there is a potential for the soil to contain a COC, a grab soil sample(s) may be collected directly underneath the debris or a composite soil sample(s) of the impacted area may be collected. If biasing factors are present in soils below locations where Decision I samples were removed, additional Decision I soil samples will be collected at depth intervals based on biasing factors to a depth where the biasing factors are no longer present. Judgmental sample locations may need to be modified based on field conditions, but only if the modified locations meet the decision needs and criteria stipulated in these DQOs. Sample analyses may be determined based on the biasing factors present and the type of PSM and will be justified in the CADD.

A.8.6.2 Decision II

If PSM is identified visually, the extent of the PSM will be defined as the physical extent of the PSM (e.g., debris). If biasing factors exist, Decision II judgmental samples will be collected from locations where PSM was identified. In general, sample locations will be arranged in a triangular pattern around the area containing PSM at distances based on site conditions, process knowledge, and biasing factors. If a COC extends beyond the initial step-outs, Decision II samples will be collected from incremental step-outs. Initial step-outs will be at least as deep as the vertical extent of contamination defined at the Decision I location and the depth of the incremental step-outs will be based on the deepest contamination observed at any location within the release. A sample collected in each step-out direction (lateral or vertical) that does not exceed the FALs, will define extent of contamination in that direction.

A.8.7 SG7, Soil Mounds

This study group includes 10 visible soil mounds identified during previous investigations at the CSII site (Figure 2-3). It is likely that two of the mounds, located southwest of the Former Staging Area (SG4), were reserved for use in the revegetation of the CSII site after remediation. The other eight soil mounds are located west and south of GZ, and are believed to be associated with a technology demonstration project conducted at the CSII site in 1998. It is expected that radioactive contamination in the soil mounds will be equal to or less than, contaminant concentrations in surface soil at undisturbed areas of the site. That is, the soil mounds only contain contamination resulting from the CSII test. For the purposes of the CSM, it is assumed that the soil within each mound is homogenous.

A.8.7.1 Decision I

Six random subsamples will be collected from the surface (0 to 5 cm [0 to 2 in.]) of each mound and composited. One composite soil sample from the interior of each mound will also be collected to confirm the homogeneity of the mounds. For each mound, this sample will be collected at the same six random subsample locations at which the surface composite sample was collected, but at a depth of 15 to 30 cm (6 to 12 in.) below the surface of the mound. All soil mound samples will be analyzed for gamma spectroscopy, isotopic Pu, isotopic Am, isotopic U, and Pu-241. One TLD will be placed on each soil mound approximately 1 m (3.3 ft) from the top of the mound.

The highest TED from either surface or subsurface samples will be used to resolve Decision I. If a subsurface sample results in a higher internal dose than a surface sample, a TLD-equivalent external dose will be calculated for the subsurface sample in accordance with the Soils RBCA document (NNSA/NFO, 2014).

Removable contamination data will be collected during the CAI from random locations on the surface of each soil mound. These data will be compared to the HCA criterion of 2,000 dpm/100 cm^2. If the data exceeds this threshold, it will be assumed that the soil mound exceeds the 25-mrem/CW-yr FAL and corrective action is required.

A.8.7.2 Decision II

If a COC is detected in a soil mound, the extent of contamination is assumed to be the physical extent of the mound above the ground surface. Thus, Decision II extent of contamination decisions will be made for each individual soil mound.

A.9.0 References

AEC/NVOO, see Atomic Energy Commission, Nevada Operations Office.

ASTM, see ASTM International.

ASTM International. 1995 (reapproved 2015). *Standard Guide for Risk-Based Corrective Action Applied at Petroleum Release Sites*, ASTM E1739-95(2015). West Conshohocken, PA.

Atomic Energy Commission, Nevada Operations Office. 1964. *Project Manager's Report, Project Roller Coaster*. NVO-10. Prepared by Reynolds Electrical & Engineering Co., Inc. Las Vegas, NV.

BN, see Bechtel Nevada.

Bechtel Nevada. 2003. *Nevada Test Site Routine Radiological Environmental Monitoring Plan*, DOE/NV/11718--804. Prepared for the U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office. Las Vegas, NV.

Burnett, W.D., H.L. Rarrick, and G.E. Tucker, Jr. 1964. *Health Physics Aspects of Operation Roller Coaster,* SC-4973(RR). Albuquerque, NM: Sandia Corporation.

CFR, see *Code of Federal Regulations*.

Code of Federal Regulations. 2015. Title 10 CFR, Part 835, "Occupational Radiation Protection." Washington, DC: U.S. Government Printing Office.

Cornish, Col. B.R., U.S. Air Force, 99 ABW/CC. 2014. Letter to R. Boehlecke (NNSA/NFO) titled "Air Force Response to DOE Request to Close Five Radiological Sites on the NTTR," 2 May. Nellis AFB, NV.

DOE, see U.S. Department of Energy.

DOE/NV, see U.S. Department of Energy, Nevada Operations Office.

EPA, see U.S. Environmental Protection Agency.

Ekren, E.B., R.E. Anderson, C.L. Rogers, and D.C. Noble. 1971. *Geology of Northern Nellis Air Force Base Bombing and Gunnery Range, Nye County, Nevada*, Professional Paper 651. Washington, DC: U.S. Geological Survey.

French, R.H. 1983. "Precipitation in Southern Nevada." In *Journal of Hydraulic Engineering*, Vol. 109(7): pp. 1023–1036.

French, R.H. 1985. *Daily, Seasonal, and Annual Precipitation at the Nevada Test Site, Nevada* (Preliminary), DOE/NV/10384--01; Publication No. 45042. Las Vegas, NV: Desert Research Institute.

Leavitt, V.D. 1974. "Soil Surveys of Five Plutonium-Contaminated Areas on the Test Range Complex in Nevada." In *The Dynamics of Plutonium in Desert Environments*, NVO-142. pp. 21–27. July. P.B. Dunaway and M.G. White eds. Las Vegas, NV: Atomic Energy Commission, Nevada Operations Office.

Menker, H.E., J.C. Armstrong, J.D. Buchanan, E.J. Forslow, and B.H. Sorensen. 1966. *Operation Roller Coaster Project Officers Report–Project 5.2/5.3a, Radiochemical Analysis of Biological and Physical Samples*, POR-2515 (WT-2515). Palo Alto, CA: Hazleton-Nuclear Science Corp.

Mizell, S.A., V. Etyemezian, G. McCurdy, G. Nikolich, C. Shadel, and J. Miller. 2014. *Radiological and Environmental Monitoring at the Clean Slate I and III Sites, Tonopah Test Range, Nevada, With Emphasis on the Implications for Off-site Transport*, DOE/NV/0000939-19; Publication No. 45257. Las Vegas, NV: Desert Research Institute.

Moore, J., Science Applications International Corporation. 1999. Memorandum to M Todd (SAIC) titled "Background Concentrations for NTS and TTR Soil Samples," 3 February. Las Vegas, NV: IT Corporation.

Myers, Maj. R.L.M., Defense Atomic Support Agency. 1963. Letter to Distribution titled "Locations, Instrumentation, Sampling Times, Samples Counted and Other Pertinent Information for the CLEAN SLATE II Event, Operation ROLLER COASTER," 14 June. Albuquerque, NM: Sandia Base, Headquarters Field Command.

NAC, see *Nevada Administrative Code*.

Navarro GIS, see Navarro Geographic Information Systems.

NBMG, see Nevada Bureau of Mines and Geology.

N-I, see Navarro-Intera, LLC.

NNSA/NFO, see U.S. Department of Energy, National Nuclear Security Administration Nevada Field Office.

NNSA/NSO, see U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office.

NSTec, see National Security Technologies, LLC.

National Security Technologies, LLC. 2009. GIS Data Transmittal to U.S. Air Force, Product ID 20091029-01-P012-R04, 15 December. Las Vegas, NV.

Navarro Geographic Information Systems. 2015. ESRI ArcGIS Software.

Navarro-Intera, LLC. 2013. *Water and Solute Travel Time Analysis for Soils Corrective Action Units 375, 411, 412, 413, 414, and 415,* N-I/28091--076. Las Vegas, NV.

Nevada Administrative Code. 2014a. NAC 445A.227, "Contamination of Soil: Order by Director for Corrective Action; Factors To Be Considered in Determining Whether Corrective Action Required." Carson City, NV. As accessed at http://www.leg.state.nv.us/nac on 24 August 2015.

Nevada Administrative Code. 2014b. NAC 445A.22705, "Contamination of Soil: Evaluation of Site by Owner or Operator; Review of Evaluation by Division." Carson City, NV. As accessed at http://www.leg.state.nv.us/nac on 24 August 2015.

Nevada Bureau of Mines and Geology. 1998. *Mineral and Energy Resource Assessment of the Nellis Air Force Range*, Open-File Report 98-1. Reno, NV.

Schaeffer, J.R. 1968. *Climatology of Tonopah Test Range, 1967*, SC-M-68-522. Albuquerque, NM: Sandia Corporation.

Sheppard, M.I., and D.H. Thibault. 1990. "Default Soil Solid/Liquid Partition Coefficients, K_ds, for Four Major Soil Types: A Compendium." In *Health Physics*, Vol. 59(4): pp. 471–482.

U.S. Department of Energy. 1997. *The Procedures Manual of the Environmental Measurements Laboratory*, HASL-300, 28th Ed., Vol. I. February. New York, NY.

U.S. Department of Energy. 2013. *Radiation Protection of the Public and the Environment*, DOE Order 458.1, Change 3. Washington, DC: Office of Health, Safety, and Security.

U.S. Department of Energy, National Nuclear Security Administration Nevada Field Office. 2014. *Soils Risk-Based Corrective Action Evaluation Process*, Rev. 1, DOE/NV--1475-Rev. 1 Las Vegas, NV.

U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office. 2004. *Corrective Action Decision Document for Corrective Action Unit 413: Clean Slate II Plutonium Dispersion (TTR)*, DOE/NV--895-Rev. 1. Las Vegas, NV.

U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office. 2012a. *Nevada National Security Site Radiological Control Manual*, DOE/NV/25946--801, Rev. 2. Prepared by Radiological Control Managers' Council. Las Vegas, NV.

U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office. 2012b. *Soils Activity Quality Assurance Plan,* Rev. 0, NNSA/NSO--1478. Las Vegas, NV.

U.S. Department of Energy, Nevada Operations Office. 1996. *Clean Slate Corrective Action Investigation Plan*, Rev. 0, DOE/NV--456. Las Vegas, NV.

U.S. Environmental Protection Agency. 2002. *Guidance for Quality Assurance Project Plans*, EPA QA/G5, EPA/240/R-02/009. Washington, DC: Office of Environmental Information.

U.S. Environmental Protection Agency. 2004. *Understanding Variation in Partition Coefficient, K_d, Values - Volume III: Review of Geochemistry and Available K_d Values for Americium, Arsenic, Curium, Iodine, Neptunium, Radium, and Technetium*, EPA 402-R-04-002C. Washington, DC.

U.S. Environmental Protection Agency. 2006. *Guidance on Systematic Planning Using the Data Quality Objectives Process*, EPA QA/G-4, EPA/240/B-06/001. Washington, DC: Office of Environmental Information.

U.S. Environmental Protection Agency. 2015a. *Pacific Southwest, Region 9: Regional Screening Levels (Formerly PRGs), Screening Levels for Chemical Contaminants.* As accessed at http://www.epa.gov/region9/superfund/prg on 24 August. Prepared by EPA Office of Superfund and Oak Ridge National Laboratory.

U.S. Environmental Protection Agency. 2015b. *SW-846, Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*. As accessed at http://www.epa.gov/epawaste/hazard/testmethods/sw846 on 24 August.

Yu, C., A.J. Zielen, J.-J. Cheng, D.J. LePoire, E. Gnanapragasam, S. Kamboj, J. Arnish, A. Wallo, III, W.A. Williams, and H. Peterson. 2001. *User's Manual for RESRAD Version 6*, ANL/EAD-4. Argonne, IL: Argonne National Laboratory, Environmental Assessment Division. (Version 6.5 released in October 2009.)

Appendix B

Activity Organization

B.1.0 Activity Organization

The NNSA/NFO Soils Activity Lead is Tiffany Lantow. She can be contacted at 702-295-7645.

The identification of the activity Health and Safety Officer and the Quality Assurance Officer can be found in the appropriate plan. However, personnel are subject to change, and it is suggested that the NNSA/NFO Soils Activity Lead be contacted for further information. The Task Manager will be identified in the FFACO Monthly Activity Report prior to the start of field activities.

Appendix C

RESRAD Input Parameter Review

C.1.0 RESRAD Input Parameters

All RESRAD input parameters for the internal dose pathway were identified and reviewed to ensure that appropriate values would be used in the development of the RRMGs. The RESRAD output files in Appendix E contain all of the input parameter values used to develop the CAU 413 RRMGs. Those input parameters specific to the CW exposure scenario are presented in Table C.1-1 with the RESRAD default values.

Table C.1-1
RESRAD Input Parameters for CW Exposure Scenario
(Page 1 of 2)

Parameter	Default	Site-Specific Value	Units
Area of contaminated zone	10,000	1,000	m^2
Thickness of contaminated zone	2	0.05	m
Cover depth	0	0	m
Density of contaminated zone	1.5	1.5	g/cm^3
Contaminated zone erosion rate	0.001	0	m/yr
Contaminated zone total porosity	0.4	0.43	None
Contaminated zone field capacity	0.2	0.2	None
Contaminated zone hydraulic conductivity	10	1,090	m/yr
Contaminated zone b parameter	5.3	4.9	None
Evapotranspiration coefficient	0.5	0.98	None
Wind speed	2	3.12	m/sec
Precipitation	1	0.096	m/yr
Irrigation	0.2	0	m/yr
Runoff coefficient	0.2	0.4	None
Inhalation rate	8,400	12,000	m^3/yr
Mass loading for inhalation	0.0001	0.0006	g/m^3
Exposure duration	30	25	years
Indoor dust filtration factor	0.4	1	None

Table C.1-1
RESRAD Input Parameters for CW Exposure Scenario
(Page 2 of 2)

Parameter	Default	Site-Specific Value	Units
Indoor time fraction	0.5	0.0274	None
Outdoor time fraction	0.25	0.0822	None
Soil ingestion	36.5	31.9	g/yr
Depth of soil mixing layer	0.15	0.45	m

g/cm^3 = Grams per cubic centimeter
g/m^3 = Grams per cubic meter
g/yr = Grams per year
m/sec = Meters per second
m/yr = Meters per year
m^3/yr = Cubic meters per year

Each parameter was reviewed for the following factors:

- Its role in modeling internal dose
- How it affects internal dose RRMG results
- How it relates to NTTR/TTR-specific conditions

While all parameters were reviewed, the parameters that had more effect on internal dose RRMG values received more scrutiny. Based on this review, values were determined and justified for each parameter that was considered to be conservatively representative of CAU 413 conditions.

C.2.0 Review of Individual Parameters

The RESRAD title screen as shown in Figure C.2-1 presents some basic options for setting up the model run and formatting the output. Input options for this title screen are discussed in Section C.2.1.

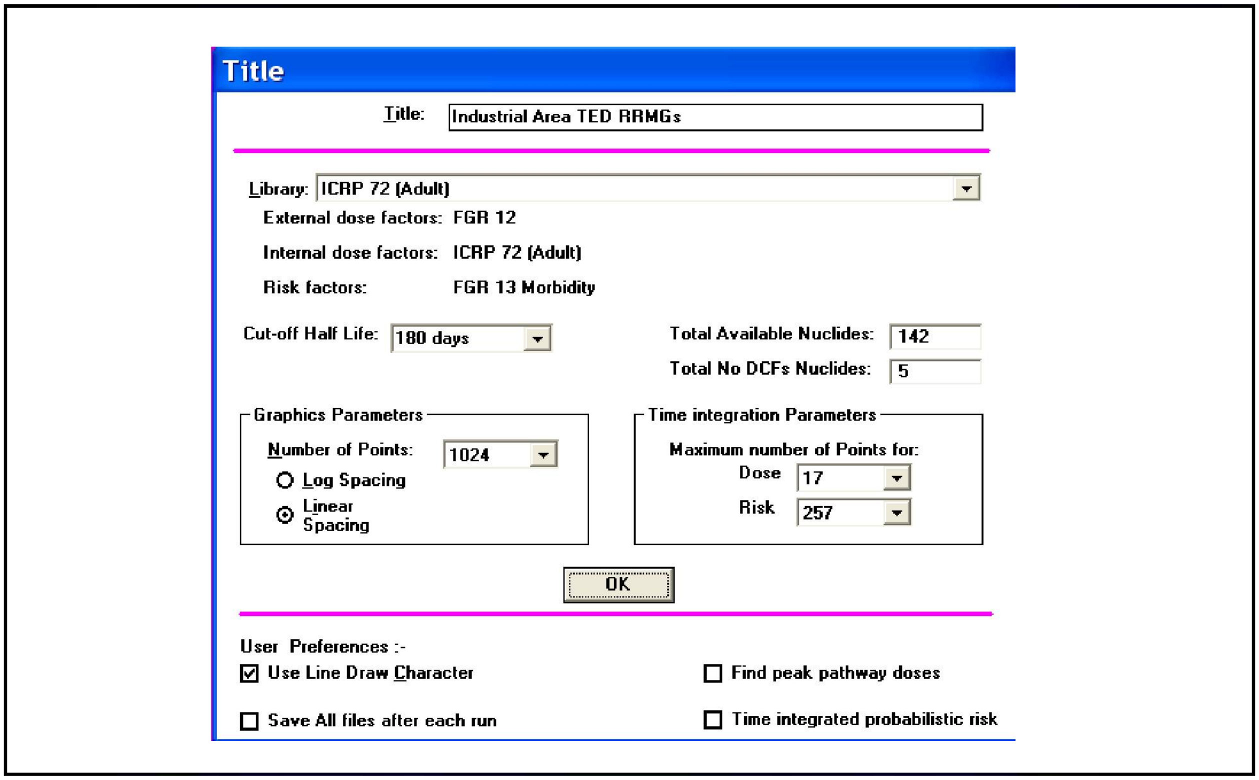


Figure C.2-1
RESRAD Title Screen

The following RESRAD input parameters were determined to be sensitive parameters and are discussed in Sections C.2.2 through C.2.8:

- Area of contaminated zone
- Thickness of contaminated zone
- Wind speed
- Inhalation rate
- Mass loading for inhalation
- Indoor time fraction and Outdoor time fraction
- Depth of soil mixing layer

The following RESRAD input parameters were determined not to be sensitive parameters and are discussed in Sections C.2.9 through C.2.18.

- Indoor dust filtration factor
- Soil ingestion
- Cover depth, Irrigation, and Contaminated zone erosion rate
- Density of contaminated zone and Contaminated zone total porosity
- Contaminated zone field capacity
- Contaminated zone hydraulic conductivity and Contaminated zone b parameter
- Evapotranspiration coefficient
- Precipitation
- Runoff coefficient
- Exposure duration

The sources for each parameter are presented in the "Source(s)" subsections at the end of each individual parameter section.

How a change in a parameter value affects the RRMGs is addressed for each input parameter in the "Model Response to Parameter" subsections throughout this appendix. This evaluation is based on a sensitivity analysis in which a single parameter value is changed while the other parameter values remain fixed. This was accomplished as described in Kamboj et al. (2005), where the influence of a parameter considers both the change it makes on the RRMGs as well as the range of its values. Therefore, a reasonable minimum and maximum value for each parameter was determined along with the recommended value presented herein.

Source: Kamboj, S., J-J. Cheng, and C. Yu. 2005. "Deterministic vs. Probabilistic Analyses To Identify Sensitive Parameters in Dose Assessment Using RESRAD." In *Health Physics*, Vol. 88: pp. S104-S106.

C.2.1 RESRAD Title Screen Inputs

The RESRAD title screen input options as shown in Figure C.2-1 are discussed in the following subsections.

C.2.1.1 Library

The International Commission on Radiological Protection 72 (Adult) internal dose conversion factor (DCF) library in RESRAD was selected for the following reasons:

- It reflects the updated dosimetric models referenced in 10 CFR 835 (CFR, 2015).
- It was developed for receptors in an outdoor environment.
- It is for an adult receptor, consistent with the CW exposure scenario selected for evaluation.

C.2.1.2 Cut-off Half-Life

The use of a larger cut-off half-life value results in some RRMGs that are slightly lower. The value of 180 days is a RESRAD default value and the maximum available value. This option is available to limit the impact of radionuclides with very short half-lives. Selection of the maximum available cut-off half-life value of 180 days was determined to be reasonable and conservative because a radionuclide with this half-life value would have decayed more than 100 half-lives since the last atmospheric nuclear detonation.

C.2.1.3 Graphics Parameters, Time Integration Parameters, and User Preferences

These input parameters are for visual presentation of RESRAD outputs and have no effect on RRMG values.

C.2.2 Area of Contaminated Zone

The area of contaminated zone parameter is defined in the User's Manual for RESRAD Version 6 (Yu et al., 2001) as a compact area that contains the locations of all soil samples with radionuclide concentrations that are clearly (two standard deviations) above background.

C.2.2.1 Model Response to Parameter

Increasing area of contaminated zone values significantly reduces RRMG values up to approximately 1,000 m^2. This was determined to be a sensitive parameter up to a value of 1,000 m^2.

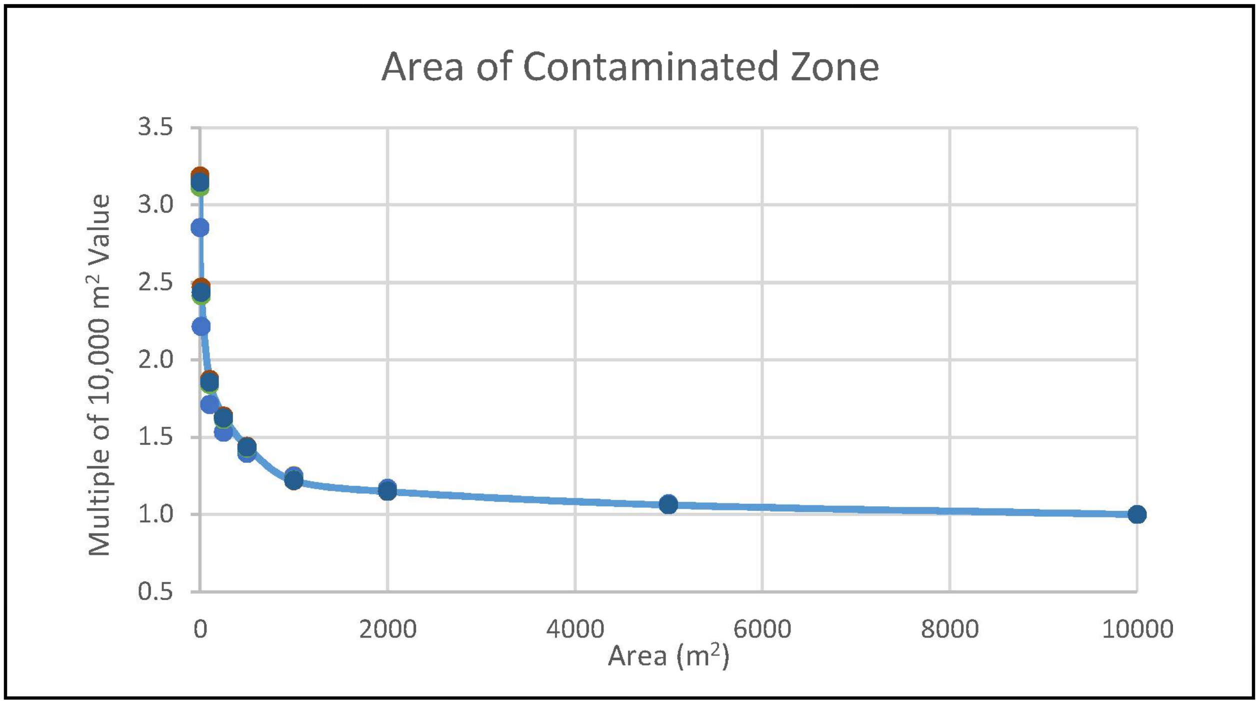


Figure C.2-2
Effect of Area of Contaminated Zone on RRMG Values

C.2.2.2 Recommended Value

At CAU 413, much of the data used to calculate dose will be collected from sample plots, which represent an area of 100 m^2 and are biased to areas of elevated radiation survey readings. Expanding the 100-m^2 area could include areas of lower radioactivity and thus result in a lower average dose. To prevent this from occurring, DOE guidance recommends that the area for dose measurements be limited to no more than 100 m^2 (DOE, 2013). However, if the area of contaminated zone is set to 100 m^2, RESRAD considers the adjacent soil to be free of contamination that could contribute to the total dose received. At CAU 413, it is assumed that the locations where dose was measured have adjacent contamination that could also contribute to dose; therefore, the area of contaminated zone was increased to include this area. This is a conservative approach, as RESRAD would consider this additional area as equally contaminated and would overestimate the resulting dose. To estimate the effect of the area of contaminated zone on RRMG values, RRMGs were determined using RESRAD for several area of contaminated zone values. The RESRAD response to increasing area of contamination values is shown in Figure C.2-2. This demonstrates that the presence of adjacent contamination does not have a significant impact on dose for areas larger than 1,000 m^2. Therefore, the value of 1,000 m^2 for the area of contaminated zone was used for CAU 413.

C.2.2.3 Sources

U.S. Department of Energy. 2013. *Radiation Protection of the Public and the Environment*, DOE Order 458.1, Change 3. Washington, DC: Office of Health, Safety and Security.

U.S. Department of Energy, National Nuclear Security Administration Nevada Field Office. 2014. *Soils Risk-Based Corrective Action Evaluation Process*, Rev. 1, DOE/NV--1475. Las Vegas, NV.

C.2.3 Thickness of Contaminated Zone

The thickness of contaminated zone parameter is defined as the distance between the shallowest and the deepest depth of contamination. This parameter value is a starting thickness of uniform contaminant concentration that is reduced by the model based on erosion.

C.2.3.1 Model Response to Parameter

Higher values of the thickness of the contaminated zone provide lower RRMG values. This was determined to be a sensitive parameter for values less than 0.1 m.

C.2.3.2 Recommended Value

The soil profile study completed at CAU 413 in 1996 indicates that the depth of radioactive contamination deposited by the CSII test is between 0 and 3.5 in. (NNSA/NSO, 2004). However, the concentrations of contaminants are highest at the surface and decrease with depth. RESRAD assumes that the soil to the depth of contamination is uniformly contaminated. This assumption can lead to overestimation of dose for sites where contaminant contributions decrease with depth. A value of 5 cm (0.05 m) for the thickness of the contaminated zone was used for CAU 413.

C.2.3.3 Sources

U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office. 2004. *Corrective Action Decision Document for Corrective Action Unit 413: Clean Slate II Plutonium Dispersion (TTR)*, DOE/NV--895-Rev. 1. Las Vegas, NV.

U.S. Department of Energy, National Nuclear Security Administration Nevada Field Office. 2014. *Soils Risk-Based Corrective Action Evaluation Process*, Rev. 1, DOE/NV--1475. Las Vegas, NV.

C.2.4 Wind Speed

The wind speed number reflects the overall average of the wind speed, measured near the ground, in a one-year period.

C.2.4.1 Model Response to Parameter

Lower values of wind speed provide lower RRMG values. This is considered to be a moderately sensitive parameter.

C.2.4.2 Recommended Value

DOE operates three meteorological stations at the TTR: Station 400, located near the Range Operations Center; Station 401, located at the north end of the CSIII site; and Station 402, located at the north end of the CSI site. Stations 400 and 401 began collecting data in 2008; Station 402 began collecting data in 2011. For each station, the average wind speed was calculated using data from complete years through 2014. The average of the three stations was used to calculate a recommended wind speed of 3.12 m/sec for use in the CAU 413 model.

C.2.4.3 Source

Desert Research Institute. 2015. "Western Regional Climate Center" web page. As accessed at www.wrcc.dri.edu/weather/ntcl.html on 16 January.

C.2.5 Inhalation Rate

The inhalation rate is an average yearly rate in cubic meters per year (m^3/yr) that accounts for different activity levels performed outdoors. A site-specific value can be obtained with the assumed land use scenario and an activity profile.

C.2.5.1 Model Response to Parameter

Higher inhalation rate values provide lower RRMG values. This parameter is considered to be moderately sensitive.

C.2.5.2 Recommended Value

The recommended value for this parameter was developed using the methodology in the RESRAD Data Collection Handbook (Yu et al., 1993, Section 43.1) with updated inhalation rate information as published in the 2011 version of the EPA Exposure Factors Handbook (EPA, 2011). The average time spent (in hours) at different levels of activity per day for the CW exposure scenario is listed in Table C.2-2. The inhalation rate was projected over 24 hr/day and 365 day/yr, resulting in the recommended annual inhalation rate of 12,000 m^3/yr for construction activities. These results are shown in Table C.2-2.

Table C.2-2
CW Inhalation Rate Calculation

Activity Level	Average Time Spent per Day at This Activity Level (hr/day)	Average Inhalation Rate (m^3/min)[a]	Inhalation Rate during This Activity Level (m^3/hr)	Workday Rate (m^3/8 hr)	Daily Rate (m^3/hr)	Annual Rate (m^3/yr)
Resting	1	4.58E-03	2.75E-01	2.75E-01	--	--
Light Work	1.5	1.25E-02	7.50E-01	1.13E+00	--	--
Moderate Physical Labor	5	2.75E-02	1.65E+00	8.25E+00	--	--
Hard Physical Labor	0.5	5.10E-02	3.06E+00	1.53E+00	--	--
Total	8	--	--	11.18	1.40	1.2E+04

[a] Average inhalation rate from Table 6-2 of EPA Exposure Factors Handbook (EPA, 2011), as the mean short-term inhalation rate for age groups 21–61.

m^3/hr = Cubic meters per hour
m^3/min = Cubic meters per minute

-- = Not applicable

C.2.5.3 Sources

U.S. Department of Energy, Nevada Operations Office. 1998. “Transmittal, Soil Related Information, Attachments A, B, C, and D: Air Force Land Uses,” 7 January. Las Vegas, NV.

Yu, C., C. Loureiro, J.-J. Cheng, L.G. Jones, Y.Y. Wang, Y.P. Chia, and E. Faillace. 1993. *Data Collection Handbook To Support Modeling the Impacts of Radioactive Material in Soil*, ANL/EAIS-8. Argonne, IL: Environmental Assessment and Information Sciences Division, Argonne National Laboratory.

C.2.6 Mass Loading for Inhalation

The mass loading parameter is the concentration of soil particles in the air, and is obtained directly from empirical data for locations and conditions similar to those applicable for the scenario used.

C.2.6.1 Model Response to Parameter

Higher values of mass loading provide lower RRMG values for most radionuclides. This parameter is considered to be sensitive.

C.2.6.2 Recommended Value

The RESRAD default value for the mass loading for inhalation parameter is 1E-04 g/m^3. This value is appropriate for the industrial worker scenario; however, it is recommended that the value be increased to 6E-04 g/m^3 for the CW exposure scenario (Yu et. al., 1998; Oztunali et al., 1981). This higher value is more appropriate as it accounts for dust-generating activities typical of a construction site (e.g., road building, vehicular traffic on unpaved roads).

C.2.6.3 Sources

Oztunali, O.I., G.C. Ré, P.M. Moskowitz, E.D. Picazo, and C.J. Pitt. 1981. *Data Base for Radioactive Waste Management, Impacts Analyses Methodology Report*, NUREG/CR-1759, Vol. 3. Prepared for the U.S. Nuclear Regulatory Commission, Office of Nuclear Material Safety and Safeguards, Division of Waste Management. White Plains, NY: Dames and Moore, Inc.

Yu, C., C. Loureiro, J.-J. Cheng, L.G. Jones, Y.Y. Wang, Y.P. Chia, and E. Faillace. 1993. *Data Collection Handbook To Support Modeling the Impacts of Radioactive Material in Soil*, ANL/EAIS-8. Argonne, IL: Environmental Assessment and Information Sciences Division, Argonne National Laboratory.

C.2.7 Indoor Time Fraction and Outdoor Time Fraction

The fraction of time spent indoors and outdoors on site is the average fraction of time in a year during which an individual stays inside and outside a building on the contaminated site, respectively.

C.2.7.1 Model Response to Parameter

Higher values for the indoor and outdoor time fractions result in lower RRMG values. Changing these parameter values changes the amount of time exposed to contamination. These are sensitive parameters.

C.2.7.2 Recommended Value

For the CW exposure scenario, it is assumed that a site worker spends 2 hr/day indoors and 6 hr/day outdoors at the site, for a total of 120 days per year. Therefore, the values for the indoor and outdoor time fractions is a simple calculation of the total hours spent at the contaminated site divided by 8,760 (the total number of hours in a year). This results in the indoor and outdoor time fractions at the contaminated site as presented in Table C.2-3 for the CW exposure scenario.

Table C.2-3
Annual Indoor and Outdoor Times Spent on Site

Exposure Scenario	Total (hr/yr)	Indoor Hours	Outdoor Hours	Indoor Time Fraction	Outdoor Time Fraction
Construction worker	8,760	240	720	0.0274	0.0822

C.2.7.3 Source

This input parameter value was agreed to by decision makers during the DQO process for CAU 413.

C.2.8 Depth of Soil Mixing Layer

The depth of the soil mixing layer is the depth of surface soil available for resuspension and is used in the calculation of the radioactivity associated with resuspended particles. This parameter reflects an assumed surface layer that is sufficiently disturbed to uniformly distribute contamination within this layer. The soil mixing layer provides a modeled pathway for subsurface contamination to be brought to the surface.

C.2.8.1 Model Response to Parameter

For sites with surface contamination such as CAU 413, soil mixing layer depths that are greater than the thickness of the contaminated zone will effectively dilute the concentration of radionuclides by mixing the additional thickness of uncontaminated soil. This will result in higher RRMG values. Soil mixing layer depths that are less than the thickness of the contaminated zone have less of an effect on RRMG values. Thus, if the depth of the soil mixing layer is greater than the thickness of the contaminated zone, this parameter is sensitive.

C.2.8.2 Recommended Value

The CW exposure scenario includes potential activities that disturb the soil at depths greater than the top 5 cm of soil (i.e., thickness of the contaminated zone), to include construction of building foundations and structure supports. Grading may also be required as part of general site preparation for roads, building foundations, parking lots, targets, or other work areas. It is recommended that a value of 0.45 m for the depth of soil mixing layer be used for CAU 413. Although this will allow for dilution of contaminated soil with uncontaminated soil in the model, it represents a more realistic scenario than using the same value as the thickness of the contaminated zone (0.05 m).

C.2.8.3 Source

This input parameter value was agreed to by decision makers during the DQO process for CAU 413.

C.2.9 Indoor Dust Filtration Factor

This factor is the ratio of airborne dust concentration indoors on site to the concentration outdoors on site. It is based on the fact that a building would provide shielding against entry of wind-blown dust particles.

C.2.9.1 Model Response to Parameter

Higher values of indoor dust filtration factor result in lower RRMG values. However, this is not considered to be a sensitive parameter.

C.2.9.2 Recommended Value

A site worker under the CW exposure scenario is defined as working 6 hr/day outdoors and 2 hr/day indoors at the site. Because the majority of time will be spent outdoors, a conservative approach is recommended that does not take credit for indoor shielding of airborne dust particles. Therefore, the recommended value for the indoor dust filtration factor parameter is 1, which results in an equal concentration of indoor and outdoor dust.

C.2.9.3 Source

This input parameter value was agreed to by decision makers during the DQO process for CAU 413.

C.2.10 Soil Ingestion

This parameter is the accidental ingestion rate of soil material or soil dust.

C.2.10.1 Model Response to Parameter

Higher values for the soil ingestion provide slightly lower RRMG values. Therefore, this is not considered to be a sensitive parameter.

C.2.10.2 Recommended Value

The values for soil ingestion are dependent upon the time spent indoors and outdoors. The EPA recommends a soil ingestion rate of 100 milligrams per day (mg/day) for outdoor activities (EPA, 2002). For the CW exposure scenario, the worker is assumed to spend 6 hr/day outdoors and 2 hr/day indoors. As shown in Table C.2-4, this results in a soil ingestion rate of 87.5 mg/day. When the rate is extrapolated to a yearly rate, it results in a value of 31.9 g/yr, which is the recommended value for use at CAU 413.

Table C.2-4
CW Exposure Scenario Ingestion Rate

Activity	Rate (mg/day)	Fraction of Time	Adjusted rate (mg/day)	Annual Total (g/yr)
Indoor	50	0.25	12.5	--
Outdoor	100	0.75	75.0	--
Total	--	--	87.5	31.9

C.2.10.3 Source

U.S. Environmental Protection Agency. 2002. *Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites*, OSWER 9355.4-24. Washington, DC: Office of Emergency and Remedial Response.

C.2.11 Cover Depth, Irrigation, and Contaminated Zone Erosion Rate

The cover depth is the distance from the ground surface to the location of the uppermost soil sample with radionuclide concentrations that are clearly above background. Irrigation is the practice of supplying water artificially to the soil in order to permit agricultural use of the land in an arid region, or to compensate for occasional droughts in semidry or semihumid regions. The erosion rate is the average volume of soil material that is removed from one place to another by running water, waves and currents, wind, or moving ice.

C.2.11.1 Model Response to Parameter

A shallower cover depth results in lower RRMG values. Lower irrigation values also result in lower RRMG values. Lower erosion rates will remove the contaminated material slower, leading to lower RRMG values. These parameters are considered sensitive but are not applicable to the CAU 413 exposure scenario.

C.2.11.2 Recommended Value

For CAU 413, it is assumed that contamination is on the surface (i.e., there is no cover) and that no irrigation or erosion will occur. Assuming no erosion is not necessarily realistic, but results in a more conservative dose estimate. Thus, a value of 0 was used for the cover depth, irrigation, and contaminated zone erosion rate for CAU 413.

C.2.11.3 Source

This input parameter value was agreed to by decision makers during the DQO process for CAU 413.

C.2.12 Density of Contaminated Zone and Contaminated Zone Total Porosity

These two parameters have the following relationship:

$$total\ porosity = 1 - \frac{bulk\ density}{particle\ density}$$

Therefore, a change in the value of one of these parameters necessitates a change in the other using this relationship. The value of the particle density is considered to be a constant for silica-based material at 2.65 g/cm^3.

C.2.12.1 Model Response to Parameter

The use of a higher bulk density (and a corresponding lower porosity) results in no significant change to the RRMG values. These are not considered to be sensitive parameters.

C.2.12.2 Recommended Values

The value of 1.5 g/cm^3 is a standard value used in EPA's Soil Screening Level Supplemental Guidance (EPA, 2002). Table C.2-5 presents the bulk density statistics of 93 soil samples collected in the Death Valley region that had a rock content of less than 50 percent. This shows very little variability in bulk density and an average bulk density value that is equal to the EPA standard value. Therefore, it is recommended that a value of 1.5 g/cm^3 for the density of the contaminated zone and the resulting total porosity of 0.43 be used for CAU 413.

Table C.2-5
Bulk Density Statistics for Samples from Death Valley Region

	Average	STDEV	n	$t_{\alpha/2}$	LCL_{95}	UCL_{95}
Bulk Density	1.50	0.0771	93	1.66	1.49	1.51

C.2.12.3 Sources

Hevesi, J.A., A.L. Flint, and L.E. Flint. 2003. *Simulation of Net Infiltration and Potential Recharge Using a Distributed-Parameter Watershed Model of the Death Valley Region, Nevada and California*, Water-Resources Investigations Report 03-4090. Sacramento, CA: U.S. Geological Survey.

U.S. Environmental Protection Agency. 2002. *Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites*, OSWER 9355.4-24. Washington, DC: Office of Emergency and Remedial Response.

C.2.13 Contaminated Zone Field Capacity

The field capacity sets the lower limit of the volumetric water content and is used to replace the calculated value when the calculated value is smaller. This is used to calculate percolation of infiltrating water through the contaminated zone.

C.2.13.1 Model Response to Parameter

There are no significant impacts to RRMG values by changing the value of this parameter. Therefore, this is not considered to be a sensitive parameter.

C.2.13.2 Recommended Value

It is recommended that the default RESRAD value of 0.2 (unitless) for the contaminated zone field capacity be used for CAU 413.

C.2.13.3 Source

Yu, C., C. Loureiro, J.-J. Cheng, L.G. Jones, Y.Y. Wang, Y.P. Chia, and E. Faillace. 1993. *Data Collection Handbook To Support Modeling the Impacts of Radioactive Material in Soil*, ANL/EAIS-8. Argonne, IL: Environmental Assessment and Information Sciences Division, Argonne National Laboratory.

C.2.14 Contaminated Zone Hydraulic Conductivity and Contaminated Zone b Parameter

Soil hydraulic conductivity is a measure of the ability of soil to transmit water when subjected to a hydraulic gradient. The soil-specific “b” parameter is an empirical and dimensionless parameter that is used to evaluate the saturation ratio (or the volumetric water saturation) of the soil, according to a soil characteristic function called the conductivity function (i.e., the relationship between the unsaturated hydraulic conductivity [K] and the saturation ratio). The soil-specific exponential “b” parameter is one of several hydrological parameters used to calculate the radionuclide leaching rate of the contaminated zone.

C.2.14.1 Model Response to Parameters

There are no significant impacts to RRMG values by changing the value of these parameters. Thus, these parameters are not considered sensitive.

C.2.14.2 Recommended Value

It is recommended that CAU 413 use the representative values for a sandy loam from Clapp and Hornberger (1978), as shown in Table C.2-6, to select the values for the contaminated zone hydraulic conductivity (1,090 m/yr) and for the contaminated zone b parameter (4.9).

Table C.2-6
Hydraulic Properties of Soil Types

Texture	Hydraulic Conductivity (m/yr)	Saturated Water Content	Soil-Specific Exponential Parameter, b
Sand	5,550	0.395	4.05
Loamy sand	4,930	0.41	4.38
Sandy loam	1,090	0.435	4.9
Silty loam	227	0.485	5.3
Loam	219	0.451	5.39
Sandy clay loam	199	0.42	7.12
Silty clay loam	53.6	0.477	7.75
Clay loam	77.3	0.476	8.52
Sandy clay	68.4	0.426	10.4
Silty clay	32.6	0.492	10.4
Clay	40.5	0.482	11.4

Source: Clapp and Hornberger, 1978

C.2.14.3 Source

Clapp, R.B., and G.M. Hornberger. 1978. "Empirical Equations for Some Soil Hydraulic Properties." In *Water Resources Research*, Vol. 14(4): pp. 601-604. Washington, DC: American Geophysical Union.

C.2.15 Evapotranspiration Coefficient

Evapotranspiration represents the combination of two separate processes: (1) evaporation (i.e., the change of phase of water near the ground surface and the direct transfer of water vapor from the ground to the atmosphere) and (2) transpiration (i.e., the transfer of water from the ground to the atmosphere through plants).

C.2.15.1 Model Response to Parameter

There are no significant impacts to RRMG values by changing the value of this parameter. Thus, this parameter is not considered sensitive.

C.2.15.2 Recommended Value

It is recommended that CAU 413 use the average value of the evapotranspiration coefficient from 61 locations in the Death Valley region from the Hevesi et al. (2003) study. As shown in Table C.2-7, the statistics for this parameter were very constant with an 95 percent LCL of 0.98 and a 95 percent UCL of 0.99. Therefore, it is recommended that the average value of 0.98 is used for CAU 413.

Table C.2-7
Evapotranspiration Coefficient Statistics from the Death Valley Region

	Average	STDEV	n	$t_{\alpha/2}$	LCL_{95}	UCL_{95}
Evapotranspiration Coefficient	0.98	0.013671	61	1.67	0.98	0.99

Source: Hevesi et al., 2003

C.2.15.3 Source

Hevesi, J.A., A.L. Flint, and L.E. Flint. 2003. *Simulation of Net Infiltration and Potential Recharge Using a Distributed-Parameter Watershed Model of the Death Valley Region, Nevada and California*, Water-Resources Investigations Report 03-4090. Sacramento, CA: U.S. Geological Survey.

C.2.16 Precipitation

The average annual precipitation is the average of the total amount of precipitation received in a one-year period.

C.2.16.1 Model Response to Parameter

There are no significant impacts to RRMG values by changing the value of this parameter. Thus, this parameter is not considered sensitive.

C.2.16.2 Recommended Value

DOE operates three meteorological stations at the TTR: Station 400, located near the Range Operations Center; Station 401, located at the north end of the CSIII site; and Station 402, located at the north end of the CSI site. Stations 400 and 401 began collecting data in 2008; Station 402 began collecting data in 2011. For each station, the average precipitation was calculated using data from complete years through 2014. The lowest average precipitation value of all three stations, 0.096 m/yr (3.8 in./yr), is recommended to be used in the model for CAU 413.

C.2.16.3 Source

Desert Research Institute. 2015. "Western Regional Climate Center" web page. As accessed at www.wrcc.dri.edu/weather/ntcl.html on 16 January.

C.2.17 Runoff Coefficient

The runoff coefficient is the fraction of the average annual precipitation in excess of the deep percolation and evapotranspiration that becomes surface flow and ends up in either perennial or intermittent surface water bodies.

C.2.17.1 Model Response to Parameter

There are no significant impacts to RRMG values by changing the value of this parameter. Thus, this parameter is not considered sensitive.

C.2.17.2 Recommended Value

A methodology for estimating the runoff coefficient is presented in the RESRAD Data Collection Handbook based on the type of soil and land utilization. The best estimate of the runoff coefficient using this methodology is 0.4. As this is not a sensitive parameter, this is the recommended value to use for the runoff coefficient for CAU 413.

C.2.17.3 Source

Yu, C., C. Loureiro, J.-J. Cheng, L.G. Jones, Y.Y. Wang, Y.P. Chia, and E. Faillace. 1993. *Data Collection Handbook To Support Modeling the Impacts of Radioactive Material in Soil*, ANL/EAIS-8. Argonne, IL: Environmental Assessment and Information Sciences Division, Argonne National Laboratory.

C.2.18 Exposure Duration

The exposure duration is the span of time, in years, during which an individual is expected to spend time on the site.

C.2.18.1 Model Response to Parameter

The value for the exposure duration does not affect RRMG values. This is not considered to be a sensitive parameter.

C.2.18.2 Recommended Value

It is recommended that the exposure duration of 25 years be used for the CW exposure scenario. The default value used by EPA in risk assessments for industrial workers is 25 years.

C.2.18.3 Source

U.S. Environmental Protection Agency. 1991. *Risk Assessment Guidance for Superfund: Volume I – Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors" Interim Final,* OSWER Directive 9285.6-03. Washington, DC: Office of Emergency and Remedial Response, Toxics Integration Branch.

C.3.0 References

CFR, see *Code of Federal Regulations*.

Clapp, R.B., and G.M. Hornberger. 1978. "Empirical Equations for Some Soil Hydraulic Properties." In *Water Resources Research*, Vol. 14(4): pp. 601-604. Washington, DC: American Geophysical Union.

Code of Federal Regulations. 2015. Title 10 CFR, Part 835, "Occupational Radiation Protection." Washington, DC: U.S. Government Printing Office.

DOE, see U.S. Department of Energy.

DOE/NV, see U.S. Department of Energy, Nevada Operations Office.

DRI, see Desert Research Institute.

Desert Research Institute. 2015. "Western Regional Climate Center" web page. As accessed at www.wrcc.dri.edu/weather/ntcl.html on 16 January.

EPA, see U.S. Environmental Protection Agency.

Hevesi, J.A., A.L. Flint, and L.E. Flint. 2003. *Simulation of Net Infiltration and Potential Recharge Using a Distributed-Parameter Watershed Model of the Death Valley Region, Nevada and California*, Water-Resources Investigations Report 03-4090. Sacramento, CA: U.S. Geological Survey.

Kamboj, S., J-J. Cheng, and C. Yu. 2005. "Deterministic vs. Probabilistic Analyses To Identify Sensitive Parameters in Dose Assessment Using RESRAD." In *Health Physics*, Vol. 88: pp. S104-S106.

NNSA/NFO, see U.S. Department of Energy, National Nuclear Security Administration Nevada Field Office.

NNSA/NSO, see U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office.

Oztunali, O.I., G.C. Ré, P.M. Moskowitz, E.D. Picazo, and C.J. Pitt. 1981. *Data Base for Radioactive Waste Management, Impacts Analyses Methodology Report*, NUREG/CR-1759, Vol. 3. Prepared for the U.S. Nuclear Regulatory Commission, Office of Nuclear Material Safety and Safeguards, Division of Waste Management. White Plains, NY: Dames and Moore, Inc.

U.S. Department of Energy. 2013. *Radiation Protection of the Public and the Environment*, DOE Order 458.1, Change 3. Washington, DC: Office of Health, Safety and Security.

U.S. Department of Energy, National Nuclear Security Administration Nevada Field Office. 2014. *Soils Risk-Based Corrective Action Evaluation Process*, Rev. 1, DOE/NV--1475-Rev. 1. Las Vegas, NV.

U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office. 2004. *Corrective Action Decision Document for Corrective Action Unit 413: Clean Slate II Plutonium Dispersion (TTR)*, DOE/NV--895-Rev. 1. Las Vegas, NV.

U.S. Department of Energy, Nevada Operations Office. 1998. "Transmittal, Soil Related Information, Attachments A, B, C, and D: Air Force Land Uses," 7 January. Las Vegas, NV.

U.S. Environmental Protection Agency. 1991. *Risk Assessment Guidance for Superfund: Volume I – Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors" Interim Final,* OSWER Directive 9285.6-03. Washington, DC: Office of Emergency and Remedial Response, Toxics Integration Branch.

U.S. Environmental Protection Agency. 2002. *Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites*, OSWER 9355.4-24. Washington, DC: Office of Emergency and Remedial Response.

U.S. Environmental Protection Agency. 2011. *Exposure Factors Handbook: 2011 Edition,* EPA/600/R-09/052F. Washington, DC: Office of Research and Development.

Yu, C., C. Loureiro, J.-J. Cheng, L.G. Jones, Y.Y. Wang, Y.P. Chia, and E. Faillace. 1993. *Data Collection Handbook To Support Modeling the Impacts of Radioactive Material in Soil*, ANL/EAIS-8. Argonne, IL: Environmental Assessment and Information Sciences Division, Argonne National Laboratory.

Yu, C., A.J. Zielen, J.-J. Cheng, D.J. LePoire, E. Gnanapragasam, S. Kamboj, J. Arnish, A. Wallo, III, W.A. Williams, and H. Peterson. 2001. *User's Manual for RESRAD Version 6*, ANL/EAD-4. Argonne, IL: Argonne National Laboratory, Environmental Assessment Division. (Version 6.5 released in October 2009.)

Appendix D

CW Exposure Scenario RRMGs for CAU 413

Table D.1-1
Total Effective Dose RRMGs
for the CW Exposure Scenario

Radionuclide	RRMG (pCi/g)
Ag-108m	5.36E+01
Al-26	3.46E+01
Am-241	3.27E+03
Am-243	3.94E+02
Cm-243	6.44E+02
Cm-244	1.14E+04
Co-60	3.68E+01
Cs-137	1.47E+02
Eu-152	7.69E+01
Eu-154	7.18E+01
Eu-155	1.93E+03
Nb-94	5.56E+01
Np-237	3.73E+02
Pu-238	5.82E+03
Pu-239/240	5.31E+03
Pu-241	2.63E+05
Sr-90	1.71E+04
Tc-99	2.32E+06
Th-232	1.06E+03
U-233	4.85E+04
U-234	5.66E+04
U-235	5.13E+02
U-238	2.92E+03

A soil sample at this RRMG value would present a TED potential of 25 mrem per calendar year.

Np = Neptunium
Sr = Strontium
Tc = Technetium

Table D.1-2
Internal Dose RRMGs
for the CW Exposure Scenario

Radionuclide	RRMG (pCi/g)
Ag-108m	5.72E+06
Al-26	4.59E+06
Am-241	6.68E+03
Am-243	6.67E+03
Cm-243	9.36E+03
Cm-244	1.14E+04
Co-60	4.44E+06
Cs-137	1.26E+06
Eu-152	7.28E+06
Eu-154	5.43E+06
Eu-155	3.79E+07
Nb-94	6.29E+06
Np-237	1.27E+04
Pu-238	5.84E+03
Pu-239/240	5.33E+03
Pu-241	2.76E+05
Sr-90	5.05E+05
Tc-99	1.90E+07
Th-232	5.68E+03
U-233	5.95E+04
U-234	6.10E+04
U-235	6.66E+04
U-238	6.97E+04

A soil sample at this RRMG value would present a TED potential of 25 mrem per calendar year.

Appendix E

RESRAD Model Output for CW Exposure Scenario

Attachment E-1
Total Dose for CW Exposure Scenario

Attachment E-2
Internal Dose for CW Exposure Scenario

Attachment E-1

Total Dose for CW Exposure Scenario

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Part I: Mixture Sums and Single Radionuclide Guidelines

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Dose Conversion Factor (and Related) Parameter Summary
Dose Library: FGR 12 & ICRP 72 (Adult)

Menu	Parameter	Current Value#	Base Case*	Parameter Name
A-1	DCF's for external ground radiation, (mrem/yr)/(pCi/g)			
A-1	Ac-225 (Source: FGR 12)	6.371E-02	6.371E-02	DCF1(1)
A-1	Ac-227 (Source: FGR 12)	4.951E-04	4.951E-04	DCF1(2)
A-1	Ac-228 (Source: FGR 12)	5.978E+00	5.978E+00	DCF1(3)
A-1	Ag-108 (Source: FGR 12)	1.143E-01	1.143E-01	DCF1(4)
A-1	Ag-108m (Source: FGR 12)	9.640E+00	9.640E+00	DCF1(5)
A-1	Al-26 (Source: FGR 12)	1.741E+01	1.741E+01	DCF1(6)
A-1	Am-241 (Source: FGR 12)	4.372E-02	4.372E-02	DCF1(7)
A-1	Am-243 (Source: FGR 12)	1.420E-01	1.420E-01	DCF1(8)
A-1	At-217 (Source: FGR 12)	1.773E-03	1.773E-03	DCF1(9)
A-1	At-218 (Source: FGR 12)	5.847E-03	5.847E-03	DCF1(10)
A-1	Ba-137m (Source: FGR 12)	3.606E+00	3.606E+00	DCF1(11)
A-1	Bi-210 (Source: FGR 12)	3.606E-03	3.606E-03	DCF1(12)
A-1	Bi-211 (Source: FGR 12)	2.559E-01	2.559E-01	DCF1(13)
A-1	Bi-212 (Source: FGR 12)	1.171E+00	1.171E+00	DCF1(14)
A-1	Bi-213 (Source: FGR 12)	7.660E-01	7.660E-01	DCF1(15)
A-1	Bi-214 (Source: FGR 12)	9.808E+00	9.808E+00	DCF1(16)
A-1	Cm-243 (Source: FGR 12)	5.829E-01	5.829E-01	DCF1(17)
A-1	Cm-244 (Source: FGR 12)	1.259E-04	1.259E-04	DCF1(18)
A-1	Co-60 (Source: FGR 12)	1.622E+01	1.622E+01	DCF1(19)
A-1	Cs-137 (Source: FGR 12)	7.510E-04	7.510E-04	DCF1(20)
A-1	Eu-152 (Source: FGR 12)	7.006E+00	7.006E+00	DCF1(21)
A-1	Eu-154 (Source: FGR 12)	7.678E+00	7.678E+00	DCF1(22)
A-1	Eu-155 (Source: FGR 12)	1.822E-01	1.822E-01	DCF1(23)
A-1	Fr-221 (Source: FGR 12)	1.536E-01	1.536E-01	DCF1(24)
A-1	Fr-223 (Source: FGR 12)	1.980E-01	1.980E-01	DCF1(25)
A-1	Gd-152 (Source: FGR 12)	0.000E+00	0.000E+00	DCF1(26)
A-1	Nb-94 (Source: FGR 12)	9.677E+00	9.677E+00	DCF1(27)
A-1	Np-237 (Source: FGR 12)	7.790E-02	7.790E-02	DCF1(28)
A-1	Np-239 (Source: FGR 12)	7.529E-01	7.529E-01	DCF1(29)
A-1	Pa-231 (Source: FGR 12)	1.906E-01	1.906E-01	DCF1(30)
A-1	Pa-233 (Source: FGR 12)	1.020E+00	1.020E+00	DCF1(31)
A-1	Pa-234 (Source: FGR 12)	1.155E+01	1.155E+01	DCF1(32)
A-1	Pa-234m (Source: FGR 12)	8.967E-02	8.967E-02	DCF1(33)
A-1	Pb-209 (Source: FGR 12)	7.734E-04	7.734E-04	DCF1(34)
A-1	Pb-210 (Source: FGR 12)	2.447E-03	2.447E-03	DCF1(35)
A-1	Pb-211 (Source: FGR 12)	3.064E-01	3.064E-01	DCF1(36)
A-1	Pb-212 (Source: FGR 12)	7.043E-01	7.043E-01	DCF1(37)
A-1	Pb-214 (Source: FGR 12)	1.341E+00	1.341E+00	DCF1(38)
A-1	Po-210 (Source: FGR 12)	5.231E-05	5.231E-05	DCF1(39)
A-1	Po-211 (Source: FGR 12)	4.764E-02	4.764E-02	DCF1(40)
A-1	Po-212 (Source: FGR 12)	0.000E+00	0.000E+00	DCF1(41)
A-1	Po-213 (Source: FGR 12)	0.000E+00	0.000E+00	DCF1(42)
A-1	Po-214 (Source: FGR 12)	5.138E-04	5.138E-04	DCF1(43)
A-1	Po-215 (Source: FGR 12)	1.016E-03	1.016E-03	DCF1(44)
A-1	Po-216 (Source: FGR 12)	1.042E-04	1.042E-04	DCF1(45)
A-1	Po-218 (Source: FGR 12)	5.642E-05	5.642E-05	DCF1(46)
A-1	Pu-238 (Source: FGR 12)	1.513E-04	1.513E-04	DCF1(47)
A-1	Pu-239 (Source: FGR 12)	2.952E-04	2.952E-04	DCF1(48)
A-1	Pu-240 (Source: FGR 12)	1.467E-04	1.467E-04	DCF1(49)

Dose Conversion Factor (and Related) Parameter Summary (continued)
Dose Library: FGR 12 & ICRP 72 (Adult)

Menu	Parameter	Current Value#	Base Case*	Parameter Name
A-1	Pu-241 (Source: FGR 12)	5.904E-06	5.904E-06	DCF1(50)
A-1	Ra-223 (Source: FGR 12)	6.034E-01	6.034E-01	DCF1(51)
A-1	Ra-224 (Source: FGR 12)	5.119E-02	5.119E-02	DCF1(52)
A-1	Ra-225 (Source: FGR 12)	1.102E-02	1.102E-02	DCF1(53)
A-1	Ra-226 (Source: FGR 12)	3.176E-02	3.176E-02	DCF1(54)
A-1	Ra-228 (Source: FGR 12)	0.000E+00	0.000E+00	DCF1(55)
A-1	Rn-219 (Source: FGR 12)	3.083E-01	3.083E-01	DCF1(56)
A-1	Rn-220 (Source: FGR 12)	2.298E-03	2.298E-03	DCF1(57)
A-1	Rn-222 (Source: FGR 12)	2.354E-03	2.354E-03	DCF1(58)
A-1	Sr-90 (Source: FGR 12)	7.043E-04	7.043E-04	DCF1(59)
A-1	Tc-99 (Source: FGR 12)	1.255E-04	1.255E-04	DCF1(60)
A-1	Th-227 (Source: FGR 12)	5.212E-01	5.212E-01	DCF1(61)
A-1	Th-228 (Source: FGR 12)	7.940E-03	7.940E-03	DCF1(62)
A-1	Th-229 (Source: FGR 12)	3.213E-01	3.213E-01	DCF1(63)
A-1	Th-230 (Source: FGR 12)	1.209E-03	1.209E-03	DCF1(64)
A-1	Th-231 (Source: FGR 12)	3.643E-02	3.643E-02	DCF1(65)
A-1	Th-232 (Source: FGR 12)	5.212E-04	5.212E-04	DCF1(66)
A-1	Th-234 (Source: FGR 12)	2.410E-02	2.410E-02	DCF1(67)
A-1	Tl-207 (Source: FGR 12)	1.980E-02	1.980E-02	DCF1(68)
A-1	Tl-208 (Source: FGR 12)	2.298E+01	2.298E+01	DCF1(69)
A-1	Tl-209 (Source: FGR 12)	1.293E+01	1.293E+01	DCF1(70)
A-1	Tl-210 (Source: no data)	0.000E+00	-2.000E+00	DCF1(71)
A-1	U-233 (Source: FGR 12)	1.397E-03	1.397E-03	DCF1(72)
A-1	U-234 (Source: FGR 12)	4.017E-04	4.017E-04	DCF1(73)
A-1	U-235 (Source: FGR 12)	7.211E-01	7.211E-01	DCF1(74)
A-1	U-236 (Source: FGR 12)	2.148E-04	2.148E-04	DCF1(75)
A-1	U-237 (Source: FGR 12)	5.306E-01	5.306E-01	DCF1(76)
A-1	U-238 (Source: FGR 12)	1.031E-04	1.031E-04	DCF1(77)
A-1	Y-90 (Source: FGR 12)	2.391E-02	2.391E-02	DCF1(78)
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	Ac-227+D	2.109E+00	2.035E+00	DCF2(1)
B-1	Ag-108m+D	1.370E-04	1.369E-04	DCF2(2)
B-1	Al-26	7.400E-05	7.400E-05	DCF2(3)
B-1	Am-241	3.550E-01	3.552E-01	DCF2(4)
B-1	Am-243+D	3.550E-01	3.552E-01	DCF2(5)
B-1	Cm-243	2.550E-01	2.553E-01	DCF2(6)
B-1	Cm-244	2.110E-01	2.109E-01	DCF2(8)
B-1	Co-60	1.150E-04	1.147E-04	DCF2(11)
B-1	Cs-137+D	1.440E-04	1.443E-04	DCF2(12)
B-1	Eu-152	1.550E-04	1.554E-04	DCF2(13)
B-1	Eu-154	1.960E-04	1.961E-04	DCF2(15)
B-1	Eu-155	2.550E-05	2.553E-05	DCF2(16)
B-1	Gd-152	7.030E-02	7.030E-02	DCF2(17)
B-1	Nb-94	1.810E-04	1.813E-04	DCF2(18)
B-1	Np-237+D	1.850E-01	1.850E-01	DCF2(19)
B-1	Pa-231	5.180E-01	5.180E-01	DCF2(20)
B-1	Pb-210+D	3.694E-02	2.072E-02	DCF2(21)
B-1	Pu-238	4.070E-01	4.070E-01	DCF2(22)
B-1	Pu-239	4.440E-01	4.440E-01	DCF2(24)

Dose Conversion Factor (and Related) Parameter Summary (continued)
Dose Library: FGR 12 & ICRP 72 (Adult)

Menu	Parameter	Current Value#	Base Case*	Parameter Name
B-1	Pu-240	4.440E-01	4.440E-01	DCF2(25)
B-1	Pu-241	8.510E-03	8.510E-03	DCF2(27)
B-1	Pu-241+D	8.517E-03	8.510E-03	DCF2(28)
B-1	Ra-226+D	3.531E-02	3.515E-02	DCF2(29)
B-1	Ra-228+D	5.929E-02	5.920E-02	DCF2(30)
B-1	Sr-90+D	5.976E-04	5.920E-04	DCF2(31)
B-1	Tc-99	4.810E-05	4.810E-05	DCF2(32)
B-1	Th-228+D	1.614E-01	1.480E-01	DCF2(33)
B-1	Th-229+D	9.481E-01	8.880E-01	DCF2(34)
B-1	Th-230	3.700E-01	3.700E-01	DCF2(35)
B-1	Th-232	4.070E-01	4.070E-01	DCF2(36)
B-1	U-233	3.550E-02	3.552E-02	DCF2(37)
B-1	U-234	3.480E-02	3.478E-02	DCF2(38)
B-1	U-235+D	3.150E-02	3.145E-02	DCF2(39)
B-1	U-236	3.220E-02	3.219E-02	DCF2(40)
B-1	U-238	2.960E-02	2.960E-02	DCF2(41)
B-1	U-238+D	2.963E-02	2.960E-02	DCF2(42)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	Ac-227+D	4.473E-03	4.070E-03	DCF3(1)
D-1	Ag-108m+D	8.510E-06	8.510E-06	DCF3(2)
D-1	Al-26	1.300E-05	1.295E-05	DCF3(3)
D-1	Am-241	7.400E-04	7.400E-04	DCF3(4)
D-1	Am-243+D	7.430E-04	7.400E-04	DCF3(5)
D-1	Cm-243	5.550E-04	5.550E-04	DCF3(6)
D-1	Cm-244	4.440E-04	4.440E-04	DCF3(8)
D-1	Co-60	1.260E-05	1.258E-05	DCF3(11)
D-1	Cs-137+D	4.810E-05	4.810E-05	DCF3(12)
D-1	Eu-152	5.180E-06	5.180E-06	DCF3(13)
D-1	Eu-154	7.400E-06	7.400E-06	DCF3(15)
D-1	Eu-155	1.180E-06	1.184E-06	DCF3(16)
D-1	Gd-152	1.520E-04	1.517E-04	DCF3(17)
D-1	Nb-94	6.290E-06	6.290E-06	DCF3(18)
D-1	Np-237+D	4.102E-04	4.070E-04	DCF3(19)
D-1	Pa-231	2.630E-03	2.627E-03	DCF3(20)
D-1	Pb-210+D	6.995E-03	2.553E-03	DCF3(21)
D-1	Pu-238	8.510E-04	8.510E-04	DCF3(22)
D-1	Pu-239	9.250E-04	9.250E-04	DCF3(24)
D-1	Pu-240	9.250E-04	9.250E-04	DCF3(25)
D-1	Pu-241	1.780E-05	1.776E-05	DCF3(27)
D-1	Pu-241+D	2.061E-05	1.776E-05	DCF3(28)
D-1	Ra-226+D	1.041E-03	1.036E-03	DCF3(29)
D-1	Ra-228+D	2.552E-03	2.553E-03	DCF3(30)
D-1	Sr-90+D	1.140E-04	1.036E-04	DCF3(31)
D-1	Tc-99	2.370E-06	2.368E-06	DCF3(32)
D-1	Th-228+D	5.302E-04	2.664E-04	DCF3(33)
D-1	Th-229+D	2.266E-03	1.813E-03	DCF3(34)
D-1	Th-230	7.770E-04	7.770E-04	DCF3(35)
D-1	Th-232	8.510E-04	8.510E-04	DCF3(36)
D-1	U-233	1.890E-04	1.887E-04	DCF3(37)

Dose Conversion Factor (and Related) Parameter Summary (continued)
Dose Library: FGR 12 & ICRP 72 (Adult)

Menu	Parameter	Current Value#	Base Case*	Parameter Name
D-1	U-234	1.810E-04	1.813E-04	DCF3(38)
D-1	U-235+D	1.753E-04	1.739E-04	DCF3(39)
D-1	U-236	1.740E-04	1.739E-04	DCF3(40)
D-1	U-238	1.670E-04	1.665E-04	DCF3(41)
D-1	U-238+D	1.796E-04	1.665E-04	DCF3(42)
D-34	Food transfer factors:			
D-34	Ac-227+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(1,1)
D-34	Ac-227+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-05	2.000E-05	RTF(1,2)
D-34	Ac-227+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-05	2.000E-05	RTF(1,3)
D-34				
D-34	Ag-108m+D , plant/soil concentration ratio, dimensionless	1.500E-01	1.500E-01	RTF(2,1)
D-34	Ag-108m+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.000E-03	3.000E-03	RTF(2,2)
D-34	Ag-108m+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.500E-02	2.500E-02	RTF(2,3)
D-34				
D-34	Al-26 , plant/soil concentration ratio, dimensionless	4.000E-03	4.000E-03	RTF(3,1)
D-34	Al-26 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	5.000E-04	5.000E-04	RTF(3,2)
D-34	Al-26 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-04	2.000E-04	RTF(3,3)
D-34				
D-34	Am-241 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(4,1)
D-34	Am-241 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	5.000E-05	5.000E-05	RTF(4,2)
D-34	Am-241 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-06	2.000E-06	RTF(4,3)
D-34				
D-34	Am-243+D , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(5,1)
D-34	Am-243+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	5.000E-05	5.000E-05	RTF(5,2)
D-34	Am-243+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-06	2.000E-06	RTF(5,3)
D-34				
D-34	Cm-243 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(6,1)
D-34	Cm-243 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-05	2.000E-05	RTF(6,2)
D-34	Cm-243 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-06	2.000E-06	RTF(6,3)
D-34				
D-34	Cm-244 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(8,1)
D-34	Cm-244 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-05	2.000E-05	RTF(8,2)
D-34	Cm-244 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-06	2.000E-06	RTF(8,3)
D-34				
D-34	Co-60 , plant/soil concentration ratio, dimensionless	8.000E-02	8.000E-02	RTF(11,1)
D-34	Co-60 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-02	2.000E-02	RTF(11,2)
D-34	Co-60 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-03	2.000E-03	RTF(11,3)
D-34				
D-34	Cs-137+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(12,1)
D-34	Cs-137+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.000E-02	3.000E-02	RTF(12,2)
D-34	Cs-137+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	8.000E-03	8.000E-03	RTF(12,3)
D-34				
D-34	Eu-152 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(13,1)
D-34	Eu-152 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-03	2.000E-03	RTF(13,2)
D-34	Eu-152 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-05	5.000E-05	RTF(13,3)
D-34				
D-34	Eu-154 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(15,1)
D-34	Eu-154 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-03	2.000E-03	RTF(15,2)
D-34	Eu-154 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-05	5.000E-05	RTF(15,3)

Dose Conversion Factor (and Related) Parameter Summary (continued)
Dose Library: FGR 12 & ICRP 72 (Adult)

Menu	Parameter	Current Value#	Base Case*	Parameter Name
D-34	Eu-155 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(16,1)
D-34	Eu-155 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-03	2.000E-03	RTF(16,2)
D-34	Eu-155 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-05	5.000E-05	RTF(16,3)
D-34				
D-34	Gd-152 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(17,1)
D-34	Gd-152 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-03	2.000E-03	RTF(17,2)
D-34	Gd-152 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-05	2.000E-05	RTF(17,3)
D-34				
D-34	Nb-94 , plant/soil concentration ratio, dimensionless	1.000E-02	1.000E-02	RTF(18,1)
D-34	Nb-94 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.000E-07	3.000E-07	RTF(18,2)
D-34	Nb-94 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-06	2.000E-06	RTF(18,3)
D-34				
D-34	Np-237+D , plant/soil concentration ratio, dimensionless	2.000E-02	2.000E-02	RTF(19,1)
D-34	Np-237+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(19,2)
D-34	Np-237+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(19,3)
D-34				
D-34	Pa-231 , plant/soil concentration ratio, dimensionless	1.000E-02	1.000E-02	RTF(20,1)
D-34	Pa-231 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	5.000E-03	5.000E-03	RTF(20,2)
D-34	Pa-231 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(20,3)
D-34				
D-34	Pb-210+D , plant/soil concentration ratio, dimensionless	1.000E-02	1.000E-02	RTF(21,1)
D-34	Pb-210+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	8.000E-04	8.000E-04	RTF(21,2)
D-34	Pb-210+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	3.000E-04	3.000E-04	RTF(21,3)
D-34				
D-34	Pu-238 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(22,1)
D-34	Pu-238 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(22,2)
D-34	Pu-238 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-06	1.000E-06	RTF(22,3)
D-34				
D-34	Pu-239 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(24,1)
D-34	Pu-239 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(24,2)
D-34	Pu-239 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-06	1.000E-06	RTF(24,3)
D-34				
D-34	Pu-240 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(25,1)
D-34	Pu-240 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(25,2)
D-34	Pu-240 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-06	1.000E-06	RTF(25,3)
D-34				
D-34	Pu-241 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(27,1)
D-34	Pu-241 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(27,2)
D-34	Pu-241 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-06	1.000E-06	RTF(27,3)
D-34				
D-34	Pu-241+D , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(28,1)
D-34	Pu-241+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(28,2)
D-34	Pu-241+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-06	1.000E-06	RTF(28,3)
D-34				
D-34	Ra-226+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(29,1)
D-34	Ra-226+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(29,2)
D-34	Ra-226+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-03	1.000E-03	RTF(29,3)
D-34				

Dose Conversion Factor (and Related) Parameter Summary (continued)
Dose Library: FGR 12 & ICRP 72 (Adult)

Menu	Parameter	Current Value#	Base Case*	Parameter Name
D-34	Ra-228+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(30,1)
D-34	Ra-228+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(30,2)
D-34	Ra-228+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-03	1.000E-03	RTF(30,3)
D-34				
D-34	Sr-90+D , plant/soil concentration ratio, dimensionless	3.000E-01	3.000E-01	RTF(31,1)
D-34	Sr-90+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	8.000E-03	8.000E-03	RTF(31,2)
D-34	Sr-90+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-03	2.000E-03	RTF(31,3)
D-34				
D-34	Tc-99 , plant/soil concentration ratio, dimensionless	5.000E+00	5.000E+00	RTF(32,1)
D-34	Tc-99 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(32,2)
D-34	Tc-99 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-03	1.000E-03	RTF(32,3)
D-34				
D-34	Th-228+D , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(33,1)
D-34	Th-228+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(33,2)
D-34	Th-228+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(33,3)
D-34				
D-34	Th-229+D , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(34,1)
D-34	Th-229+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(34,2)
D-34	Th-229+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(34,3)
D-34				
D-34	Th-230 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(35,1)
D-34	Th-230 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(35,2)
D-34	Th-230 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(35,3)
D-34				
D-34	Th-232 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(36,1)
D-34	Th-232 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(36,2)
D-34	Th-232 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(36,3)
D-34				
D-34	U-233 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(37,1)
D-34	U-233 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(37,2)
D-34	U-233 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(37,3)
D-34				
D-34	U-234 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(38,1)
D-34	U-234 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(38,2)
D-34	U-234 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(38,3)
D-34				
D-34	U-235+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(39,1)
D-34	U-235+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(39,2)
D-34	U-235+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(39,3)
D-34				
D-34	U-236 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(40,1)
D-34	U-236 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(40,2)
D-34	U-236 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(40,3)
D-34				
D-34	U-238 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(41,1)
D-34	U-238 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(41,2)
D-34	U-238 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(41,3)
D-34				

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

Dose Library: FGR 12 & ICRP 72 (Adult)

Menu	Parameter	Current Value#	Base Case*	Parameter Name
D-34	U-238+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(42,1)
D-34	U-238+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(42,2)
D-34	U-238+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(42,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	Ac-227+D , fish	1.500E+01	1.500E+01	BIOFAC(1,1)
D-5	Ac-227+D , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(1,2)
D-5				
D-5	Ag-108m+D , fish	5.000E+00	5.000E+00	BIOFAC(2,1)
D-5	Ag-108m+D , crustacea and mollusks	7.700E+02	7.700E+02	BIOFAC(2,2)
D-5				
D-5	Al-26 , fish	5.000E+02	5.000E+02	BIOFAC(3,1)
D-5	Al-26 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(3,2)
D-5				
D-5	Am-241 , fish	3.000E+01	3.000E+01	BIOFAC(4,1)
D-5	Am-241 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(4,2)
D-5				
D-5	Am-243+D , fish	3.000E+01	3.000E+01	BIOFAC(5,1)
D-5	Am-243+D , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(5,2)
D-5				
D-5	Cm-243 , fish	3.000E+01	3.000E+01	BIOFAC(6,1)
D-5	Cm-243 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(6,2)
D-5				
D-5	Cm-244 , fish	3.000E+01	3.000E+01	BIOFAC(8,1)
D-5	Cm-244 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(8,2)
D-5				
D-5	Co-60 , fish	3.000E+02	3.000E+02	BIOFAC(11,1)
D-5	Co-60 , crustacea and mollusks	2.000E+02	2.000E+02	BIOFAC(11,2)
D-5				
D-5	Cs-137+D , fish	2.000E+03	2.000E+03	BIOFAC(12,1)
D-5	Cs-137+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(12,2)
D-5				
D-5	Eu-152 , fish	5.000E+01	5.000E+01	BIOFAC(13,1)
D-5	Eu-152 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(13,2)
D-5				
D-5	Eu-154 , fish	5.000E+01	5.000E+01	BIOFAC(15,1)
D-5	Eu-154 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(15,2)
D-5				
D-5	Eu-155 , fish	5.000E+01	5.000E+01	BIOFAC(16,1)
D-5	Eu-155 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(16,2)
D-5				
D-5	Gd-152 , fish	2.500E+01	2.500E+01	BIOFAC(17,1)
D-5	Gd-152 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(17,2)
D-5				
D-5	Nb-94 , fish	3.000E+02	3.000E+02	BIOFAC(18,1)
D-5	Nb-94 , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(18,2)
D-5				
D-5	Np-237+D , fish	3.000E+01	3.000E+01	BIOFAC(19,1)
D-5	Np-237+D , crustacea and mollusks	4.000E+02	4.000E+02	BIOFAC(19,2)
D-5				

Dose Conversion Factor (and Related) Parameter Summary (continued)
Dose Library: FGR 12 & ICRP 72 (Adult)

Menu	Parameter	Current Value#	Base Case*	Parameter Name
D-5	Pa-231 , fish	1.000E+01	1.000E+01	BIOFAC(20,1)
D-5	Pa-231 , crustacea and mollusks	1.100E+02	1.100E+02	BIOFAC(20,2)
D-5				
D-5	Pb-210+D , fish	3.000E+02	3.000E+02	BIOFAC(21,1)
D-5	Pb-210+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(21,2)
D-5				
D-5	Pu-238 , fish	3.000E+01	3.000E+01	BIOFAC(22,1)
D-5	Pu-238 , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(22,2)
D-5				
D-5	Pu-239 , fish	3.000E+01	3.000E+01	BIOFAC(24,1)
D-5	Pu-239 , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(24,2)
D-5				
D-5	Pu-240 , fish	3.000E+01	3.000E+01	BIOFAC(25,1)
D-5	Pu-240 , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(25,2)
D-5				
D-5	Pu-241 , fish	3.000E+01	3.000E+01	BIOFAC(27,1)
D-5	Pu-241 , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(27,2)
D-5				
D-5	Pu-241+D , fish	3.000E+01	3.000E+01	BIOFAC(28,1)
D-5	Pu-241+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(28,2)
D-5				
D-5	Ra-226+D , fish	5.000E+01	5.000E+01	BIOFAC(29,1)
D-5	Ra-226+D , crustacea and mollusks	2.500E+02	2.500E+02	BIOFAC(29,2)
D-5				
D-5	Ra-228+D , fish	5.000E+01	5.000E+01	BIOFAC(30,1)
D-5	Ra-228+D , crustacea and mollusks	2.500E+02	2.500E+02	BIOFAC(30,2)
D-5				
D-5	Sr-90+D , fish	6.000E+01	6.000E+01	BIOFAC(31,1)
D-5	Sr-90+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(31,2)
D-5				
D-5	Tc-99 , fish	2.000E+01	2.000E+01	BIOFAC(32,1)
D-5	Tc-99 , crustacea and mollusks	5.000E+00	5.000E+00	BIOFAC(32,2)
D-5				
D-5	Th-228+D , fish	1.000E+02	1.000E+02	BIOFAC(33,1)
D-5	Th-228+D , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(33,2)
D-5				
D-5	Th-229+D , fish	1.000E+02	1.000E+02	BIOFAC(34,1)
D-5	Th-229+D , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(34,2)
D-5				
D-5	Th-230 , fish	1.000E+02	1.000E+02	BIOFAC(35,1)
D-5	Th-230 , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(35,2)
D-5				
D-5	Th-232 , fish	1.000E+02	1.000E+02	BIOFAC(36,1)
D-5	Th-232 , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(36,2)
D-5				
D-5	U-233 , fish	1.000E+01	1.000E+01	BIOFAC(37,1)
D-5	U-233 , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(37,2)
D-5				
D-5	U-234 , fish	1.000E+01	1.000E+01	BIOFAC(38,1)
D-5	U-234 , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(38,2)

Dose Conversion Factor (and Related) Parameter Summary (continued)
Dose Library: FGR 12 & ICRP 72 (Adult)

Menu	Parameter	Current Value#	Base Case*	Parameter Name
D-5	U-235+D , fish	1.000E+01	1.000E+01	BIOFAC(39,1)
D-5	U-235+D , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(39,2)
D-5				
D-5	U-236 , fish	1.000E+01	1.000E+01	BIOFAC(40,1)
D-5	U-236 , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(40,2)
D-5				
D-5	U-238 , fish	1.000E+01	1.000E+01	BIOFAC(41,1)
D-5	U-238 , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(41,2)
D-5				
D-5	U-238+D , fish	1.000E+01	1.000E+01	BIOFAC(42,1)
D-5	U-238+D , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(42,2)

#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.

Site-Specific Parameter Summary

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R011	Area of contaminated zone (m**2)	1.000E+03	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	5.000E-02	2.000E+00	---	THICK0
R011	Fraction of contamination that is submerged	0.000E+00	0.000E+00	---	SUBMFRACT
R011	Length parallel to aquifer flow (m)	not used	1.000E+02	---	LCZPAQ
R011	Basic radiation dose limit (mrem/yr)	2.500E+01	3.000E+01	---	BRDL
R011	Time since placement of material (yr)	0.000E+00	0.000E+00	---	TI
R011	Times for calculations (yr)	1.000E+00	1.000E+00	---	T(2)
R011	Times for calculations (yr)	1.000E+01	3.000E+00	---	T(3)
R011	Times for calculations (yr)	1.000E+02	1.000E+01	---	T(4)
R011	Times for calculations (yr)	1.000E+03	3.000E+01	---	T(5)
R011	Times for calculations (yr)	not used	1.000E+02	---	T(6)
R011	Times for calculations (yr)	not used	3.000E+02	---	T(7)
R011	Times for calculations (yr)	not used	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): Ag-108m	1.000E+02	0.000E+00	---	S1(2)
R012	Initial principal radionuclide (pCi/g): Al-26	1.000E+02	0.000E+00	---	S1(3)
R012	Initial principal radionuclide (pCi/g): Am-241	1.000E+02	0.000E+00	---	S1(4)
R012	Initial principal radionuclide (pCi/g): Am-243	1.000E+02	0.000E+00	---	S1(5)
R012	Initial principal radionuclide (pCi/g): Cm-243	1.000E+02	0.000E+00	---	S1(6)
R012	Initial principal radionuclide (pCi/g): Cm-244	1.000E+02	0.000E+00	---	S1(8)
R012	Initial principal radionuclide (pCi/g): Co-60	1.000E+02	0.000E+00	---	S1(11)
R012	Initial principal radionuclide (pCi/g): Cs-137	1.000E+02	0.000E+00	---	S1(12)
R012	Initial principal radionuclide (pCi/g): Eu-152	1.000E+02	0.000E+00	---	S1(13)
R012	Initial principal radionuclide (pCi/g): Eu-154	1.000E+02	0.000E+00	---	S1(15)
R012	Initial principal radionuclide (pCi/g): Eu-155	1.000E+02	0.000E+00	---	S1(16)
R012	Initial principal radionuclide (pCi/g): Nb-94	1.000E+02	0.000E+00	---	S1(18)
R012	Initial principal radionuclide (pCi/g): Np-237	1.000E+02	0.000E+00	---	S1(19)
R012	Initial principal radionuclide (pCi/g): Pu-238	1.000E+02	0.000E+00	---	S1(22)
R012	Initial principal radionuclide (pCi/g): Pu-239	1.000E+02	0.000E+00	---	S1(24)
R012	Initial principal radionuclide (pCi/g): Pu-240	1.000E+02	0.000E+00	---	S1(25)
R012	Initial principal radionuclide (pCi/g): Pu-241	1.000E+02	0.000E+00	---	S1(27)
R012	Initial principal radionuclide (pCi/g): Sr-90	1.000E+02	0.000E+00	---	S1(31)
R012	Initial principal radionuclide (pCi/g): Tc-99	1.000E+02	0.000E+00	---	S1(32)
R012	Initial principal radionuclide (pCi/g): Th-232	1.000E+02	0.000E+00	---	S1(36)
R012	Initial principal radionuclide (pCi/g): U-233	1.000E+02	0.000E+00	---	S1(37)
R012	Initial principal radionuclide (pCi/g): U-234	1.000E+02	0.000E+00	---	S1(38)
R012	Initial principal radionuclide (pCi/g): U-235	1.000E+02	0.000E+00	---	S1(39)
R012	Initial principal radionuclide (pCi/g): U-238	1.000E+02	0.000E+00	---	S1(41)
R012	Concentration in groundwater (pCi/L): Ag-108m	not used	0.000E+00	---	W1(2)
R012	Concentration in groundwater (pCi/L): Al-26	not used	0.000E+00	---	W1(3)
R012	Concentration in groundwater (pCi/L): Am-241	not used	0.000E+00	---	W1(4)
R012	Concentration in groundwater (pCi/L): Am-243	not used	0.000E+00	---	W1(5)
R012	Concentration in groundwater (pCi/L): Cm-243	not used	0.000E+00	---	W1(6)
R012	Concentration in groundwater (pCi/L): Cm-244	not used	0.000E+00	---	W1(8)
R012	Concentration in groundwater (pCi/L): Co-60	not used	0.000E+00	---	W1(11)
R012	Concentration in groundwater (pCi/L): Cs-137	not used	0.000E+00	---	W1(12)
R012	Concentration in groundwater (pCi/L): Eu-152	not used	0.000E+00	---	W1(13)
R012	Concentration in groundwater (pCi/L): Eu-154	not used	0.000E+00	---	W1(15)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R012	Concentration in groundwater (pCi/L): Eu-155	not used	0.000E+00	---	W1(16)
R012	Concentration in groundwater (pCi/L): Nb-94	not used	0.000E+00	---	W1(18)
R012	Concentration in groundwater (pCi/L): Np-237	not used	0.000E+00	---	W1(19)
R012	Concentration in groundwater (pCi/L): Pu-238	not used	0.000E+00	---	W1(22)
R012	Concentration in groundwater (pCi/L): Pu-239	not used	0.000E+00	---	W1(24)
R012	Concentration in groundwater (pCi/L): Pu-240	not used	0.000E+00	---	W1(25)
R012	Concentration in groundwater (pCi/L): Pu-241	not used	0.000E+00	---	W1(27)
R012	Concentration in groundwater (pCi/L): Sr-90	not used	0.000E+00	---	W1(31)
R012	Concentration in groundwater (pCi/L): Tc-99	not used	0.000E+00	---	W1(32)
R012	Concentration in groundwater (pCi/L): Th-232	not used	0.000E+00	---	W1(36)
R012	Concentration in groundwater (pCi/L): U-233	not used	0.000E+00	---	W1(37)
R012	Concentration in groundwater (pCi/L): U-234	not used	0.000E+00	---	W1(38)
R012	Concentration in groundwater (pCi/L): U-235	not used	0.000E+00	---	W1(39)
R012	Concentration in groundwater (pCi/L): U-238	not used	0.000E+00	---	W1(41)
R013	Cover depth (m)	0.000E+00	0.000E+00	---	COVER0
R013	Density of cover material (g/cm**3)	not used	1.500E+00	---	DENSCV
R013	Cover depth erosion rate (m/yr)	not used	1.000E-03	---	VCV
R013	Density of contaminated zone (g/cm**3)	1.500E+00	1.500E+00	---	DENSCZ
R013	Contaminated zone erosion rate (m/yr)	0.000E+00	1.000E-03	---	VCZ
R013	Contaminated zone total porosity	4.300E-01	4.000E-01	---	TPCZ
R013	Contaminated zone field capacity	2.000E-01	2.000E-01	---	FCCZ
R013	Contaminated zone hydraulic conductivity (m/yr)	1.090E+03	1.000E+01	---	HCCZ
R013	Contaminated zone b parameter	4.900E+00	5.300E+00	---	BCZ
R013	Average annual wind speed (m/sec)	3.120E+00	2.000E+00	---	WIND
R013	Humidity in air (g/m**3)	not used	8.000E+00	---	HUMID
R013	Evapotranspiration coefficient	9.800E-01	5.000E-01	---	EVAPTR
R013	Precipitation (m/yr)	9.600E-02	1.000E+00	---	PRECIP
R013	Irrigation (m/yr)	0.000E+00	2.000E-01	---	RI
R013	Irrigation mode	overhead	overhead	---	IDITCH
R013	Runoff coefficient	4.000E-01	2.000E-01	---	RUNOFF
R013	Watershed area for nearby stream or pond (m**2)	not used	1.000E+06	---	WAREA
R013	Accuracy for water/soil computations	not used	1.000E-03	---	EPS
R014	Density of saturated zone (g/cm**3)	not used	1.500E+00	---	DENSAQ
R014	Saturated zone total porosity	not used	4.000E-01	---	TPSZ
R014	Saturated zone effective porosity	not used	2.000E-01	---	EPSZ
R014	Saturated zone field capacity	not used	2.000E-01	---	FCSZ
R014	Saturated zone hydraulic conductivity (m/yr)	not used	1.000E+02	---	HCSZ
R014	Saturated zone hydraulic gradient	not used	2.000E-02	---	HGWT
R014	Saturated zone b parameter	not used	5.300E+00	---	BSZ
R014	Water table drop rate (m/yr)	not used	1.000E-03	---	VWT
R014	Well pump intake depth (m below water table)	not used	1.000E+01	---	DWIBWT
R014	Model: Nondispersion (ND) or Mass-Balance (MB)	not used	ND	---	MODEL
R014	Well pumping rate (m**3/yr)	not used	2.500E+02	---	UW
R015	Number of unsaturated zone strata	not used	1	---	NS

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R015	Unsat. zone 1, thickness (m)	not used	4.000E+00	---	H(1)
R015	Unsat. zone 1, soil density (g/cm**3)	not used	1.500E+00	---	DENSUZ(1)
R015	Unsat. zone 1, total porosity	not used	4.000E-01	---	TPUZ(1)
R015	Unsat. zone 1, effective porosity	not used	2.000E-01	---	EPUZ(1)
R015	Unsat. zone 1, field capacity	not used	2.000E-01	---	FCUZ(1)
R015	Unsat. zone 1, soil-specific b parameter	not used	5.300E+00	---	BUZ(1)
R015	Unsat. zone 1, hydraulic conductivity (m/yr)	not used	1.000E+01	---	HCUZ(1)
R016	Distribution coefficients for Ag-108m				
R016	Contaminated zone (cm**3/g)	0.000E+00	0.000E+00	---	DCNUCC(2)
R016	Unsaturated zone 1 (cm**3/g)	not used	0.000E+00	---	DCNUCU(2,1)
R016	Saturated zone (cm**3/g)	not used	0.000E+00	---	DCNUCS(2)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.152E-01	ALEACH(2)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(2)
R016	Distribution coefficients for Al-26				
R016	Contaminated zone (cm**3/g)	0.000E+00	0.000E+00	---	DCNUCC(3)
R016	Unsaturated zone 1 (cm**3/g)	not used	0.000E+00	---	DCNUCU(3,1)
R016	Saturated zone (cm**3/g)	not used	0.000E+00	---	DCNUCS(3)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.152E-01	ALEACH(3)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(3)
R016	Distribution coefficients for Am-241				
R016	Contaminated zone (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCC(4)
R016	Unsaturated zone 1 (cm**3/g)	not used	2.000E+01	---	DCNUCU(4,1)
R016	Saturated zone (cm**3/g)	not used	2.000E+01	---	DCNUCS(4)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	7.629E-04	ALEACH(4)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(4)
R016	Distribution coefficients for Am-243				
R016	Contaminated zone (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCC(5)
R016	Unsaturated zone 1 (cm**3/g)	not used	2.000E+01	---	DCNUCU(5,1)
R016	Saturated zone (cm**3/g)	not used	2.000E+01	---	DCNUCS(5)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	7.629E-04	ALEACH(5)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(5)
R016	Distribution coefficients for Cm-243				
R016	Contaminated zone (cm**3/g)	-1.000E+00	-1.000E+00	1.378E+03	DCNUCC(6)
R016	Unsaturated zone 1 (cm**3/g)	not used	-1.000E+00	---	DCNUCU(6,1)
R016	Saturated zone (cm**3/g)	not used	-1.000E+00	---	DCNUCS(6)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.115E-05	ALEACH(6)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(6)
R016	Distribution coefficients for Cm-244				
R016	Contaminated zone (cm**3/g)	-1.000E+00	-1.000E+00	1.378E+03	DCNUCC(8)
R016	Unsaturated zone 1 (cm**3/g)	not used	-1.000E+00	---	DCNUCU(8,1)
R016	Saturated zone (cm**3/g)	not used	-1.000E+00	---	DCNUCS(8)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.115E-05	ALEACH(8)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(8)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R016	Distribution coefficients for Co-60				
R016	Contaminated zone (cm**3/g)	1.000E+03	1.000E+03	---	DCNUCC(11)
R016	Unsaturated zone 1 (cm**3/g)	not used	1.000E+03	---	DCNUCU(11,1)
R016	Saturated zone (cm**3/g)	not used	1.000E+03	---	DCNUCS(11)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.536E-05	ALEACH(11)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(11)
R016	Distribution coefficients for Cs-137				
R016	Contaminated zone (cm**3/g)	4.600E+03	4.600E+03	---	DCNUCC(12)
R016	Unsaturated zone 1 (cm**3/g)	not used	4.600E+03	---	DCNUCU(12,1)
R016	Saturated zone (cm**3/g)	not used	4.600E+03	---	DCNUCS(12)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.339E-06	ALEACH(12)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(12)
R016	Distribution coefficients for Eu-152				
R016	Contaminated zone (cm**3/g)	-1.000E+00	-1.000E+00	8.249E+02	DCNUCC(13)
R016	Unsaturated zone 1 (cm**3/g)	not used	-1.000E+00	---	DCNUCU(13,1)
R016	Saturated zone (cm**3/g)	not used	-1.000E+00	---	DCNUCS(13)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.862E-05	ALEACH(13)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(13)
R016	Distribution coefficients for Eu-154				
R016	Contaminated zone (cm**3/g)	-1.000E+00	-1.000E+00	8.249E+02	DCNUCC(15)
R016	Unsaturated zone 1 (cm**3/g)	not used	-1.000E+00	---	DCNUCU(15,1)
R016	Saturated zone (cm**3/g)	not used	-1.000E+00	---	DCNUCS(15)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.862E-05	ALEACH(15)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(15)
R016	Distribution coefficients for Eu-155				
R016	Contaminated zone (cm**3/g)	-1.000E+00	-1.000E+00	8.249E+02	DCNUCC(16)
R016	Unsaturated zone 1 (cm**3/g)	not used	-1.000E+00	---	DCNUCU(16,1)
R016	Saturated zone (cm**3/g)	not used	-1.000E+00	---	DCNUCS(16)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.862E-05	ALEACH(16)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(16)
R016	Distribution coefficients for Nb-94				
R016	Contaminated zone (cm**3/g)	0.000E+00	0.000E+00	---	DCNUCC(18)
R016	Unsaturated zone 1 (cm**3/g)	not used	0.000E+00	---	DCNUCU(18,1)
R016	Saturated zone (cm**3/g)	not used	0.000E+00	---	DCNUCS(18)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.152E-01	ALEACH(18)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(18)
R016	Distribution coefficients for Np-237				
R016	Contaminated zone (cm**3/g)	-1.000E+00	-1.000E+00	2.574E+02	DCNUCC(19)
R016	Unsaturated zone 1 (cm**3/g)	not used	-1.000E+00	---	DCNUCU(19,1)
R016	Saturated zone (cm**3/g)	not used	-1.000E+00	---	DCNUCS(19)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	5.964E-05	ALEACH(19)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(19)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R016	Distribution coefficients for Pu-238				
R016	Contaminated zone (cm**3/g)	2.000E+03	2.000E+03	---	DCNUCC(22)
R016	Unsaturated zone 1 (cm**3/g)	not used	2.000E+03	---	DCNUCU(22,1)
R016	Saturated zone (cm**3/g)	not used	2.000E+03	---	DCNUCS(22)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	7.679E-06	ALEACH(22)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(22)
R016	Distribution coefficients for Pu-239				
R016	Contaminated zone (cm**3/g)	2.000E+03	2.000E+03	---	DCNUCC(24)
R016	Unsaturated zone 1 (cm**3/g)	not used	2.000E+03	---	DCNUCU(24,1)
R016	Saturated zone (cm**3/g)	not used	2.000E+03	---	DCNUCS(24)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	7.679E-06	ALEACH(24)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(24)
R016	Distribution coefficients for Pu-240				
R016	Contaminated zone (cm**3/g)	2.000E+03	2.000E+03	---	DCNUCC(25)
R016	Unsaturated zone 1 (cm**3/g)	not used	2.000E+03	---	DCNUCU(25,1)
R016	Saturated zone (cm**3/g)	not used	2.000E+03	---	DCNUCS(25)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	7.679E-06	ALEACH(25)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(25)
R016	Distribution coefficients for Pu-241				
R016	Contaminated zone (cm**3/g)	2.000E+03	2.000E+03	---	DCNUCC(27)
R016	Unsaturated zone 1 (cm**3/g)	not used	2.000E+03	---	DCNUCU(27,1)
R016	Saturated zone (cm**3/g)	not used	2.000E+03	---	DCNUCS(27)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	7.679E-06	ALEACH(27)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(27)
R016	Distribution coefficients for Sr-90				
R016	Contaminated zone (cm**3/g)	3.000E+01	3.000E+01	---	DCNUCC(31)
R016	Unsaturated zone 1 (cm**3/g)	not used	3.000E+01	---	DCNUCU(31,1)
R016	Saturated zone (cm**3/g)	not used	3.000E+01	---	DCNUCS(31)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	5.097E-04	ALEACH(31)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(31)
R016	Distribution coefficients for Tc-99				
R016	Contaminated zone (cm**3/g)	0.000E+00	0.000E+00	---	DCNUCC(32)
R016	Unsaturated zone 1 (cm**3/g)	not used	0.000E+00	---	DCNUCU(32,1)
R016	Saturated zone (cm**3/g)	not used	0.000E+00	---	DCNUCS(32)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.152E-01	ALEACH(32)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(32)
R016	Distribution coefficients for Th-232				
R016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCC(36)
R016	Unsaturated zone 1 (cm**3/g)	not used	6.000E+04	---	DCNUCU(36,1)
R016	Saturated zone (cm**3/g)	not used	6.000E+04	---	DCNUCS(36)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.560E-07	ALEACH(36)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(36)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R016	Distribution coefficients for U-233				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(37)
R016	Unsaturated zone 1 (cm**3/g)	not used	5.000E+01	---	DCNUCU(37,1)
R016	Saturated zone (cm**3/g)	not used	5.000E+01	---	DCNUCS(37)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.064E-04	ALEACH(37)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(37)
R016	Distribution coefficients for U-234				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(38)
R016	Unsaturated zone 1 (cm**3/g)	not used	5.000E+01	---	DCNUCU(38,1)
R016	Saturated zone (cm**3/g)	not used	5.000E+01	---	DCNUCS(38)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.064E-04	ALEACH(38)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(38)
R016	Distribution coefficients for U-235				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(39)
R016	Unsaturated zone 1 (cm**3/g)	not used	5.000E+01	---	DCNUCU(39,1)
R016	Saturated zone (cm**3/g)	not used	5.000E+01	---	DCNUCS(39)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.064E-04	ALEACH(39)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(39)
R016	Distribution coefficients for U-238				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(41)
R016	Unsaturated zone 1 (cm**3/g)	not used	5.000E+01	---	DCNUCU(41,1)
R016	Saturated zone (cm**3/g)	not used	5.000E+01	---	DCNUCS(41)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.064E-04	ALEACH(41)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(41)
R016	Distribution coefficients for daughter Ac-227				
R016	Contaminated zone (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCC(1)
R016	Unsaturated zone 1 (cm**3/g)	not used	2.000E+01	---	DCNUCU(1,1)
R016	Saturated zone (cm**3/g)	not used	2.000E+01	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	7.629E-04	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
R016	Distribution coefficients for daughter Gd-152				
R016	Contaminated zone (cm**3/g)	-1.000E+00	-1.000E+00	8.249E+02	DCNUCC(17)
R016	Unsaturated zone 1 (cm**3/g)	not used	-1.000E+00	---	DCNUCU(17,1)
R016	Saturated zone (cm**3/g)	not used	-1.000E+00	---	DCNUCS(17)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.862E-05	ALEACH(17)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(17)
R016	Distribution coefficients for daughter Pa-231				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(20)
R016	Unsaturated zone 1 (cm**3/g)	not used	5.000E+01	---	DCNUCU(20,1)
R016	Saturated zone (cm**3/g)	not used	5.000E+01	---	DCNUCS(20)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.064E-04	ALEACH(20)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(20)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R016	Distribution coefficients for daughter Pb-210				
R016	Contaminated zone (cm**3/g)	1.000E+02	1.000E+02	---	DCNUCC(21)
R016	Unsaturated zone 1 (cm**3/g)	not used	1.000E+02	---	DCNUCU(21,1)
R016	Saturated zone (cm**3/g)	not used	1.000E+02	---	DCNUCS(21)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.534E-04	ALEACH(21)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(21)
R016	Distribution coefficients for daughter Ra-226				
R016	Contaminated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCC(29)
R016	Unsaturated zone 1 (cm**3/g)	not used	7.000E+01	---	DCNUCU(29,1)
R016	Saturated zone (cm**3/g)	not used	7.000E+01	---	DCNUCS(29)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.190E-04	ALEACH(29)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(29)
R016	Distribution coefficients for daughter Ra-228				
R016	Contaminated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCC(30)
R016	Unsaturated zone 1 (cm**3/g)	not used	7.000E+01	---	DCNUCU(30,1)
R016	Saturated zone (cm**3/g)	not used	7.000E+01	---	DCNUCS(30)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.190E-04	ALEACH(30)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(30)
R016	Distribution coefficients for daughter Th-228				
R016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCC(33)
R016	Unsaturated zone 1 (cm**3/g)	not used	6.000E+04	---	DCNUCU(33,1)
R016	Saturated zone (cm**3/g)	not used	6.000E+04	---	DCNUCS(33)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.560E-07	ALEACH(33)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(33)
R016	Distribution coefficients for daughter Th-229				
R016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCC(34)
R016	Unsaturated zone 1 (cm**3/g)	not used	6.000E+04	---	DCNUCU(34,1)
R016	Saturated zone (cm**3/g)	not used	6.000E+04	---	DCNUCS(34)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.560E-07	ALEACH(34)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(34)
R016	Distribution coefficients for daughter Th-230				
R016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCC(35)
R016	Unsaturated zone 1 (cm**3/g)	not used	6.000E+04	---	DCNUCU(35,1)
R016	Saturated zone (cm**3/g)	not used	6.000E+04	---	DCNUCS(35)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.560E-07	ALEACH(35)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(35)
R016	Distribution coefficients for daughter U-236				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(40)
R016	Unsaturated zone 1 (cm**3/g)	not used	5.000E+01	---	DCNUCU(40,1)
R016	Saturated zone (cm**3/g)	not used	5.000E+01	---	DCNUCS(40)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.064E-04	ALEACH(40)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(40)
R017	Inhalation rate (m**3/yr)	1.200E+04	8.400E+03	---	INHALR

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R017	Mass loading for inhalation (g/m**3)	6.000E-04	1.000E-04	---	MLINH
R017	Exposure duration	2.500E+01	3.000E+01	---	ED
R017	Shielding factor, inhalation	1.000E+00	4.000E-01	---	SHF3
R017	Shielding factor, external gamma	7.000E-01	7.000E-01	---	SHF1
R017	Fraction of time spent indoors	2.740E-02	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	8.220E-02	2.500E-01	---	FOTD
R017	Shape factor flag, external gamma	1.000E+00	1.000E+00	>0 shows circular AREA.	FS
R017	Radii of shape factor array (used if FS = -1):				
R017	Outer annular radius (m), ring 1:	not used	5.000E+01	---	RAD_SHAPE(1)
R017	Outer annular radius (m), ring 2:	not used	7.071E+01	---	RAD_SHAPE(2)
R017	Outer annular radius (m), ring 3:	not used	0.000E+00	---	RAD_SHAPE(3)
R017	Outer annular radius (m), ring 4:	not used	0.000E+00	---	RAD_SHAPE(4)
R017	Outer annular radius (m), ring 5:	not used	0.000E+00	---	RAD_SHAPE(5)
R017	Outer annular radius (m), ring 6:	not used	0.000E+00	---	RAD_SHAPE(6)
R017	Outer annular radius (m), ring 7:	not used	0.000E+00	---	RAD_SHAPE(7)
R017	Outer annular radius (m), ring 8:	not used	0.000E+00	---	RAD_SHAPE(8)
R017	Outer annular radius (m), ring 9:	not used	0.000E+00	---	RAD_SHAPE(9)
R017	Outer annular radius (m), ring 10:	not used	0.000E+00	---	RAD_SHAPE(10)
R017	Outer annular radius (m), ring 11:	not used	0.000E+00	---	RAD_SHAPE(11)
R017	Outer annular radius (m), ring 12:	not used	0.000E+00	---	RAD_SHAPE(12)
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)	3.190E+01	3.650E+01	---	SOIL
R018	Drinking water intake (L/yr)	not used	5.100E+02	---	DWI
R018	Contamination fraction of drinking water	not used	1.000E+00	---	FDW
R018	Contamination fraction of household water	not used	1.000E+00	---	FHHW
R018	Contamination fraction of livestock water	not used	1.000E+00	---	FLW
R018	Contamination fraction of irrigation water	not used	1.000E+00	---	FIRW
R018	Contamination fraction of aquatic food	not used	5.000E-01	---	FR9
R018	Contamination fraction of plant food	not used	-1	---	FPLANT
R018	Contamination fraction of meat	not used	-1	---	FMEAT

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
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)	4.500E-01	1.500E-01	---	DM
R019	Depth of roots (m)	not used	9.000E-01	---	DROOT
R019	Drinking water fraction from ground water	not used	1.000E+00	---	FGWDW
R019	Household water fraction from ground water	not used	1.000E+00	---	FGWHH
R019	Livestock water fraction from ground water	not used	1.000E+00	---	FGWLW
R019	Irrigation fraction from ground water	not used	1.000E+00	---	FGWIR
R19B	Wet weight crop yield for Non-Leafy (kg/m**2)	not used	7.000E-01	---	YV(1)
R19B	Wet weight crop yield for Leafy (kg/m**2)	not used	1.500E+00	---	YV(2)
R19B	Wet weight crop yield for Fodder (kg/m**2)	not used	1.100E+00	---	YV(3)
R19B	Growing Season for Non-Leafy (years)	not used	1.700E-01	---	TE(1)
R19B	Growing Season for Leafy (years)	not used	2.500E-01	---	TE(2)
R19B	Growing Season for Fodder (years)	not used	8.000E-02	---	TE(3)
R19B	Translocation Factor for Non-Leafy	not used	1.000E-01	---	TIV(1)
R19B	Translocation Factor for Leafy	not used	1.000E+00	---	TIV(2)
R19B	Translocation Factor for Fodder	not used	1.000E+00	---	TIV(3)
R19B	Dry Foliar Interception Fraction for Non-Leafy	not used	2.500E-01	---	RDRY(1)
R19B	Dry Foliar Interception Fraction for Leafy	not used	2.500E-01	---	RDRY(2)
R19B	Dry Foliar Interception Fraction for Fodder	not used	2.500E-01	---	RDRY(3)
R19B	Wet Foliar Interception Fraction for Non-Leafy	not used	2.500E-01	---	RWET(1)
R19B	Wet Foliar Interception Fraction for Leafy	not used	2.500E-01	---	RWET(2)
R19B	Wet Foliar Interception Fraction for Fodder	not used	2.500E-01	---	RWET(3)
R19B	Weathering Removal Constant for Vegetation	not used	2.000E+01	---	WLAM
C14	C-12 concentration in water (g/cm**3)	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)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
STOR	Surface water	1.000E+00	1.000E+00	---	STOR_T(8)
STOR	Livestock fodder	4.500E+01	4.500E+01	---	STOR_T(9)
R021	Thickness of building foundation (m)	not used	1.500E-01	---	FLOOR1
R021	Bulk density of building foundation (g/cm**3)	not used	2.400E+00	---	DENSFL
R021	Total porosity of the cover material	not used	4.000E-01	---	TPCV
R021	Total porosity of the building foundation	not used	1.000E-01	---	TPFL
R021	Volumetric water content of the cover material	not used	5.000E-02	---	PH2OCV
R021	Volumetric water content of the foundation	not used	3.000E-02	---	PH2OFL
R021	Diffusion coefficient for radon gas (m/sec):				
R021	in cover material	not used	2.000E-06	---	DIFCV
R021	in foundation material	not used	3.000E-07	---	DIFFL
R021	in contaminated zone soil	not used	2.000E-06	---	DIFCZ
R021	Radon vertical dimension of mixing (m)	not used	2.000E+00	---	HMIX
R021	Average building air exchange rate (1/hr)	not used	5.000E-01	---	REXG
R021	Height of the building (room) (m)	not used	2.500E+00	---	HRM
R021	Building interior area factor	not used	0.000E+00	---	FAI
R021	Building depth below ground surface (m)	not used	-1.000E+00	---	DMFL
R021	Emanating power of Rn-222 gas	not used	2.500E-01	---	EMANA(1)
R021	Emanating power of Rn-220 gas	not used	1.500E-01	---	EMANA(2)
TITL	Number of graphical time points	32	---	---	NPTS
TITL	Maximum number of integration points for dose	17	---	---	LYMAX
TITL	Maximum number of integration points for risk	257	---	---	KYMAX

Summary of Pathway Selections

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

Contaminated Zone Dimensions		Initial Soil Concentrations, pCi/g	
Area:	1000.00 square meters	Ag-108m	1.000E+02
Thickness:	0.05 meters	Al-26	1.000E+02
Cover Depth:	0.00 meters	Am-241	1.000E+02
		Am-243	1.000E+02
		Cm-243	1.000E+02
		Cm-244	1.000E+02
		Co-60	1.000E+02
		Cs-137	1.000E+02
		Eu-152	1.000E+02
		Eu-154	1.000E+02
		Eu-155	1.000E+02
		Nb-94	1.000E+02
		Np-237	1.000E+02
		Pu-238	1.000E+02
		Pu-239	1.000E+02
		Pu-240	1.000E+02
		Pu-241	1.000E+02
		Sr-90	1.000E+02
		Tc-99	1.000E+02
		Th-232	1.000E+02
		U-233	1.000E+02
		U-234	1.000E+02
		U-235	1.000E+02
		U-238	1.000E+02

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	1.000E+01	1.000E+02	1.000E+03
TDOSE(t):	3.451E+02	3.182E+02	1.887E+02	9.419E+01	8.726E+01
M(t):	1.380E+01	1.273E+01	7.547E+00	3.768E+00	3.490E+00

Maximum TDOSE(t): 3.451E+02 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-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Ag-108m	4.668E+01	0.1353	1.259E-04	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.114E-04	0.0000
Al-26	7.225E+01	0.2094	6.817E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.770E-04	0.0000
Am-241	3.901E-01	0.0011	3.458E-01	0.0010	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.871E-02	0.0001
Am-243	5.970E+00	0.0173	3.461E-01	0.0010	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.885E-02	0.0001
Cm-243	3.615E+00	0.0105	2.457E-01	0.0007	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.130E-02	0.0001
Cm-244	1.239E-03	0.0000	2.019E-01	0.0006	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.692E-02	0.0000
Co-60	6.789E+01	0.1967	1.051E-04	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.587E-04	0.0000
Cs-137	1.705E+01	0.0494	1.388E-04	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.847E-03	0.0000
Eu-152	3.252E+01	0.0942	1.473E-04	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.961E-04	0.0000
Eu-154	3.484E+01	0.1010	1.838E-04	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.764E-04	0.0000
Eu-155	1.294E+00	0.0037	2.321E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.278E-05	0.0000
Nb-94	4.494E+01	0.1302	1.667E-04	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.308E-04	0.0000
Np-237	6.506E+00	0.0189	1.804E-01	0.0005	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.594E-02	0.0000
Pu-238	1.402E-03	0.0000	3.954E-01	0.0011	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.293E-02	0.0001
Pu-239	1.994E-03	0.0000	4.330E-01	0.0013	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.593E-02	0.0001
Pu-240	1.366E-03	0.0000	4.330E-01	0.0013	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.593E-02	0.0001
Pu-241	4.341E-04	0.0000	8.376E-03	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.978E-04	0.0000
Sr-90	1.417E-01	0.0004	5.757E-04	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.375E-03	0.0000
Tc-99	9.470E-04	0.0000	4.431E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.696E-05	0.0000
Th-232	1.918E+00	0.0056	4.013E-01	0.0012	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.893E-02	0.0001
U-233	9.518E-03	0.0000	3.466E-02	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.345E-03	0.0000
U-234	3.223E-03	0.0000	3.394E-02	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.030E-03	0.0000
U-235	4.833E+00	0.0140	3.072E-02	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.808E-03	0.0000
U-238	8.197E-01	0.0024	2.889E-02	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.976E-03	0.0000
Total	3.417E+02	0.9901	3.121E+00	0.0090	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.926E-01	0.0008

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

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Ag-108m	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.668E+01	0.1353
Al-26	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.225E+01	0.2094
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.646E-01	0.0022
Am-243	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.345E+00	0.0184
Cm-243	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.882E+00	0.0113
Cm-244	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.201E-01	0.0006
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.789E+01	0.1967
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.705E+01	0.0494
Eu-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.252E+01	0.0942
Eu-154	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.484E+01	0.1010
Eu-155	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.294E+00	0.0037
Nb-94	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.494E+01	0.1302
Np-237	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.703E+00	0.0194
Pu-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	4.297E-01	0.0012
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.709E-01	0.0014
Pu-240	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.703E-01	0.0014
Pu-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.508E-03	0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.466E-01	0.0004
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.078E-03	0.0000
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.358E+00	0.0068
U-233	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.152E-02	0.0001
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.419E-02	0.0001
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.871E+00	0.0141
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	8.556E-01	0.0025
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	3.451E+02	1.0000

*Sum of all water independent and dependent pathways.

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

Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	Soil mrem/yr	Soil fract.
Ag-108m	4.137E+01	0.1300	1.116E-04	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.760E-04	0.0000
Al-26	6.438E+01	0.2024	6.075E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.251E-04	0.0000
Am-241	3.892E-01	0.0012	3.450E-01	0.0011	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.865E-02	0.0001
Am-243	5.965E+00	0.0187	3.458E-01	0.0011	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.883E-02	0.0001
Cm-243	3.528E+00	0.0111	2.398E-01	0.0008	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.079E-02	0.0001
Cm-244	1.193E-03	0.0000	1.944E-01	0.0006	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.629E-02	0.0001
Co-60	5.952E+01	0.1871	9.214E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.021E-04	0.0000
Cs-137	1.666E+01	0.0524	1.357E-04	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.805E-03	0.0000
Eu-152	3.087E+01	0.0970	1.398E-04	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.861E-04	0.0000
Eu-154	3.220E+01	0.1012	1.699E-04	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.555E-04	0.0000
Eu-155	1.125E+00	0.0035	2.018E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.720E-05	0.0000
Nb-94	4.005E+01	0.1259	1.486E-04	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.057E-04	0.0000
Np-237	6.506E+00	0.0204	1.804E-01	0.0006	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.593E-02	0.0001
Pu-238	1.391E-03	0.0000	3.922E-01	0.0012	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.267E-02	0.0001
Pu-239	1.994E-03	0.0000	4.330E-01	0.0014	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.593E-02	0.0001
Pu-240	1.366E-03	0.0000	4.329E-01	0.0014	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.593E-02	0.0001
Pu-241	1.024E-03	0.0000	8.523E-03	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.099E-04	0.0000
Sr-90	1.383E-01	0.0004	5.619E-04	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.270E-03	0.0000
Tc-99	8.440E-04	0.0000	3.949E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.750E-05	0.0000
Th-232	6.369E+00	0.0200	4.127E-01	0.0013	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.022E-02	0.0002
U-233	1.037E-02	0.0000	3.474E-02	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.351E-03	0.0000
U-234	3.222E-03	0.0000	3.393E-02	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.028E-03	0.0000
U-235	4.832E+00	0.0152	3.073E-02	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.809E-03	0.0000
U-238	8.194E-01	0.0026	2.888E-02	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.974E-03	0.0000
Total	3.147E+02	0.9893	3.115E+00	0.0098	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.020E-01	0.0009

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 mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
Ag-108m	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.137E+01	0.1300
Al-26	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.439E+01	0.2024
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.628E-01	0.0024
Am-243	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.340E+00	0.0199
Cm-243	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.789E+00	0.0119
Cm-244	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.119E-01	0.0007
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.952E+01	0.1871
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.666E+01	0.0524
Eu-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.087E+01	0.0970
Eu-154	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.220E+01	0.1012
Eu-155	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.125E+00	0.0035
Nb-94	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.005E+01	0.1259
Np-237	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.702E+00	0.0211
Pu-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	4.263E-01	0.0013
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.709E-01	0.0015
Pu-240	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.702E-01	0.0015
Pu-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.026E-02	0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.431E-01	0.0004
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.609E-04	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	6.831E+00	0.0215
U-233	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.246E-02	0.0002
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	4.418E-02	0.0001
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.869E+00	0.0153
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	8.553E-01	0.0027
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	3.182E+02	1.0000

*Sum of all water independent and dependent pathways.

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

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Ag-108m	1.397E+01	0.0740	3.766E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.318E-05	0.0000
Al-26	2.283E+01	0.1210	2.154E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.507E-04	0.0000
Am-241	3.810E-01	0.0020	3.377E-01	0.0018	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.804E-02	0.0001
Am-243	5.919E+00	0.0314	3.432E-01	0.0018	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.861E-02	0.0002
Cm-243	2.835E+00	0.0150	1.927E-01	0.0010	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.671E-02	0.0001
Cm-244	8.462E-04	0.0000	1.381E-01	0.0007	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.157E-02	0.0001
Co-60	1.822E+01	0.0966	2.821E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.231E-04	0.0000
Cs-137	1.353E+01	0.0717	1.102E-04	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.466E-03	0.0000
Eu-152	1.933E+01	0.1024	8.756E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.166E-04	0.0000
Eu-154	1.584E+01	0.0840	8.360E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.257E-04	0.0000
Eu-155	3.198E-01	0.0017	5.737E-06	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.057E-05	0.0000
Nb-94	1.420E+01	0.0752	5.267E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.291E-05	0.0000
Np-237	6.502E+00	0.0345	1.803E-01	0.0010	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.593E-02	0.0001
Pu-238	1.296E-03	0.0000	3.653E-01	0.0019	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.043E-02	0.0002
Pu-239	1.993E-03	0.0000	4.328E-01	0.0023	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.592E-02	0.0002
Pu-240	1.365E-03	0.0000	4.325E-01	0.0023	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.589E-02	0.0002
Pu-241	5.171E-03	0.0000	9.521E-03	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.920E-04	0.0000
Sr-90	1.111E-01	0.0006	4.515E-04	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.431E-03	0.0000
Tc-99	2.992E-04	0.0000	1.400E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.748E-05	0.0000
Th-232	4.557E+01	0.2415	5.309E-01	0.0028	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.162E-01	0.0006
U-233	1.801E-02	0.0001	3.542E-02	0.0002	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.405E-03	0.0000
U-234	3.225E-03	0.0000	3.386E-02	0.0002	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.011E-03	0.0000
U-235	4.819E+00	0.0255	3.080E-02	0.0002	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.815E-03	0.0000
U-238	8.172E-01	0.0043	2.880E-02	0.0002	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.955E-03	0.0000
Total	1.852E+02	0.9817	3.093E+00	0.0164	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.539E-01	0.0019

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-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Ag-108m	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.397E+01	0.0740
Al-26	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.283E+01	0.1210
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.468E-01	0.0040
Am-243	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.291E+00	0.0333
Cm-243	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.044E+00	0.0161
Cm-244	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.505E-01	0.0008
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.822E+01	0.0966
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.353E+01	0.0717
Eu-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.933E+01	0.1024
Eu-154	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.584E+01	0.0840
Eu-155	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.198E-01	0.0017
Nb-94	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.420E+01	0.0752
Np-237	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.699E+00	0.0355
Pu-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	3.970E-01	0.0021
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.708E-01	0.0025
Pu-240	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.697E-01	0.0025
Pu-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.548E-02	0.0001
Sr-90	0.000E+00	0.0000	0.000E+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-01	0.0006
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.407E-04	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	4.622E+01	0.2450
U-233	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.083E-02	0.0003
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.410E-02	0.0002
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.857E+00	0.0257
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	8.529E-01	0.0045
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	1.887E+02	1.0000

*Sum of all water independent and dependent pathways.

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

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Ag-108m	2.685E-04	0.0000	7.241E-10	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.792E-09	0.0000
Al-26	7.173E-04	0.0000	6.768E-10	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.736E-09	0.0000
Am-241	3.081E-01	0.0033	2.729E-01	0.0029	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.266E-02	0.0002
Am-243	5.480E+00	0.0582	3.189E-01	0.0034	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.658E-02	0.0003
Cm-243	3.173E-01	0.0034	2.203E-02	0.0002	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.908E-03	0.0000
Cm-244	3.061E-05	0.0000	5.553E-03	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.645E-04	0.0000
Co-60	1.318E-04	0.0000	2.041E-10	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.908E-10	0.0000
Cs-137	1.691E+00	0.0180	1.377E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.832E-04	0.0000
Eu-152	1.791E-01	0.0019	8.112E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.080E-06	0.0000
Eu-154	1.320E-02	0.0001	6.963E-08	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.047E-07	0.0000
Eu-155	1.101E-06	0.0000	1.976E-11	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.642E-11	0.0000
Nb-94	4.448E-04	0.0000	1.650E-09	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.284E-09	0.0000
Np-237	6.467E+00	0.0687	1.794E-01	0.0019	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.584E-02	0.0002
Pu-238	6.366E-04	0.0000	1.793E-01	0.0019	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.493E-02	0.0002
Pu-239	1.987E-03	0.0000	4.314E-01	0.0046	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.580E-02	0.0004
Pu-240	1.351E-03	0.0000	4.281E-01	0.0045	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.553E-02	0.0004
Pu-241	1.068E-02	0.0001	9.532E-03	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.914E-04	0.0000
Sr-90	1.246E-02	0.0001	5.062E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.846E-04	0.0000
Tc-99	9.400E-09	0.0000	4.398E-10	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.632E-10	0.0000
Th-232	7.118E+01	0.7557	6.118E-01	0.0065	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.526E-01	0.0016
U-233	9.287E-02	0.0010	4.216E-02	0.0004	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.935E-03	0.0001
U-234	4.103E-03	0.0000	3.322E-02	0.0004	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.847E-03	0.0001
U-235	4.706E+00	0.0500	3.377E-02	0.0004	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.061E-03	0.0001
U-238	7.950E-01	0.0084	2.803E-02	0.0003	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.768E-03	0.0001
Total	9.126E+01	0.9689	2.596E+00	0.0276	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.362E-01	0.0036

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-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Ag-108m	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.685E-04	0.0000
Al-26	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.173E-04	0.0000
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.037E-01	0.0064
Am-243	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.825E+00	0.0618
Cm-243	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.413E-01	0.0036
Cm-244	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.048E-03	0.0001
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.318E-04	0.0000
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.691E+00	0.0180
Eu-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.791E-01	0.0019
Eu-154	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.320E-02	0.0001
Eu-155	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.101E-06	0.0000
Nb-94	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.448E-04	0.0000
Np-237	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.663E+00	0.0707
Pu-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	1.949E-01	0.0021
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.692E-01	0.0050
Pu-240	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.650E-01	0.0049
Pu-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.101E-02	0.0002
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.289E-02	0.0001
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.070E-08	0.0000
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	7.194E+01	0.7638
U-233	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.430E-01	0.0015
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	4.417E-02	0.0005
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.747E+00	0.0504
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	8.297E-01	0.0088
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.419E+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 mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	Soil mrem/yr	Soil fract.
Ag-108m	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Al-26	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Am-241	3.736E-02	0.0004	3.246E-02	0.0004	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.695E-03	0.0000
Am-243	2.534E+00	0.0290	1.551E-01	0.0018	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.293E-02	0.0001
Cm-243	2.661E-05	0.0000	4.952E-04	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.110E-05	0.0000
Cm-244	3.388E-06	0.0000	1.073E-03	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.908E-05	0.0000
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Cs-137	1.570E-09	0.0000	1.278E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.701E-13	0.0000
Eu-152	8.339E-22	0.0000	2.319E-15	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.997E-16	0.0000
Eu-154	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Eu-155	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Nb-94	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Np-237	6.129E+00	0.0702	1.702E-01	0.0020	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.505E-02	0.0002
Pu-238	2.229E-05	0.0000	1.557E-04	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.423E-05	0.0000
Pu-239	1.926E-03	0.0000	4.175E-01	0.0048	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.465E-02	0.0004
Pu-240	1.220E-03	0.0000	3.864E-01	0.0044	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.207E-02	0.0004
Pu-241	1.308E-03	0.0000	1.137E-03	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.441E-05	0.0000
Sr-90	3.911E-12	0.0000	1.590E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.208E-13	0.0000
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-232	7.116E+01	0.8155	6.116E-01	0.0070	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.525E-01	0.0017
U-233	7.053E-01	0.0081	9.683E-02	0.0011	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.218E-02	0.0001
U-234	7.494E-02	0.0009	2.779E-02	0.0003	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.815E-03	0.0001
U-235	3.747E+00	0.0429	6.070E-02	0.0007	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.146E-03	0.0001
U-238	6.034E-01	0.0069	2.134E-02	0.0002	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.150E-03	0.0001
Total	8.500E+01	0.9740	1.983E+00	0.0227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.824E-01	0.0032

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 mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
Ag-108m	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Al-26	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.251E-02	0.0008
Am-243	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.702E+00	0.0310
Cm-243	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.630E-04	0.0000
Cm-244	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.166E-03	0.0000
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.570E-09	0.0000
Eu-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.519E-15	0.0000
Eu-154	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Eu-155	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Nb-94	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Np-237	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.314E+00	0.0724
Pu-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	1.922E-04	0.0000
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.541E-01	0.0052
Pu-240	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.197E-01	0.0048
Pu-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.539E-03	0.0000
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.048E-12	0.0000
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.192E+01	0.8242
U-233	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.143E-01	0.0093
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	1.085E-01	0.0012
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.816E+00	0.0437
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	6.299E-01	0.0072
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.726E+01	1.0000

*Sum of all water independent and dependent pathways.

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

Parent (i)	Product (j)	Thread Fraction	DSR(j,t) At Time in Years (mrem/yr)/(pCi/g) 0.000E+00	1.000E+00	1.000E+01	1.000E+02	1.000E+03
Ag-108m+D	Ag-108m+D	1.000E+00	4.668E-01	4.137E-01	1.397E-01	2.685E-06	0.000E+00
Al-26	Al-26	1.000E+00	7.225E-01	6.439E-01	2.283E-01	7.173E-06	0.000E+00
Am-241	Am-241	1.000E+00	7.646E-03	7.628E-03	7.467E-03	6.035E-03	7.171E-04
Am-241	Np-237+D	1.000E+00	1.085E-08	3.250E-08	2.251E-07	1.936E-06	7.982E-06
Am-241	U-233	1.000E+00	1.204E-16	8.425E-16	3.952E-14	3.337E-12	1.638E-10
Am-241	Th-229+D	1.000E+00	5.599E-19	8.393E-18	2.581E-15	2.120E-12	1.200E-09
Am-241	äDSR(j)		7.646E-03	7.628E-03	7.468E-03	6.037E-03	7.251E-04
Am-243+D	Am-243+D	1.000E+00	6.345E-02	6.340E-02	6.291E-02	5.824E-02	2.694E-02
Am-243+D	Pu-239	1.000E+00	6.780E-08	2.033E-07	1.418E-06	1.304E-05	8.926E-05
Am-243+D	U-235+D	1.000E+00	2.302E-16	1.611E-15	7.591E-14	6.705E-12	4.702E-10
Am-243+D	Pa-231	1.000E+00	4.246E-22	6.367E-21	1.963E-18	1.660E-15	1.171E-12
Am-243+D	Ac-227+D	1.000E+00	2.202E-23	6.787E-22	1.260E-18	6.392E-15	8.645E-12
Am-243+D	äDSR(j)		6.345E-02	6.340E-02	6.291E-02	5.825E-02	2.702E-02
Cm-243	Cm-243	2.400E-03	9.318E-05	9.094E-05	7.305E-05	8.177E-06	2.524E-15
Cm-243	Am-243+D	2.400E-03	7.095E-09	2.105E-08	1.320E-07	5.064E-07	2.586E-07
Cm-243	Pu-239	2.400E-03	5.064E-15	3.520E-14	1.547E-12	7.642E-11	8.054E-10
Cm-243	U-235+D	2.400E-03	1.291E-23	1.926E-22	5.639E-20	3.050E-17	4.070E-15
Cm-243	Pa-231	2.400E-03	1.907E-29	5.885E-28	1.108E-24	6.214E-21	9.749E-18
Cm-243	Ac-227+D	2.400E-03	8.254E-31	5.156E-29	5.801E-25	2.164E-20	7.169E-17
Cm-243	äDSR(j)		9.318E-05	9.096E-05	7.318E-05	8.683E-06	2.594E-07
Cm-243	Cm-243	9.976E-01	3.873E-02	3.780E-02	3.037E-02	3.399E-03	1.049E-12
Cm-243	Pu-239	9.976E-01	6.711E-08	1.992E-07	1.254E-06	5.066E-06	5.370E-06
Cm-243	U-235+D	9.976E-01	2.283E-16	1.587E-15	6.987E-14	3.520E-12	4.623E-11
Cm-243	Pa-231	9.976E-01	4.216E-22	6.291E-21	1.844E-18	1.010E-15	1.557E-13
Cm-243	Ac-227+D	9.976E-01	2.188E-23	6.717E-22	1.197E-18	4.128E-15	1.176E-12
Cm-243	äDSR(j)		3.873E-02	3.780E-02	3.037E-02	3.404E-03	5.370E-06
Cm-244	Cm-244	1.350E-06	2.971E-09	2.859E-09	2.026E-09	6.459E-11	7.010E-26
Cm-244	Cm-244	4.950E-08	1.089E-10	1.048E-10	7.428E-11	2.368E-12	2.570E-27
Cm-244	Pu-240	4.950E-08	1.219E-14	3.594E-14	2.133E-13	6.255E-13	5.771E-13
Cm-244	äDSR(j)		1.089E-10	1.049E-10	7.449E-11	2.994E-12	5.771E-13
Cm-244	Cm-244	1.000E+00	2.200E-03	2.118E-03	1.501E-03	4.784E-05	5.192E-20
Cm-244	Pu-240	1.000E+00	2.462E-07	7.261E-07	4.308E-06	1.264E-05	1.166E-05
Cm-244	U-236	1.000E+00	2.071E-16	1.434E-15	6.070E-14	2.414E-12	2.606E-11
Cm-244	Th-232	1.000E+00	2.780E-26	4.136E-25	1.178E-22	5.366E-20	7.290E-18
Cm-244	Ra-228+D	1.000E+00	4.303E-26	1.298E-24	1.965E-21	2.878E-18	4.685E-16
Cm-244	Th-228+D	1.000E+00	3.775E-27	2.211E-25	1.407E-21	4.078E-18	7.095E-16
Cm-244	äDSR(j)		2.201E-03	2.119E-03	1.505E-03	6.048E-05	1.166E-05

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

Parent (i)	Product (j)	Thread Fraction	DSR(j,t) At Time in Years (mrem/yr)/(pCi/g) 0.000E+00	1.000E+00	1.000E+01	1.000E+02	1.000E+03
Co-60	Co-60	1.000E+00	6.789E-01	5.952E-01	1.822E-01	1.318E-06	0.000E+00
Cs-137+D	Cs-137+D	1.000E+00	1.705E-01	1.666E-01	1.353E-01	1.691E-02	1.570E-11
Eu-152	Eu-152	7.208E-01	2.344E-01	2.225E-01	1.393E-01	1.291E-03	6.011E-24
Eu-152	Eu-152	2.792E-01	9.079E-02	8.619E-02	5.397E-02	5.000E-04	2.328E-24
Eu-152	Gd-152	2.792E-01	6.557E-19	1.923E-18	1.079E-17	2.548E-17	2.519E-17
Eu-152	äDSR(j)		9.079E-02	8.619E-02	5.397E-02	5.000E-04	2.519E-17
Eu-154	Eu-154	1.000E+00	3.484E-01	3.220E-01	1.584E-01	1.320E-04	2.118E-35
Eu-155	Eu-155	1.000E+00	1.294E-02	1.125E-02	3.198E-03	1.101E-08	0.000E+00
Nb-94	Nb-94	1.000E+00	4.494E-01	4.005E-01	1.420E-01	4.448E-06	0.000E+00
Np-237+D	Np-237+D	1.000E+00	6.703E-02	6.702E-02	6.699E-02	6.663E-02	6.313E-02
Np-237+D	U-233	1.000E+00	1.116E-09	3.348E-09	2.340E-08	2.203E-07	1.861E-06
Np-237+D	Th-229+D	1.000E+00	6.918E-12	4.842E-11	2.286E-09	2.064E-07	1.782E-05
Np-237+D	äDSR(j)		6.703E-02	6.702E-02	6.699E-02	6.663E-02	6.314E-02
Pu-238	Pu-238	1.840E-09	7.906E-12	7.844E-12	7.305E-12	3.585E-12	2.909E-15
Pu-238	Pu-238	1.000E+00	4.297E-03	4.263E-03	3.970E-03	1.949E-03	1.581E-06
Pu-238	U-234	1.000E+00	6.247E-10	1.867E-09	1.260E-08	8.536E-08	1.209E-07
Pu-238	Th-230	1.000E+00	1.699E-14	1.186E-13	5.475E-12	3.979E-10	9.824E-09
Pu-238	Ra-226+D	1.000E+00	2.342E-16	3.507E-15	1.064E-12	7.703E-10	2.088E-07
Pu-238	Pb-210+D	1.000E+00	1.007E-20	3.101E-19	5.695E-16	2.562E-12	1.356E-09
Pu-238	äDSR(j)		4.297E-03	4.263E-03	3.970E-03	1.949E-03	1.922E-06
Pu-239	Pu-239	1.000E+00	4.709E-03	4.709E-03	4.708E-03	4.692E-03	4.541E-03
Pu-239	U-235+D	1.000E+00	2.399E-11	7.195E-11	5.028E-10	4.739E-09	4.056E-08
Pu-239	Pa-231	1.000E+00	5.898E-17	4.128E-16	1.948E-14	1.748E-12	1.420E-10
Pu-239	Ac-227+D	1.000E+00	3.819E-18	5.688E-17	1.638E-14	7.978E-12	1.075E-09
Pu-239	äDSR(j)		4.709E-03	4.709E-03	4.708E-03	4.692E-03	4.541E-03
Pu-240	Pu-240	4.950E-08	2.328E-10	2.328E-10	2.325E-10	2.302E-10	2.078E-10
Pu-240	Pu-240	1.000E+00	4.703E-03	4.702E-03	4.697E-03	4.650E-03	4.197E-03
Pu-240	U-236	1.000E+00	5.915E-12	1.774E-11	1.240E-10	1.164E-09	9.609E-09
Pu-240	Th-232	1.000E+00	1.057E-21	7.395E-21	3.493E-19	3.157E-17	2.764E-15
Pu-240	Ra-228+D	1.000E+00	2.034E-21	2.974E-20	7.229E-18	1.751E-15	1.777E-13
Pu-240	Th-228+D	1.000E+00	2.123E-22	6.079E-21	5.925E-18	2.514E-15	2.692E-13
Pu-240	äDSR(j)		4.703E-03	4.702E-03	4.697E-03	4.650E-03	4.197E-03

Dose/Source Ratios Summed Over All Pathways

Parent and Progeny Principal Radionuclide Contributions Indicated

Parent (i)	Product (j)	Thread Fraction	DSR(j,t) At Time in Years (mrem/yr)/(pCi/g) 0.000E+00	1.000E+00	1.000E+01	1.000E+02	1.000E+03
Pu-241	Pu-241	1.000E+00	8.819E-05	8.405E-05	5.449E-05	7.155E-07	1.090E-25
Pu-241	Am-241	1.000E+00	6.036E-06	1.771E-05	9.982E-05	2.093E-04	2.512E-05
Pu-241	Np-237+D	1.000E+00	5.730E-12	3.954E-11	1.619E-09	5.222E-08	2.647E-07
Pu-241	U-233	1.000E+00	4.784E-20	7.099E-19	1.971E-16	7.551E-14	5.308E-12
Pu-241	Th-229+D	1.000E+00	1.782E-22	5.476E-21	9.885E-18	4.156E-14	3.798E-11
Pu-241	äDSR(j)		9.423E-05	1.018E-04	1.543E-04	2.101E-04	2.539E-05
Pu-241+D	Pu-241+D	2.450E-05	8.494E-07	8.095E-07	5.249E-07	6.891E-09	1.049E-27
Pu-241+D	Np-237+D	2.450E-05	2.617E-13	7.687E-13	4.382E-12	1.091E-11	1.042E-11
Pu-241+D	U-233	2.450E-05	2.918E-21	2.014E-20	8.303E-19	2.894E-17	3.014E-16
Pu-241+D	Th-229+D	2.450E-05	1.359E-23	2.018E-22	5.631E-20	2.289E-17	2.826E-15
Pu-241+D	äDSR(j)		8.494E-07	8.095E-07	5.249E-07	6.902E-09	1.042E-11
Sr-90+D	Sr-90+D	1.000E+00	1.466E-03	1.431E-03	1.150E-03	1.289E-04	4.048E-14
Tc-99	Tc-99	1.000E+00	1.078E-05	9.609E-06	3.407E-06	1.070E-10	0.000E+00
Th-232	Th-232	1.000E+00	4.341E-03	4.341E-03	4.341E-03	4.341E-03	4.340E-03
Th-232	Ra-228+D	1.000E+00	1.645E-02	4.682E-02	2.036E-01	2.834E-01	2.834E-01
Th-232	Th-228+D	1.000E+00	2.796E-03	1.715E-02	2.542E-01	4.316E-01	4.315E-01
Th-232	äDSR(j)		2.358E-02	6.831E-02	4.622E-01	7.194E-01	7.192E-01
U-233	U-233	1.000E+00	5.105E-04	5.103E-04	5.089E-04	4.949E-04	3.741E-04
U-233	Th-229+D	1.000E+00	4.745E-06	1.423E-05	9.946E-05	9.347E-04	7.769E-03
U-233	äDSR(j)		5.152E-04	5.246E-04	6.083E-04	1.430E-03	8.143E-03
U-234	U-234	1.000E+00	4.419E-04	4.417E-04	4.405E-04	4.284E-04	3.243E-04
U-234	Th-230	1.000E+00	1.801E-08	5.402E-08	3.776E-07	3.563E-06	3.085E-05
U-234	Ra-226+D	1.000E+00	3.310E-10	2.316E-09	1.092E-07	9.712E-06	7.255E-04
U-234	Pb-210+D	1.000E+00	1.776E-14	2.647E-13	7.639E-11	3.761E-08	4.750E-06
U-234	äDSR(j)		4.419E-04	4.418E-04	4.410E-04	4.417E-04	1.085E-03
U-235+D	U-235+D	1.000E+00	4.871E-02	4.869E-02	4.856E-02	4.724E-02	3.585E-02
U-235+D	Pa-231	1.000E+00	1.796E-07	5.388E-07	3.761E-06	3.498E-05	2.618E-04
U-235+D	Ac-227+D	1.000E+00	1.548E-08	1.074E-07	4.614E-06	1.988E-04	2.049E-03
U-235+D	äDSR(j)		4.871E-02	4.869E-02	4.857E-02	4.747E-02	3.816E-02
U-238	U-238	5.400E-05	1.963E-08	1.962E-08	1.957E-08	1.904E-08	1.445E-08
U-238+D	U-238+D	9.999E-01	8.555E-03	8.553E-03	8.529E-03	8.297E-03	6.298E-03
U-238+D	U-234	9.999E-01	6.263E-10	1.878E-09	1.311E-08	1.221E-07	9.212E-07
U-238+D	Th-230	9.999E-01	1.702E-14	1.191E-13	5.621E-12	5.050E-10	4.160E-08
U-238+D	Ra-226+D	9.999E-01	2.346E-16	3.518E-15	1.085E-12	9.227E-10	6.865E-07
U-238+D	Pb-210+D	9.999E-01	1.008E-20	3.108E-19	5.787E-16	2.997E-12	4.359E-09
U-238+D	äDSR(j)		8.555E-03	8.553E-03	8.529E-03	8.297E-03	6.299E-03

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

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

Nuclide (i)	t= 0.000E+00	1.000E+00	1.000E+01	1.000E+02	1.000E+03
Ag-108m	5.356E+01	6.043E+01	1.790E+02	9.309E+06	*2.609E+13
Al-26	3.460E+01	3.883E+01	1.095E+02	3.485E+06	*1.921E+10
Am-241	3.270E+03	3.277E+03	3.348E+03	4.141E+03	3.448E+04
Am-243	3.940E+02	3.943E+02	3.974E+02	4.292E+02	9.251E+02
Cm-243	6.439E+02	6.598E+02	8.213E+02	7.326E+03	4.441E+06
Cm-244	1.136E+04	1.180E+04	1.661E+04	4.134E+05	2.144E+06
Co-60	3.683E+01	4.200E+01	1.372E+02	1.896E+07	*1.132E+15
Cs-137	1.466E+02	1.500E+02	1.847E+02	1.478E+03	1.592E+12
Eu-152	7.688E+01	8.099E+01	1.293E+02	1.396E+04	*1.765E+14
Eu-154	7.176E+01	7.765E+01	1.578E+02	1.895E+05	*2.639E+14
Eu-155	1.932E+03	2.222E+03	7.816E+03	2.270E+09	*4.652E+14
Nb-94	5.562E+01	6.242E+01	1.761E+02	5.621E+06	*1.875E+11
Np-237	3.730E+02	3.730E+02	3.732E+02	3.752E+02	3.959E+02
Pu-238	5.818E+03	5.864E+03	6.297E+03	1.283E+04	1.301E+07
Pu-239	5.309E+03	5.309E+03	5.311E+03	5.328E+03	5.506E+03
Pu-240	5.316E+03	5.317E+03	5.322E+03	5.377E+03	5.956E+03
Pu-241	2.629E+05	2.437E+05	1.615E+05	1.190E+05	9.847E+05
Sr-90	1.705E+04	1.747E+04	2.174E+04	1.939E+05	*1.365E+14
Tc-99	2.319E+06	2.602E+06	7.337E+06	*1.697E+10	*1.697E+10
Th-232	1.060E+03	3.660E+02	5.409E+01	3.475E+01	3.476E+01
U-233	4.852E+04	4.766E+04	4.109E+04	1.749E+04	3.070E+03
U-234	5.658E+04	5.659E+04	5.669E+04	5.660E+04	2.303E+04
U-235	5.133E+02	5.134E+02	5.148E+02	5.266E+02	6.551E+02
U-238	2.922E+03	2.923E+03	2.931E+03	3.013E+03	3.969E+03

*At specific activity limit

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

Nuclide (i)	Initial (pCi/g)	tmin (years)	DSR(i,tmin)	G(i,tmin) (pCi/g)	DSR(i,tmax)	G(i,tmax) (pCi/g)
Ag-108m	1.000E+02	0.000E+00	4.668E-01	5.356E+01	4.668E-01	5.356E+01
Al-26	1.000E+02	0.000E+00	7.225E-01	3.460E+01	7.225E-01	3.460E+01
Am-241	1.000E+02	0.000E+00	7.646E-03	3.270E+03	7.646E-03	3.270E+03
Am-243	1.000E+02	0.000E+00	6.345E-02	3.940E+02	6.345E-02	3.940E+02
Cm-243	1.000E+02	0.000E+00	3.882E-02	6.439E+02	3.882E-02	6.439E+02
Cm-244	1.000E+02	0.000E+00	2.201E-03	1.136E+04	2.201E-03	1.136E+04
Co-60	1.000E+02	0.000E+00	6.789E-01	3.683E+01	6.789E-01	3.683E+01
Cs-137	1.000E+02	0.000E+00	1.705E-01	1.466E+02	1.705E-01	1.466E+02
Eu-152	1.000E+02	0.000E+00	3.252E-01	7.688E+01	3.252E-01	7.688E+01
Eu-154	1.000E+02	0.000E+00	3.484E-01	7.176E+01	3.484E-01	7.176E+01
Eu-155	1.000E+02	0.000E+00	1.294E-02	1.932E+03	1.294E-02	1.932E+03
Nb-94	1.000E+02	0.000E+00	4.494E-01	5.562E+01	4.494E-01	5.562E+01
Np-237	1.000E+02	0.000E+00	6.703E-02	3.730E+02	6.703E-02	3.730E+02
Pu-238	1.000E+02	0.000E+00	4.297E-03	5.818E+03	4.297E-03	5.818E+03
Pu-239	1.000E+02	0.000E+00	4.709E-03	5.309E+03	4.709E-03	5.309E+03
Pu-240	1.000E+02	0.000E+00	4.703E-03	5.316E+03	4.703E-03	5.316E+03
Pu-241	1.000E+02	56.2 ñ 0.1	2.230E-04	1.121E+05	9.508E-05	2.629E+05
Sr-90	1.000E+02	0.000E+00	1.466E-03	1.705E+04	1.466E-03	1.705E+04
Tc-99	1.000E+02	0.000E+00	1.078E-05	2.319E+06	1.078E-05	2.319E+06
Th-232	1.000E+02	109.3 ñ 0.2	7.194E-01	3.475E+01	2.358E-02	1.060E+03
U-233	1.000E+02	1.000E+03	8.143E-03	3.070E+03	5.152E-04	4.852E+04
U-234	1.000E+02	1.000E+03	1.085E-03	2.303E+04	4.419E-04	5.658E+04
U-235	1.000E+02	0.000E+00	4.871E-02	5.133E+02	4.871E-02	5.133E+02
U-238	1.000E+02	0.000E+00	8.556E-03	2.922E+03	8.556E-03	2.922E+03

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

Nuclide (j)	Parent (i)	THF(i)	DOSE(j,t), mrem/yr t= 0.000E+00	1.000E+00	1.000E+01	1.000E+02	1.000E+03
Ag-108m	Ag-108m	1.000E+00	4.668E+01	4.137E+01	1.397E+01	2.685E-04	0.000E+00
Al-26	Al-26	1.000E+00	7.225E+01	6.439E+01	2.283E+01	7.173E-04	0.000E+00
Am-241	Am-241	1.000E+00	7.646E-01	7.628E-01	7.467E-01	6.035E-01	7.171E-02
Am-241	Pu-241	1.000E+00	6.036E-04	1.771E-03	9.982E-03	2.093E-02	2.512E-03
Am-241	äDOSE(j)		7.652E-01	7.646E-01	7.567E-01	6.244E-01	7.423E-02
Np-237	Am-241	1.000E+00	1.085E-06	3.250E-06	2.251E-05	1.936E-04	7.982E-04
Np-237	Np-237	1.000E+00	6.703E+00	6.702E+00	6.699E+00	6.663E+00	6.313E+00
Np-237	Pu-241	1.000E+00	5.730E-10	3.954E-09	1.619E-07	5.222E-06	2.647E-05
Np-237	Pu-241	2.450E-05	2.617E-11	7.687E-11	4.382E-10	1.091E-09	1.042E-09
Np-237	äDOSE(j)		6.703E+00	6.702E+00	6.699E+00	6.663E+00	6.313E+00
U-233	Am-241	1.000E+00	1.204E-14	8.425E-14	3.952E-12	3.337E-10	1.638E-08
U-233	Np-237	1.000E+00	1.116E-07	3.348E-07	2.340E-06	2.203E-05	1.861E-04
U-233	Pu-241	1.000E+00	4.784E-18	7.099E-17	1.971E-14	7.551E-12	5.308E-10
U-233	Pu-241	2.450E-05	2.918E-19	2.014E-18	8.303E-17	2.894E-15	3.014E-14
U-233	U-233	1.000E+00	5.105E-02	5.103E-02	5.089E-02	4.949E-02	3.741E-02
U-233	äDOSE(j)		5.105E-02	5.103E-02	5.089E-02	4.951E-02	3.760E-02
Th-229	Am-241	1.000E+00	5.599E-17	8.393E-16	2.581E-13	2.120E-10	1.200E-07
Th-229	Np-237	1.000E+00	6.918E-10	4.842E-09	2.286E-07	2.064E-05	1.782E-03
Th-229	Pu-241	1.000E+00	1.782E-20	5.476E-19	9.885E-16	4.156E-12	3.798E-09
Th-229	Pu-241	2.450E-05	1.359E-21	2.018E-20	5.631E-18	2.289E-15	2.826E-13
Th-229	U-233	1.000E+00	4.745E-04	1.423E-03	9.946E-03	9.347E-02	7.769E-01
Th-229	äDOSE(j)		4.745E-04	1.423E-03	9.946E-03	9.349E-02	7.786E-01
Am-243	Am-243	1.000E+00	6.345E+00	6.340E+00	6.291E+00	5.824E+00	2.694E+00
Am-243	Cm-243	2.400E-03	7.095E-07	2.105E-06	1.320E-05	5.064E-05	2.586E-05
Am-243	äDOSE(j)		6.345E+00	6.340E+00	6.291E+00	5.824E+00	2.694E+00
Pu-239	Am-243	1.000E+00	6.780E-06	2.033E-05	1.418E-04	1.304E-03	8.926E-03
Pu-239	Cm-243	2.400E-03	5.064E-13	3.520E-12	1.547E-10	7.642E-09	8.054E-08
Pu-239	Cm-243	9.976E-01	6.711E-06	1.992E-05	1.254E-04	5.066E-04	5.370E-04
Pu-239	Pu-239	1.000E+00	4.709E-01	4.709E-01	4.708E-01	4.692E-01	4.541E-01
Pu-239	äDOSE(j)		4.709E-01	4.710E-01	4.710E-01	4.710E-01	4.635E-01
U-235	Am-243	1.000E+00	2.302E-14	1.611E-13	7.591E-12	6.705E-10	4.702E-08
U-235	Cm-243	2.400E-03	1.291E-21	1.926E-20	5.639E-18	3.050E-15	4.070E-13
U-235	Cm-243	9.976E-01	2.283E-14	1.587E-13	6.987E-12	3.520E-10	4.623E-09
U-235	Pu-239	1.000E+00	2.399E-09	7.195E-09	5.028E-08	4.739E-07	4.056E-06
U-235	U-235	1.000E+00	4.871E+00	4.869E+00	4.856E+00	4.724E+00	3.585E+00
U-235	äDOSE(j)		4.871E+00	4.869E+00	4.856E+00	4.724E+00	3.585E+00
Pa-231	Am-243	1.000E+00	4.246E-20	6.367E-19	1.963E-16	1.660E-13	1.171E-10
Pa-231	Cm-243	2.400E-03	1.907E-27	5.885E-26	1.108E-22	6.214E-19	9.749E-16
Pa-231	Cm-243	9.976E-01	4.216E-20	6.291E-19	1.844E-16	1.010E-13	1.557E-11
Pa-231	Pu-239	1.000E+00	5.898E-15	4.128E-14	1.948E-12	1.748E-10	1.420E-08

Individual Nuclide Dose Summed Over All Pathways

Parent Nuclide and Branch Fraction Indicated

Nuclide	Parent	THF(i)	DOSE(j,t), mrem/yr				
(j)	(i)	t=	0.000E+00	1.000E+00	1.000E+01	1.000E+02	1.000E+03
ÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ
Pa-231	U-235	1.000E+00	1.796E-05	5.388E-05	3.761E-04	3.498E-03	2.618E-02
Pa-231	äDOSE(j)		1.796E-05	5.388E-05	3.761E-04	3.498E-03	2.618E-02
Ac-227	Am-243	1.000E+00	2.202E-21	6.787E-20	1.260E-16	6.392E-13	8.645E-10
Ac-227	Cm-243	2.400E-03	0.000E+00	5.091E-27	5.801E-23	2.164E-18	7.169E-15
Ac-227	Cm-243	9.976E-01	2.188E-21	6.717E-20	1.197E-16	4.128E-13	1.176E-10
Ac-227	Pu-239	1.000E+00	3.819E-16	5.688E-15	1.638E-12	7.978E-10	1.075E-07
Ac-227	U-235	1.000E+00	1.548E-06	1.074E-05	4.614E-04	1.988E-02	2.049E-01
Ac-227	äDOSE(j)		1.548E-06	1.074E-05	4.614E-04	1.988E-02	2.049E-01
Cm-243	Cm-243	2.400E-03	9.318E-03	9.094E-03	7.305E-03	8.177E-04	2.524E-13
Cm-243	Cm-243	9.976E-01	3.873E+00	3.780E+00	3.037E+00	3.399E-01	1.049E-10
Cm-243	äDOSE(j)		3.882E+00	3.789E+00	3.044E+00	3.407E-01	1.051E-10
Cm-244	Cm-244	1.350E-06	2.971E-07	2.859E-07	2.026E-07	6.459E-09	7.010E-24
Cm-244	Cm-244	4.950E-08	1.089E-08	1.048E-08	7.428E-09	2.368E-10	2.570E-25
Cm-244	äDOSE(j)		3.080E-07	2.964E-07	2.100E-07	6.695E-09	7.267E-24
Pu-240	Cm-244	4.950E-08	1.219E-12	3.594E-12	2.133E-11	6.255E-11	5.771E-11
Pu-240	Pu-240	4.950E-08	2.328E-08	2.328E-08	2.325E-08	2.302E-08	2.078E-08
Pu-240	äDOSE(j)		2.328E-08	2.328E-08	2.327E-08	2.308E-08	2.083E-08
Cm-244	Cm-244	1.000E+00	2.200E-01	2.118E-01	1.501E-01	4.784E-03	5.192E-18
Pu-240	Cm-244	1.000E+00	2.462E-05	7.261E-05	4.308E-04	1.264E-03	1.166E-03
U-236	Cm-244	1.000E+00	2.071E-14	1.434E-13	6.070E-12	2.414E-10	2.606E-09
U-236	Pu-240	1.000E+00	5.915E-10	1.774E-09	1.240E-08	1.164E-07	9.609E-07
U-236	äDOSE(j)		5.915E-10	1.774E-09	1.240E-08	1.167E-07	9.635E-07
Th-232	Cm-244	1.000E+00	2.780E-24	4.136E-23	1.178E-20	5.366E-18	7.290E-16
Th-232	Pu-240	1.000E+00	1.057E-19	7.395E-19	3.493E-17	3.157E-15	2.764E-13
Th-232	Th-232	1.000E+00	4.341E-01	4.341E-01	4.341E-01	4.341E-01	4.340E-01
Th-232	äDOSE(j)		4.341E-01	4.341E-01	4.341E-01	4.341E-01	4.340E-01
Ra-228	Cm-244	1.000E+00	4.303E-24	1.298E-22	1.965E-19	2.878E-16	4.685E-14
Ra-228	Pu-240	1.000E+00	2.034E-19	2.974E-18	7.229E-16	1.751E-13	1.777E-11
Ra-228	Th-232	1.000E+00	1.645E+00	4.682E+00	2.036E+01	2.834E+01	2.834E+01
Ra-228	äDOSE(j)		1.645E+00	4.682E+00	2.036E+01	2.834E+01	2.834E+01
Th-228	Cm-244	1.000E+00	3.775E-25	2.211E-23	1.407E-19	4.078E-16	7.095E-14
Th-228	Pu-240	1.000E+00	2.123E-20	6.079E-19	5.925E-16	2.514E-13	2.692E-11
Th-228	Th-232	1.000E+00	2.796E-01	1.715E+00	2.542E+01	4.316E+01	4.315E+01
Th-228	äDOSE(j)		2.796E-01	1.715E+00	2.542E+01	4.316E+01	4.315E+01
Co-60	Co-60	1.000E+00	6.789E+01	5.952E+01	1.822E+01	1.318E-04	0.000E+00
Cs-137	Cs-137	1.000E+00	1.705E+01	1.666E+01	1.353E+01	1.691E+00	1.570E-09

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

Nuclide (j)	Parent (i)	THF(i)	DOSE(j,t), mrem/yr t= 0.000E+00	1.000E+00	1.000E+01	1.000E+02	1.000E+03
ÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ
Eu-152	Eu-152	7.208E-01	2.344E+01	2.225E+01	1.393E+01	1.291E-01	6.011E-22
Eu-152	Eu-152	2.792E-01	9.079E+00	8.619E+00	5.397E+00	5.000E-02	2.328E-22
Eu-152	äDOSE(j)		3.252E+01	3.087E+01	1.933E+01	1.791E-01	8.339E-22
Gd-152	Eu-152	2.792E-01	6.557E-17	1.923E-16	1.079E-15	2.548E-15	2.519E-15
Eu-154	Eu-154	1.000E+00	3.484E+01	3.220E+01	1.584E+01	1.320E-02	0.000E+00
Eu-155	Eu-155	1.000E+00	1.294E+00	1.125E+00	3.198E-01	1.101E-06	0.000E+00
Nb-94	Nb-94	1.000E+00	4.494E+01	4.005E+01	1.420E+01	4.448E-04	0.000E+00
Pu-238	Pu-238	1.840E-09	7.906E-10	7.844E-10	7.305E-10	3.585E-10	2.909E-13
Pu-238	Pu-238	1.000E+00	4.297E-01	4.263E-01	3.970E-01	1.949E-01	1.581E-04
Pu-238	äDOSE(j)		4.297E-01	4.263E-01	3.970E-01	1.949E-01	1.581E-04
U-234	Pu-238	1.000E+00	6.247E-08	1.867E-07	1.260E-06	8.536E-06	1.209E-05
U-234	U-234	1.000E+00	4.419E-02	4.417E-02	4.405E-02	4.284E-02	3.243E-02
U-234	U-238	9.999E-01	6.263E-08	1.878E-07	1.311E-06	1.221E-05	9.212E-05
U-234	äDOSE(j)		4.419E-02	4.417E-02	4.405E-02	4.286E-02	3.254E-02
Th-230	Pu-238	1.000E+00	1.699E-12	1.186E-11	5.475E-10	3.979E-08	9.824E-07
Th-230	U-234	1.000E+00	1.801E-06	5.402E-06	3.776E-05	3.563E-04	3.085E-03
Th-230	U-238	9.999E-01	1.702E-12	1.191E-11	5.621E-10	5.050E-08	4.160E-06
Th-230	äDOSE(j)		1.801E-06	5.402E-06	3.776E-05	3.564E-04	3.090E-03
Ra-226	Pu-238	1.000E+00	2.342E-14	3.507E-13	1.064E-10	7.703E-08	2.088E-05
Ra-226	U-234	1.000E+00	3.310E-08	2.316E-07	1.092E-05	9.712E-04	7.255E-02
Ra-226	U-238	9.999E-01	2.346E-14	3.518E-13	1.085E-10	9.227E-08	6.865E-05
Ra-226	äDOSE(j)		3.310E-08	2.316E-07	1.092E-05	9.714E-04	7.264E-02
Pb-210	Pu-238	1.000E+00	1.007E-18	3.101E-17	5.695E-14	2.562E-10	1.356E-07
Pb-210	U-234	1.000E+00	1.776E-12	2.647E-11	7.639E-09	3.761E-06	4.750E-04
Pb-210	U-238	9.999E-01	1.008E-18	3.108E-17	5.787E-14	2.997E-10	4.359E-07
Pb-210	äDOSE(j)		1.776E-12	2.647E-11	7.639E-09	3.761E-06	4.756E-04
Pu-240	Pu-240	1.000E+00	4.703E-01	4.702E-01	4.697E-01	4.650E-01	4.197E-01
Pu-241	Pu-241	1.000E+00	8.819E-03	8.405E-03	5.449E-03	7.155E-05	1.090E-23
Pu-241	Pu-241	2.450E-05	8.494E-05	8.095E-05	5.249E-05	6.891E-07	1.049E-25
Pu-241	äDOSE(j)		8.904E-03	8.486E-03	5.502E-03	7.224E-05	1.100E-23
Sr-90	Sr-90	1.000E+00	1.466E-01	1.431E-01	1.150E-01	1.289E-02	4.048E-12
Tc-99	Tc-99	1.000E+00	1.078E-03	9.609E-04	3.407E-04	1.070E-08	0.000E+00
U-238	U-238	5.400E-05	1.963E-06	1.962E-06	1.957E-06	1.904E-06	1.445E-06
U-238	U-238	9.999E-01	8.555E-01	8.553E-01	8.529E-01	8.297E-01	6.298E-01
U-238	äDOSE(j)		8.556E-01	8.553E-01	8.529E-01	8.297E-01	6.298E-01
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THF(i) is the thread fraction of the parent nuclide.

Individual Nuclide Soil Concentration
Parent Nuclide and Branch Fraction Indicated

Nuclide (j)	Parent (i)	THF(i)	S(j,t), pCi/g t= 0.000E+00	1.000E+00	1.000E+01	1.000E+02	1.000E+03
Ag-108m	Ag-108m	1.000E+00	1.000E+02	8.863E+01	2.992E+01	5.753E-04	0.000E+00
Al-26	Al-26	1.000E+00	1.000E+02	8.912E+01	3.160E+01	9.929E-04	0.000E+00
Am-241	Am-241	1.000E+00	1.000E+02	9.976E+01	9.766E+01	7.893E+01	9.379E+00
Am-241	Pu-241	1.000E+00	0.000E+00	1.564E-01	1.257E+00	2.737E+00	3.286E-01
Am-241	äS(j):		1.000E+02	9.992E+01	9.892E+01	8.166E+01	9.708E+00
Np-237	Am-241	1.000E+00	0.000E+00	3.235E-05	3.200E-04	2.875E-03	1.191E-02
Np-237	Np-237	1.000E+00	1.000E+02	9.999E+01	9.994E+01	9.940E+01	9.418E+01
Np-237	Pu-241	1.000E+00	0.000E+00	2.554E-08	2.208E-06	7.747E-05	3.949E-04
Np-237	Pu-241	2.450E-05	0.000E+00	7.747E-10	6.296E-09	1.627E-08	1.554E-08
Np-237	äS(j):		1.000E+02	9.999E+01	9.994E+01	9.941E+01	9.419E+01
U-233	Am-241	1.000E+00	0.000E+00	7.076E-11	7.018E-09	6.473E-07	3.206E-05
U-233	Np-237	1.000E+00	0.000E+00	4.372E-04	4.365E-03	4.293E-02	3.643E-01
U-233	Pu-241	1.000E+00	0.000E+00	3.738E-14	3.347E-11	1.462E-08	1.039E-06
U-233	Pu-241	2.450E-05	0.000E+00	1.707E-15	1.485E-13	5.635E-12	5.901E-11
U-233	U-233	1.000E+00	1.000E+02	9.997E+01	9.969E+01	9.694E+01	7.329E+01
U-233	äS(j):		1.000E+02	9.997E+01	9.969E+01	9.698E+01	7.365E+01
Th-229	Am-241	1.000E+00	0.000E+00	2.228E-15	2.214E-12	2.079E-09	1.192E-06
Th-229	Np-237	1.000E+00	0.000E+00	2.065E-08	2.062E-06	2.033E-04	1.771E-02
Th-229	Pu-241	1.000E+00	0.000E+00	8.848E-19	8.096E-15	4.065E-11	3.774E-08
Th-229	Pu-241	2.450E-05	0.000E+00	5.396E-20	4.857E-17	2.250E-14	2.809E-12
Th-229	U-233	1.000E+00	0.000E+00	9.442E-03	9.424E-02	9.254E-01	7.726E+00
Th-229	äS(j):		0.000E+00	9.442E-03	9.425E-02	9.256E-01	7.743E+00
Am-243	Am-243	1.000E+00	1.000E+02	9.991E+01	9.915E+01	9.179E+01	4.245E+01
Am-243	Cm-243	2.400E-03	0.000E+00	2.226E-05	1.992E-04	7.971E-04	4.076E-04
Am-243	äS(j):		1.000E+02	9.991E+01	9.915E+01	9.179E+01	4.245E+01
Pu-239	Am-243	1.000E+00	0.000E+00	2.879E-03	2.867E-02	2.755E-01	1.895E+00
Pu-239	Cm-243	2.400E-03	0.000E+00	3.219E-10	2.989E-08	1.611E-06	1.710E-05
Pu-239	Cm-243	9.976E-01	0.000E+00	2.839E-03	2.550E-02	1.075E-01	1.140E-01
Pu-239	Pu-239	1.000E+00	1.000E+02	1.000E+02	9.996E+01	9.964E+01	9.642E+01
Pu-239	äS(j):		1.000E+02	1.000E+02	1.000E+02	1.000E+02	9.843E+01
U-235	Am-243	1.000E+00	0.000E+00	1.418E-12	1.413E-10	1.363E-08	9.645E-07
U-235	Cm-243	2.400E-03	0.000E+00	1.059E-19	1.001E-16	6.182E-14	8.349E-12
U-235	Cm-243	9.976E-01	0.000E+00	1.403E-12	1.305E-10	7.174E-09	9.486E-08
U-235	Pu-239	1.000E+00	0.000E+00	9.847E-08	9.832E-07	9.682E-06	8.322E-05
U-235	U-235	1.000E+00	1.000E+02	9.997E+01	9.969E+01	9.698E+01	7.361E+01
U-235	äS(j):		1.000E+02	9.997E+01	9.969E+01	9.698E+01	7.361E+01
Pa-231	Am-243	1.000E+00	0.000E+00	1.000E-17	9.965E-15	9.629E-12	6.888E-09
Pa-231	Cm-243	2.400E-03	0.000E+00	5.608E-25	5.357E-21	3.593E-17	5.732E-14
Pa-231	Cm-243	9.976E-01	0.000E+00	9.917E-18	9.385E-15	5.873E-12	9.160E-10
Pa-231	Pu-239	1.000E+00	0.000E+00	1.042E-12	1.040E-10	1.019E-08	8.351E-07

Individual Nuclide Soil Concentration

Parent Nuclide and Branch Fraction Indicated

Nuclide (j)	Parent (i)	THF(i)	S(j,t), pCi/g t= 0.000E+00	1.000E+00	1.000E+01	1.000E+02	1.000E+03
Pa-231	U-235	1.000E+00	0.000E+00	2.115E-03	2.109E-02	2.050E-01	1.541E+00
Pa-231	äS(j):		0.000E+00	2.115E-03	2.109E-02	2.050E-01	1.541E+00
Ac-227	Am-243	1.000E+00	0.000E+00	7.907E-20	7.446E-16	4.516E-12	6.208E-09
Ac-227	Cm-243	2.400E-03	0.000E+00	3.554E-27	3.260E-22	1.524E-17	5.148E-14
Ac-227	Cm-243	9.976E-01	0.000E+00	7.852E-20	7.090E-16	2.922E-12	8.446E-10
Ac-227	Pu-239	1.000E+00	0.000E+00	1.097E-14	1.019E-11	5.666E-09	7.719E-07
Ac-227	U-235	1.000E+00	0.000E+00	3.331E-05	3.023E-03	1.420E-01	1.473E+00
Ac-227	äS(j):		0.000E+00	3.331E-05	3.023E-03	1.420E-01	1.473E+00
Cm-243	Cm-243	2.400E-03	2.400E-01	2.342E-01	1.882E-01	2.106E-02	6.500E-12
Cm-243	Cm-243	9.976E-01	9.976E+01	9.736E+01	7.821E+01	8.754E+00	2.702E-09
Cm-243	äS(j):		1.000E+02	9.760E+01	7.840E+01	8.775E+00	2.708E-09
Cm-244	Cm-244	1.350E-06	1.350E-04	1.299E-04	9.206E-05	2.935E-06	3.186E-21
Cm-244	Cm-244	4.950E-08	4.950E-06	4.764E-06	3.375E-06	1.076E-07	1.168E-22
Cm-244	äS(j):		1.400E-04	1.347E-04	9.543E-05	3.043E-06	3.302E-21
Pu-240	Cm-244	4.950E-08	0.000E+00	5.149E-10	4.358E-09	1.330E-08	1.227E-08
Pu-240	Pu-240	4.950E-08	4.950E-06	4.949E-06	4.944E-06	4.894E-06	4.418E-06
Pu-240	äS(j):		4.950E-06	4.950E-06	4.949E-06	4.907E-06	4.430E-06
Cm-244	Cm-244	1.000E+00	1.000E+02	9.624E+01	6.819E+01	2.174E+00	2.360E-15
Pu-240	Cm-244	1.000E+00	0.000E+00	1.040E-02	8.804E-02	2.686E-01	2.479E-01
U-236	Cm-244	1.000E+00	0.000E+00	1.549E-10	1.385E-08	6.000E-07	6.516E-06
U-236	Pu-240	1.000E+00	0.000E+00	2.960E-06	2.954E-05	2.899E-04	2.403E-03
U-236	äS(j):		0.000E+00	2.960E-06	2.955E-05	2.905E-04	2.410E-03
Th-232	Cm-244	1.000E+00	0.000E+00	2.556E-21	2.349E-18	1.221E-15	1.677E-13
Th-232	Pu-240	1.000E+00	0.000E+00	7.301E-17	7.292E-15	7.201E-13	6.360E-11
Th-232	Th-232	1.000E+00	1.000E+02	1.000E+02	1.000E+02	1.000E+02	9.997E+01
Th-232	äS(j):		1.000E+02	1.000E+02	1.000E+02	1.000E+02	9.997E+01
Ra-228	Cm-244	1.000E+00	0.000E+00	7.535E-23	5.753E-19	1.000E-15	1.648E-13
Ra-228	Pu-240	1.000E+00	0.000E+00	2.847E-18	2.223E-15	6.102E-13	6.251E-11
Ra-228	Th-232	1.000E+00	0.000E+00	1.136E+01	6.998E+01	9.982E+01	9.979E+01
Ra-228	äS(j):		0.000E+00	1.136E+01	6.998E+01	9.982E+01	9.979E+01
Th-228	Cm-244	1.000E+00	0.000E+00	5.173E-24	2.623E-19	9.304E-16	1.639E-13
Th-228	Pu-240	1.000E+00	0.000E+00	2.417E-19	1.164E-15	5.751E-13	6.219E-11
Th-228	Th-232	1.000E+00	0.000E+00	1.864E+00	5.640E+01	9.982E+01	9.979E+01
Th-228	äS(j):		0.000E+00	1.864E+00	5.640E+01	9.982E+01	9.979E+01
Co-60	Co-60	1.000E+00	1.000E+02	8.768E+01	2.684E+01	1.942E-04	0.000E+00
Cs-137	Cs-137	1.000E+00	1.000E+02	9.772E+01	7.937E+01	9.918E+00	9.209E-09

Individual Nuclide Soil Concentration

Parent Nuclide and Branch Fraction Indicated

Nuclide	Parent	THF(i)	S(j,t), pCi/g				
(j)	(i)	t=	0.000E+00	1.000E+00	1.000E+01	1.000E+02	1.000E+03
ÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ
Eu-152	Eu-152	7.208E-01	7.208E+01	6.843E+01	4.285E+01	3.969E-01	1.849E-21
Eu-152	Eu-152	2.792E-01	2.792E+01	2.650E+01	1.660E+01	1.538E-01	7.160E-22
Eu-152	äS(j):		1.000E+02	9.493E+01	5.944E+01	5.507E-01	2.565E-21
Gd-152	Eu-152	2.792E-01	0.000E+00	1.746E-13	1.397E-12	3.421E-12	3.382E-12
Eu-154	Eu-154	1.000E+00	1.000E+02	9.242E+01	4.548E+01	3.788E-02	6.081E-33
Eu-155	Eu-155	1.000E+00	1.000E+02	8.696E+01	2.472E+01	8.512E-05	0.000E+00
Nb-94	Nb-94	1.000E+00	1.000E+02	8.912E+01	3.159E+01	9.896E-04	0.000E+00
Pu-238	Pu-238	1.840E-09	1.840E-07	1.826E-07	1.700E-07	8.344E-08	6.769E-11
Pu-238	Pu-238	1.000E+00	1.000E+02	9.921E+01	9.240E+01	4.535E+01	3.679E-02
Pu-238	äS(j):		1.000E+02	9.921E+01	9.240E+01	4.535E+01	3.679E-02
U-234	Pu-238	1.000E+00	0.000E+00	2.823E-04	2.721E-03	1.925E-02	2.737E-02
U-234	U-234	1.000E+00	1.000E+02	9.997E+01	9.969E+01	9.696E+01	7.340E+01
U-234	U-238	9.999E-01	0.000E+00	2.834E-04	2.826E-03	2.749E-02	2.084E-01
U-234	äS(j):		1.000E+02	9.997E+01	9.970E+01	9.700E+01	7.364E+01
Th-230	Pu-238	1.000E+00	0.000E+00	1.273E-09	1.242E-07	9.857E-06	2.454E-04
Th-230	U-234	1.000E+00	0.000E+00	9.000E-04	8.988E-03	8.860E-02	7.706E-01
Th-230	U-238	9.999E-01	0.000E+00	1.276E-09	1.273E-07	1.250E-05	1.039E-03
Th-230	äS(j):		0.000E+00	9.001E-04	8.988E-03	8.862E-02	7.718E-01
Ra-226	Pu-238	1.000E+00	0.000E+00	1.839E-13	1.802E-10	1.491E-07	4.095E-05
Ra-226	U-234	1.000E+00	0.000E+00	1.949E-07	1.944E-05	1.888E-03	1.423E-01
Ra-226	U-238	9.999E-01	0.000E+00	1.842E-13	1.837E-10	1.785E-07	1.346E-04
Ra-226	äS(j):		0.000E+00	1.949E-07	1.944E-05	1.888E-03	1.425E-01
Pb-210	Pu-238	1.000E+00	0.000E+00	1.420E-15	1.323E-11	7.117E-08	3.827E-05
Pb-210	U-234	1.000E+00	0.000E+00	2.004E-09	1.867E-06	1.049E-03	1.341E-01
Pb-210	U-238	9.999E-01	0.000E+00	1.423E-15	1.343E-11	8.317E-08	1.230E-04
Pb-210	äS(j):		0.000E+00	2.004E-09	1.867E-06	1.050E-03	1.342E-01
Pu-240	Pu-240	1.000E+00	1.000E+02	9.999E+01	9.989E+01	9.887E+01	8.925E+01
Pu-241	Pu-241	1.000E+00	1.000E+02	9.530E+01	6.179E+01	8.113E-01	1.235E-19
Pu-241	Pu-241	2.450E-05	2.450E-03	2.335E-03	1.514E-03	1.988E-05	3.027E-24
Pu-241	äS(j):		1.000E+02	9.530E+01	6.179E+01	8.113E-01	1.235E-19
Sr-90	Sr-90	1.000E+00	1.000E+02	9.760E+01	7.842E+01	8.792E+00	2.761E-09
Tc-99	Tc-99	1.000E+00	1.000E+02	8.912E+01	3.160E+01	9.926E-04	0.000E+00
U-238	U-238	5.400E-05	5.400E-03	5.398E-03	5.383E-03	5.237E-03	3.975E-03
U-238	U-238	9.999E-01	9.999E+01	9.996E+01	9.969E+01	9.698E+01	7.361E+01
U-238	äS(j):		1.000E+02	9.997E+01	9.969E+01	9.698E+01	7.361E+01
ÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ	ÍÍÍÍÍÍÍÍÍ

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

RESCALC.EXE execution time = 4.82 seconds

Attachment E-2

Internal Dose for CW Exposure Scenario

(44 Pages)

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Part I: Mixture Sums and Single Radionuclide Guidelines
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Dose Conversion Factor (and Related) Parameter Summary
Dose Library: FGR 12 & ICRP 72 (Adult)

Menu	Parameter	Current Value#	Base Case*	Parameter Name
A-1	DCF's for external ground radiation, (mrem/yr)/(pCi/g)			
A-1	Ac-225 (Source: FGR 12)	6.371E-02	6.371E-02	DCF1(1)
A-1	Ac-227 (Source: FGR 12)	4.951E-04	4.951E-04	DCF1(2)
A-1	Ac-228 (Source: FGR 12)	5.978E+00	5.978E+00	DCF1(3)
A-1	Ag-108 (Source: FGR 12)	1.143E-01	1.143E-01	DCF1(4)
A-1	Ag-108m (Source: FGR 12)	9.640E+00	9.640E+00	DCF1(5)
A-1	Al-26 (Source: FGR 12)	1.741E+01	1.741E+01	DCF1(6)
A-1	Am-241 (Source: FGR 12)	4.372E-02	4.372E-02	DCF1(7)
A-1	Am-243 (Source: FGR 12)	1.420E-01	1.420E-01	DCF1(8)
A-1	At-217 (Source: FGR 12)	1.773E-03	1.773E-03	DCF1(9)
A-1	At-218 (Source: FGR 12)	5.847E-03	5.847E-03	DCF1(10)
A-1	Ba-137m (Source: FGR 12)	3.606E+00	3.606E+00	DCF1(11)
A-1	Bi-210 (Source: FGR 12)	3.606E-03	3.606E-03	DCF1(12)
A-1	Bi-211 (Source: FGR 12)	2.559E-01	2.559E-01	DCF1(13)
A-1	Bi-212 (Source: FGR 12)	1.171E+00	1.171E+00	DCF1(14)
A-1	Bi-213 (Source: FGR 12)	7.660E-01	7.660E-01	DCF1(15)
A-1	Bi-214 (Source: FGR 12)	9.808E+00	9.808E+00	DCF1(16)
A-1	Cm-243 (Source: FGR 12)	5.829E-01	5.829E-01	DCF1(17)
A-1	Cm-244 (Source: FGR 12)	1.259E-04	1.259E-04	DCF1(18)
A-1	Co-60 (Source: FGR 12)	1.622E+01	1.622E+01	DCF1(19)
A-1	Cs-137 (Source: FGR 12)	7.510E-04	7.510E-04	DCF1(20)
A-1	Eu-152 (Source: FGR 12)	7.006E+00	7.006E+00	DCF1(21)
A-1	Eu-154 (Source: FGR 12)	7.678E+00	7.678E+00	DCF1(22)
A-1	Eu-155 (Source: FGR 12)	1.822E-01	1.822E-01	DCF1(23)
A-1	Fr-221 (Source: FGR 12)	1.536E-01	1.536E-01	DCF1(24)
A-1	Fr-223 (Source: FGR 12)	1.980E-01	1.980E-01	DCF1(25)
A-1	Gd-152 (Source: FGR 12)	0.000E+00	0.000E+00	DCF1(26)
A-1	Nb-94 (Source: FGR 12)	9.677E+00	9.677E+00	DCF1(27)
A-1	Np-237 (Source: FGR 12)	7.790E-02	7.790E-02	DCF1(28)
A-1	Np-239 (Source: FGR 12)	7.529E-01	7.529E-01	DCF1(29)
A-1	Pa-231 (Source: FGR 12)	1.906E-01	1.906E-01	DCF1(30)
A-1	Pa-233 (Source: FGR 12)	1.020E+00	1.020E+00	DCF1(31)
A-1	Pa-234 (Source: FGR 12)	1.155E+01	1.155E+01	DCF1(32)
A-1	Pa-234m (Source: FGR 12)	8.967E-02	8.967E-02	DCF1(33)
A-1	Pb-209 (Source: FGR 12)	7.734E-04	7.734E-04	DCF1(34)
A-1	Pb-210 (Source: FGR 12)	2.447E-03	2.447E-03	DCF1(35)
A-1	Pb-211 (Source: FGR 12)	3.064E-01	3.064E-01	DCF1(36)
A-1	Pb-212 (Source: FGR 12)	7.043E-01	7.043E-01	DCF1(37)
A-1	Pb-214 (Source: FGR 12)	1.341E+00	1.341E+00	DCF1(38)
A-1	Po-210 (Source: FGR 12)	5.231E-05	5.231E-05	DCF1(39)
A-1	Po-211 (Source: FGR 12)	4.764E-02	4.764E-02	DCF1(40)
A-1	Po-212 (Source: FGR 12)	0.000E+00	0.000E+00	DCF1(41)
A-1	Po-213 (Source: FGR 12)	0.000E+00	0.000E+00	DCF1(42)
A-1	Po-214 (Source: FGR 12)	5.138E-04	5.138E-04	DCF1(43)
A-1	Po-215 (Source: FGR 12)	1.016E-03	1.016E-03	DCF1(44)
A-1	Po-216 (Source: FGR 12)	1.042E-04	1.042E-04	DCF1(45)
A-1	Po-218 (Source: FGR 12)	5.642E-05	5.642E-05	DCF1(46)
A-1	Pu-238 (Source: FGR 12)	1.513E-04	1.513E-04	DCF1(47)
A-1	Pu-239 (Source: FGR 12)	2.952E-04	2.952E-04	DCF1(48)
A-1	Pu-240 (Source: FGR 12)	1.467E-04	1.467E-04	DCF1(49)

Dose Conversion Factor (and Related) Parameter Summary (continued)
Dose Library: FGR 12 & ICRP 72 (Adult)

Menu	Parameter	Current Value#	Base Case*	Parameter Name
A-1	Pu-241 (Source: FGR 12)	5.904E-06	5.904E-06	DCF1(50)
A-1	Ra-223 (Source: FGR 12)	6.034E-01	6.034E-01	DCF1(51)
A-1	Ra-224 (Source: FGR 12)	5.119E-02	5.119E-02	DCF1(52)
A-1	Ra-225 (Source: FGR 12)	1.102E-02	1.102E-02	DCF1(53)
A-1	Ra-226 (Source: FGR 12)	3.176E-02	3.176E-02	DCF1(54)
A-1	Ra-228 (Source: FGR 12)	0.000E+00	0.000E+00	DCF1(55)
A-1	Rn-219 (Source: FGR 12)	3.083E-01	3.083E-01	DCF1(56)
A-1	Rn-220 (Source: FGR 12)	2.298E-03	2.298E-03	DCF1(57)
A-1	Rn-222 (Source: FGR 12)	2.354E-03	2.354E-03	DCF1(58)
A-1	Sr-90 (Source: FGR 12)	7.043E-04	7.043E-04	DCF1(59)
A-1	Tc-99 (Source: FGR 12)	1.255E-04	1.255E-04	DCF1(60)
A-1	Th-227 (Source: FGR 12)	5.212E-01	5.212E-01	DCF1(61)
A-1	Th-228 (Source: FGR 12)	7.940E-03	7.940E-03	DCF1(62)
A-1	Th-229 (Source: FGR 12)	3.213E-01	3.213E-01	DCF1(63)
A-1	Th-230 (Source: FGR 12)	1.209E-03	1.209E-03	DCF1(64)
A-1	Th-231 (Source: FGR 12)	3.643E-02	3.643E-02	DCF1(65)
A-1	Th-232 (Source: FGR 12)	5.212E-04	5.212E-04	DCF1(66)
A-1	Th-234 (Source: FGR 12)	2.410E-02	2.410E-02	DCF1(67)
A-1	Tl-207 (Source: FGR 12)	1.980E-02	1.980E-02	DCF1(68)
A-1	Tl-208 (Source: FGR 12)	2.298E+01	2.298E+01	DCF1(69)
A-1	Tl-209 (Source: FGR 12)	1.293E+01	1.293E+01	DCF1(70)
A-1	Tl-210 (Source: no data)	0.000E+00	-2.000E+00	DCF1(71)
A-1	U-233 (Source: FGR 12)	1.397E-03	1.397E-03	DCF1(72)
A-1	U-234 (Source: FGR 12)	4.017E-04	4.017E-04	DCF1(73)
A-1	U-235 (Source: FGR 12)	7.211E-01	7.211E-01	DCF1(74)
A-1	U-236 (Source: FGR 12)	2.148E-04	2.148E-04	DCF1(75)
A-1	U-237 (Source: FGR 12)	5.306E-01	5.306E-01	DCF1(76)
A-1	U-238 (Source: FGR 12)	1.031E-04	1.031E-04	DCF1(77)
A-1	Y-90 (Source: FGR 12)	2.391E-02	2.391E-02	DCF1(78)
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	Ac-227+D	2.109E+00	2.035E+00	DCF2(1)
B-1	Ag-108m+D	1.370E-04	1.369E-04	DCF2(2)
B-1	Al-26	7.400E-05	7.400E-05	DCF2(3)
B-1	Am-241	3.550E-01	3.552E-01	DCF2(4)
B-1	Am-243+D	3.550E-01	3.552E-01	DCF2(5)
B-1	Cm-243	2.550E-01	2.553E-01	DCF2(6)
B-1	Cm-244	2.110E-01	2.109E-01	DCF2(8)
B-1	Co-60	1.150E-04	1.147E-04	DCF2(11)
B-1	Cs-137+D	1.440E-04	1.443E-04	DCF2(12)
B-1	Eu-152	1.550E-04	1.554E-04	DCF2(13)
B-1	Eu-154	1.960E-04	1.961E-04	DCF2(15)
B-1	Eu-155	2.550E-05	2.553E-05	DCF2(16)
B-1	Gd-152	7.030E-02	7.030E-02	DCF2(17)
B-1	Nb-94	1.810E-04	1.813E-04	DCF2(18)
B-1	Np-237+D	1.850E-01	1.850E-01	DCF2(19)
B-1	Pa-231	5.180E-01	5.180E-01	DCF2(20)
B-1	Pb-210+D	3.694E-02	2.072E-02	DCF2(21)
B-1	Pu-238	4.070E-01	4.070E-01	DCF2(22)
B-1	Pu-239	4.440E-01	4.440E-01	DCF2(24)

Dose Conversion Factor (and Related) Parameter Summary (continued)
Dose Library: FGR 12 & ICRP 72 (Adult)

Menu	Parameter	Current Value#	Base Case*	Parameter Name
B-1	Pu-240	4.440E-01	4.440E-01	DCF2(25)
B-1	Pu-241	8.510E-03	8.510E-03	DCF2(27)
B-1	Pu-241+D	8.517E-03	8.510E-03	DCF2(28)
B-1	Ra-226+D	3.531E-02	3.515E-02	DCF2(29)
B-1	Ra-228+D	5.929E-02	5.920E-02	DCF2(30)
B-1	Sr-90+D	5.976E-04	5.920E-04	DCF2(31)
B-1	Tc-99	4.810E-05	4.810E-05	DCF2(32)
B-1	Th-228+D	1.614E-01	1.480E-01	DCF2(33)
B-1	Th-229+D	9.481E-01	8.880E-01	DCF2(34)
B-1	Th-230	3.700E-01	3.700E-01	DCF2(35)
B-1	Th-232	4.070E-01	4.070E-01	DCF2(36)
B-1	U-233	3.550E-02	3.552E-02	DCF2(37)
B-1	U-234	3.480E-02	3.478E-02	DCF2(38)
B-1	U-235+D	3.150E-02	3.145E-02	DCF2(39)
B-1	U-236	3.220E-02	3.219E-02	DCF2(40)
B-1	U-238	2.960E-02	2.960E-02	DCF2(41)
B-1	U-238+D	2.963E-02	2.960E-02	DCF2(42)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	Ac-227+D	4.473E-03	4.070E-03	DCF3(1)
D-1	Ag-108m+D	8.510E-06	8.510E-06	DCF3(2)
D-1	Al-26	1.300E-05	1.295E-05	DCF3(3)
D-1	Am-241	7.400E-04	7.400E-04	DCF3(4)
D-1	Am-243+D	7.430E-04	7.400E-04	DCF3(5)
D-1	Cm-243	5.550E-04	5.550E-04	DCF3(6)
D-1	Cm-244	4.440E-04	4.440E-04	DCF3(8)
D-1	Co-60	1.260E-05	1.258E-05	DCF3(11)
D-1	Cs-137+D	4.810E-05	4.810E-05	DCF3(12)
D-1	Eu-152	5.180E-06	5.180E-06	DCF3(13)
D-1	Eu-154	7.400E-06	7.400E-06	DCF3(15)
D-1	Eu-155	1.180E-06	1.184E-06	DCF3(16)
D-1	Gd-152	1.520E-04	1.517E-04	DCF3(17)
D-1	Nb-94	6.290E-06	6.290E-06	DCF3(18)
D-1	Np-237+D	4.102E-04	4.070E-04	DCF3(19)
D-1	Pa-231	2.630E-03	2.627E-03	DCF3(20)
D-1	Pb-210+D	6.995E-03	2.553E-03	DCF3(21)
D-1	Pu-238	8.510E-04	8.510E-04	DCF3(22)
D-1	Pu-239	9.250E-04	9.250E-04	DCF3(24)
D-1	Pu-240	9.250E-04	9.250E-04	DCF3(25)
D-1	Pu-241	1.780E-05	1.776E-05	DCF3(27)
D-1	Pu-241+D	2.061E-05	1.776E-05	DCF3(28)
D-1	Ra-226+D	1.041E-03	1.036E-03	DCF3(29)
D-1	Ra-228+D	2.552E-03	2.553E-03	DCF3(30)
D-1	Sr-90+D	1.140E-04	1.036E-04	DCF3(31)
D-1	Tc-99	2.370E-06	2.368E-06	DCF3(32)
D-1	Th-228+D	5.302E-04	2.664E-04	DCF3(33)
D-1	Th-229+D	2.266E-03	1.813E-03	DCF3(34)
D-1	Th-230	7.770E-04	7.770E-04	DCF3(35)
D-1	Th-232	8.510E-04	8.510E-04	DCF3(36)
D-1	U-233	1.890E-04	1.887E-04	DCF3(37)

Dose Conversion Factor (and Related) Parameter Summary (continued)
Dose Library: FGR 12 & ICRP 72 (Adult)

Menu	Parameter	Current Value#	Base Case*	Parameter Name
D-1	U-234	1.810E-04	1.813E-04	DCF3(38)
D-1	U-235+D	1.753E-04	1.739E-04	DCF3(39)
D-1	U-236	1.740E-04	1.739E-04	DCF3(40)
D-1	U-238	1.670E-04	1.665E-04	DCF3(41)
D-1	U-238+D	1.796E-04	1.665E-04	DCF3(42)
D-34	Food transfer factors:			
D-34	Ac-227+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(1,1)
D-34	Ac-227+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-05	2.000E-05	RTF(1,2)
D-34	Ac-227+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-05	2.000E-05	RTF(1,3)
D-34				
D-34	Ag-108m+D , plant/soil concentration ratio, dimensionless	1.500E-01	1.500E-01	RTF(2,1)
D-34	Ag-108m+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.000E-03	3.000E-03	RTF(2,2)
D-34	Ag-108m+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.500E-02	2.500E-02	RTF(2,3)
D-34				
D-34	Al-26 , plant/soil concentration ratio, dimensionless	4.000E-03	4.000E-03	RTF(3,1)
D-34	Al-26 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	5.000E-04	5.000E-04	RTF(3,2)
D-34	Al-26 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-04	2.000E-04	RTF(3,3)
D-34				
D-34	Am-241 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(4,1)
D-34	Am-241 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	5.000E-05	5.000E-05	RTF(4,2)
D-34	Am-241 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-06	2.000E-06	RTF(4,3)
D-34				
D-34	Am-243+D , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(5,1)
D-34	Am-243+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	5.000E-05	5.000E-05	RTF(5,2)
D-34	Am-243+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-06	2.000E-06	RTF(5,3)
D-34				
D-34	Cm-243 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(6,1)
D-34	Cm-243 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-05	2.000E-05	RTF(6,2)
D-34	Cm-243 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-06	2.000E-06	RTF(6,3)
D-34				
D-34	Cm-244 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(8,1)
D-34	Cm-244 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-05	2.000E-05	RTF(8,2)
D-34	Cm-244 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-06	2.000E-06	RTF(8,3)
D-34				
D-34	Co-60 , plant/soil concentration ratio, dimensionless	8.000E-02	8.000E-02	RTF(11,1)
D-34	Co-60 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-02	2.000E-02	RTF(11,2)
D-34	Co-60 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-03	2.000E-03	RTF(11,3)
D-34				
D-34	Cs-137+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(12,1)
D-34	Cs-137+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.000E-02	3.000E-02	RTF(12,2)
D-34	Cs-137+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	8.000E-03	8.000E-03	RTF(12,3)
D-34				
D-34	Eu-152 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(13,1)
D-34	Eu-152 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-03	2.000E-03	RTF(13,2)
D-34	Eu-152 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-05	5.000E-05	RTF(13,3)
D-34				
D-34	Eu-154 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(15,1)
D-34	Eu-154 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-03	2.000E-03	RTF(15,2)
D-34	Eu-154 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-05	5.000E-05	RTF(15,3)

Dose Conversion Factor (and Related) Parameter Summary (continued)
Dose Library: FGR 12 & ICRP 72 (Adult)

Menu	Parameter	Current Value#	Base Case*	Parameter Name
D-34	Eu-155 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(16,1)
D-34	Eu-155 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-03	2.000E-03	RTF(16,2)
D-34	Eu-155 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-05	5.000E-05	RTF(16,3)
D-34				
D-34	Gd-152 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(17,1)
D-34	Gd-152 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-03	2.000E-03	RTF(17,2)
D-34	Gd-152 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-05	2.000E-05	RTF(17,3)
D-34				
D-34	Nb-94 , plant/soil concentration ratio, dimensionless	1.000E-02	1.000E-02	RTF(18,1)
D-34	Nb-94 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.000E-07	3.000E-07	RTF(18,2)
D-34	Nb-94 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-06	2.000E-06	RTF(18,3)
D-34				
D-34	Np-237+D , plant/soil concentration ratio, dimensionless	2.000E-02	2.000E-02	RTF(19,1)
D-34	Np-237+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(19,2)
D-34	Np-237+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(19,3)
D-34				
D-34	Pa-231 , plant/soil concentration ratio, dimensionless	1.000E-02	1.000E-02	RTF(20,1)
D-34	Pa-231 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	5.000E-03	5.000E-03	RTF(20,2)
D-34	Pa-231 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(20,3)
D-34				
D-34	Pb-210+D , plant/soil concentration ratio, dimensionless	1.000E-02	1.000E-02	RTF(21,1)
D-34	Pb-210+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	8.000E-04	8.000E-04	RTF(21,2)
D-34	Pb-210+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	3.000E-04	3.000E-04	RTF(21,3)
D-34				
D-34	Pu-238 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(22,1)
D-34	Pu-238 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(22,2)
D-34	Pu-238 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-06	1.000E-06	RTF(22,3)
D-34				
D-34	Pu-239 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(24,1)
D-34	Pu-239 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(24,2)
D-34	Pu-239 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-06	1.000E-06	RTF(24,3)
D-34				
D-34	Pu-240 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(25,1)
D-34	Pu-240 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(25,2)
D-34	Pu-240 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-06	1.000E-06	RTF(25,3)
D-34				
D-34	Pu-241 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(27,1)
D-34	Pu-241 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(27,2)
D-34	Pu-241 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-06	1.000E-06	RTF(27,3)
D-34				
D-34	Pu-241+D , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(28,1)
D-34	Pu-241+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(28,2)
D-34	Pu-241+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-06	1.000E-06	RTF(28,3)
D-34				
D-34	Ra-226+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(29,1)
D-34	Ra-226+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(29,2)
D-34	Ra-226+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-03	1.000E-03	RTF(29,3)
D-34				

Dose Conversion Factor (and Related) Parameter Summary (continued)
Dose Library: FGR 12 & ICRP 72 (Adult)

Menu	Parameter	Current Value#	Base Case*	Parameter Name
D-34	Ra-228+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(30,1)
D-34	Ra-228+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(30,2)
D-34	Ra-228+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-03	1.000E-03	RTF(30,3)
D-34				
D-34	Sr-90+D , plant/soil concentration ratio, dimensionless	3.000E-01	3.000E-01	RTF(31,1)
D-34	Sr-90+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	8.000E-03	8.000E-03	RTF(31,2)
D-34	Sr-90+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-03	2.000E-03	RTF(31,3)
D-34				
D-34	Tc-99 , plant/soil concentration ratio, dimensionless	5.000E+00	5.000E+00	RTF(32,1)
D-34	Tc-99 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(32,2)
D-34	Tc-99 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-03	1.000E-03	RTF(32,3)
D-34				
D-34	Th-228+D , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(33,1)
D-34	Th-228+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(33,2)
D-34	Th-228+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(33,3)
D-34				
D-34	Th-229+D , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(34,1)
D-34	Th-229+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(34,2)
D-34	Th-229+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(34,3)
D-34				
D-34	Th-230 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(35,1)
D-34	Th-230 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(35,2)
D-34	Th-230 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(35,3)
D-34				
D-34	Th-232 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(36,1)
D-34	Th-232 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(36,2)
D-34	Th-232 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(36,3)
D-34				
D-34	U-233 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(37,1)
D-34	U-233 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(37,2)
D-34	U-233 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(37,3)
D-34				
D-34	U-234 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(38,1)
D-34	U-234 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(38,2)
D-34	U-234 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(38,3)
D-34				
D-34	U-235+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(39,1)
D-34	U-235+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(39,2)
D-34	U-235+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(39,3)
D-34				
D-34	U-236 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(40,1)
D-34	U-236 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(40,2)
D-34	U-236 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(40,3)
D-34				
D-34	U-238 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(41,1)
D-34	U-238 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(41,2)
D-34	U-238 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(41,3)
D-34				

Dose Conversion Factor (and Related) Parameter Summary (continued)
Dose Library: FGR 12 & ICRP 72 (Adult)

Menu	Parameter	Current Value#	Base Case*	Parameter Name
D-34	U-238+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(42,1)
D-34	U-238+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(42,2)
D-34	U-238+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(42,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	Ac-227+D , fish	1.500E+01	1.500E+01	BIOFAC(1,1)
D-5	Ac-227+D , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(1,2)
D-5				
D-5	Ag-108m+D , fish	5.000E+00	5.000E+00	BIOFAC(2,1)
D-5	Ag-108m+D , crustacea and mollusks	7.700E+02	7.700E+02	BIOFAC(2,2)
D-5				
D-5	Al-26 , fish	5.000E+02	5.000E+02	BIOFAC(3,1)
D-5	Al-26 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(3,2)
D-5				
D-5	Am-241 , fish	3.000E+01	3.000E+01	BIOFAC(4,1)
D-5	Am-241 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(4,2)
D-5				
D-5	Am-243+D , fish	3.000E+01	3.000E+01	BIOFAC(5,1)
D-5	Am-243+D , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(5,2)
D-5				
D-5	Cm-243 , fish	3.000E+01	3.000E+01	BIOFAC(6,1)
D-5	Cm-243 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(6,2)
D-5				
D-5	Cm-244 , fish	3.000E+01	3.000E+01	BIOFAC(8,1)
D-5	Cm-244 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(8,2)
D-5				
D-5	Co-60 , fish	3.000E+02	3.000E+02	BIOFAC(11,1)
D-5	Co-60 , crustacea and mollusks	2.000E+02	2.000E+02	BIOFAC(11,2)
D-5				
D-5	Cs-137+D , fish	2.000E+03	2.000E+03	BIOFAC(12,1)
D-5	Cs-137+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(12,2)
D-5				
D-5	Eu-152 , fish	5.000E+01	5.000E+01	BIOFAC(13,1)
D-5	Eu-152 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(13,2)
D-5				
D-5	Eu-154 , fish	5.000E+01	5.000E+01	BIOFAC(15,1)
D-5	Eu-154 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(15,2)
D-5				
D-5	Eu-155 , fish	5.000E+01	5.000E+01	BIOFAC(16,1)
D-5	Eu-155 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(16,2)
D-5				
D-5	Gd-152 , fish	2.500E+01	2.500E+01	BIOFAC(17,1)
D-5	Gd-152 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(17,2)
D-5				
D-5	Nb-94 , fish	3.000E+02	3.000E+02	BIOFAC(18,1)
D-5	Nb-94 , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(18,2)
D-5				
D-5	Np-237+D , fish	3.000E+01	3.000E+01	BIOFAC(19,1)
D-5	Np-237+D , crustacea and mollusks	4.000E+02	4.000E+02	BIOFAC(19,2)
D-5				

Dose Conversion Factor (and Related) Parameter Summary (continued)
Dose Library: FGR 12 & ICRP 72 (Adult)

Menu	Parameter	Current Value#	Base Case*	Parameter Name
D-5	Pa-231 , fish	1.000E+01	1.000E+01	BIOFAC(20,1)
D-5	Pa-231 , crustacea and mollusks	1.100E+02	1.100E+02	BIOFAC(20,2)
D-5				
D-5	Pb-210+D , fish	3.000E+02	3.000E+02	BIOFAC(21,1)
D-5	Pb-210+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(21,2)
D-5				
D-5	Pu-238 , fish	3.000E+01	3.000E+01	BIOFAC(22,1)
D-5	Pu-238 , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(22,2)
D-5				
D-5	Pu-239 , fish	3.000E+01	3.000E+01	BIOFAC(24,1)
D-5	Pu-239 , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(24,2)
D-5				
D-5	Pu-240 , fish	3.000E+01	3.000E+01	BIOFAC(25,1)
D-5	Pu-240 , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(25,2)
D-5				
D-5	Pu-241 , fish	3.000E+01	3.000E+01	BIOFAC(27,1)
D-5	Pu-241 , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(27,2)
D-5				
D-5	Pu-241+D , fish	3.000E+01	3.000E+01	BIOFAC(28,1)
D-5	Pu-241+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(28,2)
D-5				
D-5	Ra-226+D , fish	5.000E+01	5.000E+01	BIOFAC(29,1)
D-5	Ra-226+D , crustacea and mollusks	2.500E+02	2.500E+02	BIOFAC(29,2)
D-5				
D-5	Ra-228+D , fish	5.000E+01	5.000E+01	BIOFAC(30,1)
D-5	Ra-228+D , crustacea and mollusks	2.500E+02	2.500E+02	BIOFAC(30,2)
D-5				
D-5	Sr-90+D , fish	6.000E+01	6.000E+01	BIOFAC(31,1)
D-5	Sr-90+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(31,2)
D-5				
D-5	Tc-99 , fish	2.000E+01	2.000E+01	BIOFAC(32,1)
D-5	Tc-99 , crustacea and mollusks	5.000E+00	5.000E+00	BIOFAC(32,2)
D-5				
D-5	Th-228+D , fish	1.000E+02	1.000E+02	BIOFAC(33,1)
D-5	Th-228+D , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(33,2)
D-5				
D-5	Th-229+D , fish	1.000E+02	1.000E+02	BIOFAC(34,1)
D-5	Th-229+D , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(34,2)
D-5				
D-5	Th-230 , fish	1.000E+02	1.000E+02	BIOFAC(35,1)
D-5	Th-230 , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(35,2)
D-5				
D-5	Th-232 , fish	1.000E+02	1.000E+02	BIOFAC(36,1)
D-5	Th-232 , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(36,2)
D-5				
D-5	U-233 , fish	1.000E+01	1.000E+01	BIOFAC(37,1)
D-5	U-233 , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(37,2)
D-5				
D-5	U-234 , fish	1.000E+01	1.000E+01	BIOFAC(38,1)
D-5	U-234 , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(38,2)

Dose Conversion Factor (and Related) Parameter Summary (continued)
Dose Library: FGR 12 & ICRP 72 (Adult)

Menu	Parameter	Current Value#	Base Case*	Parameter Name
D-5	U-235+D , fish	1.000E+01	1.000E+01	BIOFAC(39,1)
D-5	U-235+D , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(39,2)
D-5				
D-5	U-236 , fish	1.000E+01	1.000E+01	BIOFAC(40,1)
D-5	U-236 , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(40,2)
D-5				
D-5	U-238 , fish	1.000E+01	1.000E+01	BIOFAC(41,1)
D-5	U-238 , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(41,2)
D-5				
D-5	U-238+D , fish	1.000E+01	1.000E+01	BIOFAC(42,1)
D-5	U-238+D , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(42,2)

#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.

Site-Specific Parameter Summary

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R011	Area of contaminated zone (m**2)	1.000E+03	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	5.000E-02	2.000E+00	---	THICK0
R011	Fraction of contamination that is submerged	0.000E+00	0.000E+00	---	SUBMFRACT
R011	Length parallel to aquifer flow (m)	not used	1.000E+02	---	LCZPAQ
R011	Basic radiation dose limit (mrem/yr)	2.500E+01	3.000E+01	---	BRDL
R011	Time since placement of material (yr)	0.000E+00	0.000E+00	---	TI
R011	Times for calculations (yr)	1.000E+00	1.000E+00	---	T(2)
R011	Times for calculations (yr)	1.000E+01	3.000E+00	---	T(3)
R011	Times for calculations (yr)	1.000E+02	1.000E+01	---	T(4)
R011	Times for calculations (yr)	1.000E+03	3.000E+01	---	T(5)
R011	Times for calculations (yr)	not used	1.000E+02	---	T(6)
R011	Times for calculations (yr)	not used	3.000E+02	---	T(7)
R011	Times for calculations (yr)	not used	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): Ag-108m	1.000E+02	0.000E+00	---	S1(2)
R012	Initial principal radionuclide (pCi/g): Al-26	1.000E+02	0.000E+00	---	S1(3)
R012	Initial principal radionuclide (pCi/g): Am-241	1.000E+02	0.000E+00	---	S1(4)
R012	Initial principal radionuclide (pCi/g): Am-243	1.000E+02	0.000E+00	---	S1(5)
R012	Initial principal radionuclide (pCi/g): Cm-243	1.000E+02	0.000E+00	---	S1(6)
R012	Initial principal radionuclide (pCi/g): Cm-244	1.000E+02	0.000E+00	---	S1(8)
R012	Initial principal radionuclide (pCi/g): Co-60	1.000E+02	0.000E+00	---	S1(11)
R012	Initial principal radionuclide (pCi/g): Cs-137	1.000E+02	0.000E+00	---	S1(12)
R012	Initial principal radionuclide (pCi/g): Eu-152	1.000E+02	0.000E+00	---	S1(13)
R012	Initial principal radionuclide (pCi/g): Eu-154	1.000E+02	0.000E+00	---	S1(15)
R012	Initial principal radionuclide (pCi/g): Eu-155	1.000E+02	0.000E+00	---	S1(16)
R012	Initial principal radionuclide (pCi/g): Nb-94	1.000E+02	0.000E+00	---	S1(18)
R012	Initial principal radionuclide (pCi/g): Np-237	1.000E+02	0.000E+00	---	S1(19)
R012	Initial principal radionuclide (pCi/g): Pu-238	1.000E+02	0.000E+00	---	S1(22)
R012	Initial principal radionuclide (pCi/g): Pu-239	1.000E+02	0.000E+00	---	S1(24)
R012	Initial principal radionuclide (pCi/g): Pu-240	1.000E+02	0.000E+00	---	S1(25)
R012	Initial principal radionuclide (pCi/g): Pu-241	1.000E+02	0.000E+00	---	S1(27)
R012	Initial principal radionuclide (pCi/g): Sr-90	1.000E+02	0.000E+00	---	S1(31)
R012	Initial principal radionuclide (pCi/g): Tc-99	1.000E+02	0.000E+00	---	S1(32)
R012	Initial principal radionuclide (pCi/g): Th-232	1.000E+02	0.000E+00	---	S1(36)
R012	Initial principal radionuclide (pCi/g): U-233	1.000E+02	0.000E+00	---	S1(37)
R012	Initial principal radionuclide (pCi/g): U-234	1.000E+02	0.000E+00	---	S1(38)
R012	Initial principal radionuclide (pCi/g): U-235	1.000E+02	0.000E+00	---	S1(39)
R012	Initial principal radionuclide (pCi/g): U-238	1.000E+02	0.000E+00	---	S1(41)
R012	Concentration in groundwater (pCi/L): Ag-108m	not used	0.000E+00	---	W1(2)
R012	Concentration in groundwater (pCi/L): Al-26	not used	0.000E+00	---	W1(3)
R012	Concentration in groundwater (pCi/L): Am-241	not used	0.000E+00	---	W1(4)
R012	Concentration in groundwater (pCi/L): Am-243	not used	0.000E+00	---	W1(5)
R012	Concentration in groundwater (pCi/L): Cm-243	not used	0.000E+00	---	W1(6)
R012	Concentration in groundwater (pCi/L): Cm-244	not used	0.000E+00	---	W1(8)
R012	Concentration in groundwater (pCi/L): Co-60	not used	0.000E+00	---	W1(11)
R012	Concentration in groundwater (pCi/L): Cs-137	not used	0.000E+00	---	W1(12)
R012	Concentration in groundwater (pCi/L): Eu-152	not used	0.000E+00	---	W1(13)
R012	Concentration in groundwater (pCi/L): Eu-154	not used	0.000E+00	---	W1(15)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R012	Concentration in groundwater (pCi/L): Eu-155	not used	0.000E+00	---	W1(16)
R012	Concentration in groundwater (pCi/L): Nb-94	not used	0.000E+00	---	W1(18)
R012	Concentration in groundwater (pCi/L): Np-237	not used	0.000E+00	---	W1(19)
R012	Concentration in groundwater (pCi/L): Pu-238	not used	0.000E+00	---	W1(22)
R012	Concentration in groundwater (pCi/L): Pu-239	not used	0.000E+00	---	W1(24)
R012	Concentration in groundwater (pCi/L): Pu-240	not used	0.000E+00	---	W1(25)
R012	Concentration in groundwater (pCi/L): Pu-241	not used	0.000E+00	---	W1(27)
R012	Concentration in groundwater (pCi/L): Sr-90	not used	0.000E+00	---	W1(31)
R012	Concentration in groundwater (pCi/L): Tc-99	not used	0.000E+00	---	W1(32)
R012	Concentration in groundwater (pCi/L): Th-232	not used	0.000E+00	---	W1(36)
R012	Concentration in groundwater (pCi/L): U-233	not used	0.000E+00	---	W1(37)
R012	Concentration in groundwater (pCi/L): U-234	not used	0.000E+00	---	W1(38)
R012	Concentration in groundwater (pCi/L): U-235	not used	0.000E+00	---	W1(39)
R012	Concentration in groundwater (pCi/L): U-238	not used	0.000E+00	---	W1(41)
R013	Cover depth (m)	0.000E+00	0.000E+00	---	COVER0
R013	Density of cover material (g/cm**3)	not used	1.500E+00	---	DENSCV
R013	Cover depth erosion rate (m/yr)	not used	1.000E-03	---	VCV
R013	Density of contaminated zone (g/cm**3)	1.500E+00	1.500E+00	---	DENSCZ
R013	Contaminated zone erosion rate (m/yr)	0.000E+00	1.000E-03	---	VCZ
R013	Contaminated zone total porosity	4.300E-01	4.000E-01	---	TPCZ
R013	Contaminated zone field capacity	2.000E-01	2.000E-01	---	FCCZ
R013	Contaminated zone hydraulic conductivity (m/yr)	1.090E+03	1.000E+01	---	HCCZ
R013	Contaminated zone b parameter	4.900E+00	5.300E+00	---	BCZ
R013	Average annual wind speed (m/sec)	3.120E+00	2.000E+00	---	WIND
R013	Humidity in air (g/m**3)	not used	8.000E+00	---	HUMID
R013	Evapotranspiration coefficient	9.800E-01	5.000E-01	---	EVAPTR
R013	Precipitation (m/yr)	9.600E-02	1.000E+00	---	PRECIP
R013	Irrigation (m/yr)	0.000E+00	2.000E-01	---	RI
R013	Irrigation mode	overhead	overhead	---	IDITCH
R013	Runoff coefficient	4.000E-01	2.000E-01	---	RUNOFF
R013	Watershed area for nearby stream or pond (m**2)	not used	1.000E+06	---	WAREA
R013	Accuracy for water/soil computations	not used	1.000E-03	---	EPS
R014	Density of saturated zone (g/cm**3)	not used	1.500E+00	---	DENSAQ
R014	Saturated zone total porosity	not used	4.000E-01	---	TPSZ
R014	Saturated zone effective porosity	not used	2.000E-01	---	EPSZ
R014	Saturated zone field capacity	not used	2.000E-01	---	FCSZ
R014	Saturated zone hydraulic conductivity (m/yr)	not used	1.000E+02	---	HCSZ
R014	Saturated zone hydraulic gradient	not used	2.000E-02	---	HGWT
R014	Saturated zone b parameter	not used	5.300E+00	---	BSZ
R014	Water table drop rate (m/yr)	not used	1.000E-03	---	VWT
R014	Well pump intake depth (m below water table)	not used	1.000E+01	---	DWIBWT
R014	Model: Nondispersion (ND) or Mass-Balance (MB)	not used	ND	---	MODEL
R014	Well pumping rate (m**3/yr)	not used	2.500E+02	---	UW
R015	Number of unsaturated zone strata	not used	1	---	NS

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R015	Unsat. zone 1, thickness (m)	not used	4.000E+00	---	H(1)
R015	Unsat. zone 1, soil density (g/cm**3)	not used	1.500E+00	---	DENSUZ(1)
R015	Unsat. zone 1, total porosity	not used	4.000E-01	---	TPUZ(1)
R015	Unsat. zone 1, effective porosity	not used	2.000E-01	---	EPUZ(1)
R015	Unsat. zone 1, field capacity	not used	2.000E-01	---	FCUZ(1)
R015	Unsat. zone 1, soil-specific b parameter	not used	5.300E+00	---	BUZ(1)
R015	Unsat. zone 1, hydraulic conductivity (m/yr)	not used	1.000E+01	---	HCUZ(1)
R016	Distribution coefficients for Ag-108m				
R016	Contaminated zone (cm**3/g)	0.000E+00	0.000E+00	---	DCNUCC(2)
R016	Unsaturated zone 1 (cm**3/g)	not used	0.000E+00	---	DCNUCU(2,1)
R016	Saturated zone (cm**3/g)	not used	0.000E+00	---	DCNUCS(2)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.152E-01	ALEACH(2)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(2)
R016	Distribution coefficients for Al-26				
R016	Contaminated zone (cm**3/g)	0.000E+00	0.000E+00	---	DCNUCC(3)
R016	Unsaturated zone 1 (cm**3/g)	not used	0.000E+00	---	DCNUCU(3,1)
R016	Saturated zone (cm**3/g)	not used	0.000E+00	---	DCNUCS(3)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.152E-01	ALEACH(3)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(3)
R016	Distribution coefficients for Am-241				
R016	Contaminated zone (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCC(4)
R016	Unsaturated zone 1 (cm**3/g)	not used	2.000E+01	---	DCNUCU(4,1)
R016	Saturated zone (cm**3/g)	not used	2.000E+01	---	DCNUCS(4)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	7.629E-04	ALEACH(4)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(4)
R016	Distribution coefficients for Am-243				
R016	Contaminated zone (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCC(5)
R016	Unsaturated zone 1 (cm**3/g)	not used	2.000E+01	---	DCNUCU(5,1)
R016	Saturated zone (cm**3/g)	not used	2.000E+01	---	DCNUCS(5)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	7.629E-04	ALEACH(5)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(5)
R016	Distribution coefficients for Cm-243				
R016	Contaminated zone (cm**3/g)	-1.000E+00	-1.000E+00	1.378E+03	DCNUCC(6)
R016	Unsaturated zone 1 (cm**3/g)	not used	-1.000E+00	---	DCNUCU(6,1)
R016	Saturated zone (cm**3/g)	not used	-1.000E+00	---	DCNUCS(6)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.115E-05	ALEACH(6)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(6)
R016	Distribution coefficients for Cm-244				
R016	Contaminated zone (cm**3/g)	-1.000E+00	-1.000E+00	1.378E+03	DCNUCC(8)
R016	Unsaturated zone 1 (cm**3/g)	not used	-1.000E+00	---	DCNUCU(8,1)
R016	Saturated zone (cm**3/g)	not used	-1.000E+00	---	DCNUCS(8)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.115E-05	ALEACH(8)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(8)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R016	Distribution coefficients for Co-60				
R016	Contaminated zone (cm**3/g)	1.000E+03	1.000E+03	---	DCNUCC(11)
R016	Unsaturated zone 1 (cm**3/g)	not used	1.000E+03	---	DCNUCU(11,1)
R016	Saturated zone (cm**3/g)	not used	1.000E+03	---	DCNUCS(11)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.536E-05	ALEACH(11)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(11)
R016	Distribution coefficients for Cs-137				
R016	Contaminated zone (cm**3/g)	4.600E+03	4.600E+03	---	DCNUCC(12)
R016	Unsaturated zone 1 (cm**3/g)	not used	4.600E+03	---	DCNUCU(12,1)
R016	Saturated zone (cm**3/g)	not used	4.600E+03	---	DCNUCS(12)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.339E-06	ALEACH(12)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(12)
R016	Distribution coefficients for Eu-152				
R016	Contaminated zone (cm**3/g)	-1.000E+00	-1.000E+00	8.249E+02	DCNUCC(13)
R016	Unsaturated zone 1 (cm**3/g)	not used	-1.000E+00	---	DCNUCU(13,1)
R016	Saturated zone (cm**3/g)	not used	-1.000E+00	---	DCNUCS(13)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.862E-05	ALEACH(13)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(13)
R016	Distribution coefficients for Eu-154				
R016	Contaminated zone (cm**3/g)	-1.000E+00	-1.000E+00	8.249E+02	DCNUCC(15)
R016	Unsaturated zone 1 (cm**3/g)	not used	-1.000E+00	---	DCNUCU(15,1)
R016	Saturated zone (cm**3/g)	not used	-1.000E+00	---	DCNUCS(15)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.862E-05	ALEACH(15)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(15)
R016	Distribution coefficients for Eu-155				
R016	Contaminated zone (cm**3/g)	-1.000E+00	-1.000E+00	8.249E+02	DCNUCC(16)
R016	Unsaturated zone 1 (cm**3/g)	not used	-1.000E+00	---	DCNUCU(16,1)
R016	Saturated zone (cm**3/g)	not used	-1.000E+00	---	DCNUCS(16)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.862E-05	ALEACH(16)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(16)
R016	Distribution coefficients for Nb-94				
R016	Contaminated zone (cm**3/g)	0.000E+00	0.000E+00	---	DCNUCC(18)
R016	Unsaturated zone 1 (cm**3/g)	not used	0.000E+00	---	DCNUCU(18,1)
R016	Saturated zone (cm**3/g)	not used	0.000E+00	---	DCNUCS(18)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.152E-01	ALEACH(18)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(18)
R016	Distribution coefficients for Np-237				
R016	Contaminated zone (cm**3/g)	-1.000E+00	-1.000E+00	2.574E+02	DCNUCC(19)
R016	Unsaturated zone 1 (cm**3/g)	not used	-1.000E+00	---	DCNUCU(19,1)
R016	Saturated zone (cm**3/g)	not used	-1.000E+00	---	DCNUCS(19)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	5.964E-05	ALEACH(19)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(19)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R016	Distribution coefficients for Pu-238				
R016	Contaminated zone (cm**3/g)	2.000E+03	2.000E+03	---	DCNUCC(22)
R016	Unsaturated zone 1 (cm**3/g)	not used	2.000E+03	---	DCNUCU(22,1)
R016	Saturated zone (cm**3/g)	not used	2.000E+03	---	DCNUCS(22)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	7.679E-06	ALEACH(22)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(22)
R016	Distribution coefficients for Pu-239				
R016	Contaminated zone (cm**3/g)	2.000E+03	2.000E+03	---	DCNUCC(24)
R016	Unsaturated zone 1 (cm**3/g)	not used	2.000E+03	---	DCNUCU(24,1)
R016	Saturated zone (cm**3/g)	not used	2.000E+03	---	DCNUCS(24)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	7.679E-06	ALEACH(24)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(24)
R016	Distribution coefficients for Pu-240				
R016	Contaminated zone (cm**3/g)	2.000E+03	2.000E+03	---	DCNUCC(25)
R016	Unsaturated zone 1 (cm**3/g)	not used	2.000E+03	---	DCNUCU(25,1)
R016	Saturated zone (cm**3/g)	not used	2.000E+03	---	DCNUCS(25)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	7.679E-06	ALEACH(25)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(25)
R016	Distribution coefficients for Pu-241				
R016	Contaminated zone (cm**3/g)	2.000E+03	2.000E+03	---	DCNUCC(27)
R016	Unsaturated zone 1 (cm**3/g)	not used	2.000E+03	---	DCNUCU(27,1)
R016	Saturated zone (cm**3/g)	not used	2.000E+03	---	DCNUCS(27)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	7.679E-06	ALEACH(27)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(27)
R016	Distribution coefficients for Sr-90				
R016	Contaminated zone (cm**3/g)	3.000E+01	3.000E+01	---	DCNUCC(31)
R016	Unsaturated zone 1 (cm**3/g)	not used	3.000E+01	---	DCNUCU(31,1)
R016	Saturated zone (cm**3/g)	not used	3.000E+01	---	DCNUCS(31)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	5.097E-04	ALEACH(31)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(31)
R016	Distribution coefficients for Tc-99				
R016	Contaminated zone (cm**3/g)	0.000E+00	0.000E+00	---	DCNUCC(32)
R016	Unsaturated zone 1 (cm**3/g)	not used	0.000E+00	---	DCNUCU(32,1)
R016	Saturated zone (cm**3/g)	not used	0.000E+00	---	DCNUCS(32)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.152E-01	ALEACH(32)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(32)
R016	Distribution coefficients for Th-232				
R016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCC(36)
R016	Unsaturated zone 1 (cm**3/g)	not used	6.000E+04	---	DCNUCU(36,1)
R016	Saturated zone (cm**3/g)	not used	6.000E+04	---	DCNUCS(36)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.560E-07	ALEACH(36)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(36)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R016	Distribution coefficients for U-233				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(37)
R016	Unsaturated zone 1 (cm**3/g)	not used	5.000E+01	---	DCNUCU(37,1)
R016	Saturated zone (cm**3/g)	not used	5.000E+01	---	DCNUCS(37)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.064E-04	ALEACH(37)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(37)
R016	Distribution coefficients for U-234				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(38)
R016	Unsaturated zone 1 (cm**3/g)	not used	5.000E+01	---	DCNUCU(38,1)
R016	Saturated zone (cm**3/g)	not used	5.000E+01	---	DCNUCS(38)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.064E-04	ALEACH(38)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(38)
R016	Distribution coefficients for U-235				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(39)
R016	Unsaturated zone 1 (cm**3/g)	not used	5.000E+01	---	DCNUCU(39,1)
R016	Saturated zone (cm**3/g)	not used	5.000E+01	---	DCNUCS(39)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.064E-04	ALEACH(39)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(39)
R016	Distribution coefficients for U-238				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(41)
R016	Unsaturated zone 1 (cm**3/g)	not used	5.000E+01	---	DCNUCU(41,1)
R016	Saturated zone (cm**3/g)	not used	5.000E+01	---	DCNUCS(41)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.064E-04	ALEACH(41)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(41)
R016	Distribution coefficients for daughter Ac-227				
R016	Contaminated zone (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCC(1)
R016	Unsaturated zone 1 (cm**3/g)	not used	2.000E+01	---	DCNUCU(1,1)
R016	Saturated zone (cm**3/g)	not used	2.000E+01	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	7.629E-04	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
R016	Distribution coefficients for daughter Gd-152				
R016	Contaminated zone (cm**3/g)	-1.000E+00	-1.000E+00	8.249E+02	DCNUCC(17)
R016	Unsaturated zone 1 (cm**3/g)	not used	-1.000E+00	---	DCNUCU(17,1)
R016	Saturated zone (cm**3/g)	not used	-1.000E+00	---	DCNUCS(17)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.862E-05	ALEACH(17)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(17)
R016	Distribution coefficients for daughter Pa-231				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(20)
R016	Unsaturated zone 1 (cm**3/g)	not used	5.000E+01	---	DCNUCU(20,1)
R016	Saturated zone (cm**3/g)	not used	5.000E+01	---	DCNUCS(20)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.064E-04	ALEACH(20)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(20)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R016	Distribution coefficients for daughter Pb-210				
R016	Contaminated zone (cm**3/g)	1.000E+02	1.000E+02	---	DCNUCC(21)
R016	Unsaturated zone 1 (cm**3/g)	not used	1.000E+02	---	DCNUCU(21,1)
R016	Saturated zone (cm**3/g)	not used	1.000E+02	---	DCNUCS(21)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.534E-04	ALEACH(21)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(21)
R016	Distribution coefficients for daughter Ra-226				
R016	Contaminated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCC(29)
R016	Unsaturated zone 1 (cm**3/g)	not used	7.000E+01	---	DCNUCU(29,1)
R016	Saturated zone (cm**3/g)	not used	7.000E+01	---	DCNUCS(29)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.190E-04	ALEACH(29)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(29)
R016	Distribution coefficients for daughter Ra-228				
R016	Contaminated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCC(30)
R016	Unsaturated zone 1 (cm**3/g)	not used	7.000E+01	---	DCNUCU(30,1)
R016	Saturated zone (cm**3/g)	not used	7.000E+01	---	DCNUCS(30)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.190E-04	ALEACH(30)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(30)
R016	Distribution coefficients for daughter Th-228				
R016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCC(33)
R016	Unsaturated zone 1 (cm**3/g)	not used	6.000E+04	---	DCNUCU(33,1)
R016	Saturated zone (cm**3/g)	not used	6.000E+04	---	DCNUCS(33)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.560E-07	ALEACH(33)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(33)
R016	Distribution coefficients for daughter Th-229				
R016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCC(34)
R016	Unsaturated zone 1 (cm**3/g)	not used	6.000E+04	---	DCNUCU(34,1)
R016	Saturated zone (cm**3/g)	not used	6.000E+04	---	DCNUCS(34)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.560E-07	ALEACH(34)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(34)
R016	Distribution coefficients for daughter Th-230				
R016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCC(35)
R016	Unsaturated zone 1 (cm**3/g)	not used	6.000E+04	---	DCNUCU(35,1)
R016	Saturated zone (cm**3/g)	not used	6.000E+04	---	DCNUCS(35)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.560E-07	ALEACH(35)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(35)
R016	Distribution coefficients for daughter U-236				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(40)
R016	Unsaturated zone 1 (cm**3/g)	not used	5.000E+01	---	DCNUCU(40,1)
R016	Saturated zone (cm**3/g)	not used	5.000E+01	---	DCNUCS(40)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.064E-04	ALEACH(40)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(40)
R017	Inhalation rate (m**3/yr)	1.200E+04	8.400E+03	---	INHALR

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R017	Mass loading for inhalation (g/m**3)	6.000E-04	1.000E-04	---	MLINH
R017	Exposure duration	2.500E+01	3.000E+01	---	ED
R017	Shielding factor, inhalation	1.000E+00	4.000E-01	---	SHF3
R017	Shielding factor, external gamma	not used	7.000E-01	---	SHF1
R017	Fraction of time spent indoors	2.740E-02	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	8.220E-02	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)
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)	3.190E+01	3.650E+01	---	SOIL
R018	Drinking water intake (L/yr)	not used	5.100E+02	---	DWI
R018	Contamination fraction of drinking water	not used	1.000E+00	---	FDW
R018	Contamination fraction of household water	not used	1.000E+00	---	FHHW
R018	Contamination fraction of livestock water	not used	1.000E+00	---	FLW
R018	Contamination fraction of irrigation water	not used	1.000E+00	---	FIRW
R018	Contamination fraction of aquatic food	not used	5.000E-01	---	FR9
R018	Contamination fraction of plant food	not used	-1	---	FPLANT
R018	Contamination fraction of meat	not used	-1	---	FMEAT

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
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)	4.500E-01	1.500E-01	---	DM
R019	Depth of roots (m)	not used	9.000E-01	---	DROOT
R019	Drinking water fraction from ground water	not used	1.000E+00	---	FGWDW
R019	Household water fraction from ground water	not used	1.000E+00	---	FGWHH
R019	Livestock water fraction from ground water	not used	1.000E+00	---	FGWLW
R019	Irrigation fraction from ground water	not used	1.000E+00	---	FGWIR
R19B	Wet weight crop yield for Non-Leafy (kg/m**2)	not used	7.000E-01	---	YV(1)
R19B	Wet weight crop yield for Leafy (kg/m**2)	not used	1.500E+00	---	YV(2)
R19B	Wet weight crop yield for Fodder (kg/m**2)	not used	1.100E+00	---	YV(3)
R19B	Growing Season for Non-Leafy (years)	not used	1.700E-01	---	TE(1)
R19B	Growing Season for Leafy (years)	not used	2.500E-01	---	TE(2)
R19B	Growing Season for Fodder (years)	not used	8.000E-02	---	TE(3)
R19B	Translocation Factor for Non-Leafy	not used	1.000E-01	---	TIV(1)
R19B	Translocation Factor for Leafy	not used	1.000E+00	---	TIV(2)
R19B	Translocation Factor for Fodder	not used	1.000E+00	---	TIV(3)
R19B	Dry Foliar Interception Fraction for Non-Leafy	not used	2.500E-01	---	RDRY(1)
R19B	Dry Foliar Interception Fraction for Leafy	not used	2.500E-01	---	RDRY(2)
R19B	Dry Foliar Interception Fraction for Fodder	not used	2.500E-01	---	RDRY(3)
R19B	Wet Foliar Interception Fraction for Non-Leafy	not used	2.500E-01	---	RWET(1)
R19B	Wet Foliar Interception Fraction for Leafy	not used	2.500E-01	---	RWET(2)
R19B	Wet Foliar Interception Fraction for Fodder	not used	2.500E-01	---	RWET(3)
R19B	Weathering Removal Constant for Vegetation	not used	2.000E+01	---	WLAM
C14	C-12 concentration in water (g/cm**3)	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)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
STOR	Surface water	1.000E+00	1.000E+00	---	STOR_T(8)
STOR	Livestock fodder	4.500E+01	4.500E+01	---	STOR_T(9)
R021	Thickness of building foundation (m)	not used	1.500E-01	---	FLOOR1
R021	Bulk density of building foundation (g/cm**3)	not used	2.400E+00	---	DENSFL
R021	Total porosity of the cover material	not used	4.000E-01	---	TPCV
R021	Total porosity of the building foundation	not used	1.000E-01	---	TPFL
R021	Volumetric water content of the cover material	not used	5.000E-02	---	PH2OCV
R021	Volumetric water content of the foundation	not used	3.000E-02	---	PH2OFL
R021	Diffusion coefficient for radon gas (m/sec):				
R021	in cover material	not used	2.000E-06	---	DIFCV
R021	in foundation material	not used	3.000E-07	---	DIFFL
R021	in contaminated zone soil	not used	2.000E-06	---	DIFCZ
R021	Radon vertical dimension of mixing (m)	not used	2.000E+00	---	HMIX
R021	Average building air exchange rate (1/hr)	not used	5.000E-01	---	REXG
R021	Height of the building (room) (m)	not used	2.500E+00	---	HRM
R021	Building interior area factor	not used	0.000E+00	---	FAI
R021	Building depth below ground surface (m)	not used	-1.000E+00	---	DMFL
R021	Emanating power of Rn-222 gas	not used	2.500E-01	---	EMANA(1)
R021	Emanating power of Rn-220 gas	not used	1.500E-01	---	EMANA(2)
TITL	Number of graphical time points	32	---	---	NPTS
TITL	Maximum number of integration points for dose	17	---	---	LYMAX
TITL	Maximum number of integration points for risk	257	---	---	KYMAX

Summary of Pathway Selections

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

Contaminated Zone Dimensions

Area:	1000.00 square meters
Thickness:	0.05 meters
Cover Depth:	0.00 meters

Initial Soil Concentrations, pCi/g

Ag-108m	1.000E+02
Al-26	1.000E+02
Am-241	1.000E+02
Am-243	1.000E+02
Cm-243	1.000E+02
Cm-244	1.000E+02
Co-60	1.000E+02
Cs-137	1.000E+02
Eu-152	1.000E+02
Eu-154	1.000E+02
Eu-155	1.000E+02
Nb-94	1.000E+02
Np-237	1.000E+02
Pu-238	1.000E+02
Pu-239	1.000E+02
Pu-240	1.000E+02
Pu-241	1.000E+02
Sr-90	1.000E+02
Tc-99	1.000E+02
Th-232	1.000E+02
U-233	1.000E+02
U-234	1.000E+02
U-235	1.000E+02
U-238	1.000E+02

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	1.000E+01	1.000E+02	1.000E+03
TDOSE(t):	3.413E+00	3.417E+00	3.447E+00	2.932E+00	2.265E+00
M(t):	1.365E-01	1.367E-01	1.379E-01	1.173E-01	9.061E-02

Maximum TDOSE(t): 3.448E+00 mrem/yr at t = 8.68 ñ 0.02 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 = 8.675E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Ag-108m	0.000E+00	0.0000	4.419E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.093E-04	0.0000
Al-26	0.000E+00	0.0000	2.509E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.756E-04	0.0001
Am-241	0.000E+00	0.0000	3.388E-01	0.0983	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.813E-02	0.0082
Am-243	0.000E+00	0.0000	3.436E-01	0.0997	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.865E-02	0.0083
Cm-243	0.000E+00	0.0000	1.990E-01	0.0577	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.726E-02	0.0050
Cm-244	0.000E+00	0.0000	1.452E-01	0.0421	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.217E-02	0.0035
Co-60	0.000E+00	0.0000	3.358E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.465E-04	0.0000
Cs-137	0.000E+00	0.0000	1.136E-04	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.512E-03	0.0004
Eu-152	0.000E+00	0.0000	9.380E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.249E-04	0.0000
Eu-154	0.000E+00	0.0000	9.280E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.396E-04	0.0000
Eu-155	0.000E+00	0.0000	6.904E-06	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.273E-05	0.0000
Nb-94	0.000E+00	0.0000	6.136E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.493E-05	0.0000
Np-237	0.000E+00	0.0000	1.803E-01	0.0523	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.593E-02	0.0046
Pu-238	0.000E+00	0.0000	3.691E-01	0.1071	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.075E-02	0.0089
Pu-239	0.000E+00	0.0000	4.329E-01	0.1255	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.592E-02	0.0104
Pu-240	0.000E+00	0.0000	4.326E-01	0.1255	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.590E-02	0.0104
Pu-241	0.000E+00	0.0000	9.406E-03	0.0027	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.825E-04	0.0002
Sr-90	0.000E+00	0.0000	4.663E-04	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.543E-03	0.0010
Tc-99	0.000E+00	0.0000	1.631E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.201E-05	0.0000
Th-232	0.000E+00	0.0000	5.177E-01	0.1501	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.101E-01	0.0319
U-233	0.000E+00	0.0000	3.532E-02	0.0102	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.397E-03	0.0021
U-234	0.000E+00	0.0000	3.387E-02	0.0098	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.014E-03	0.0020
U-235	0.000E+00	0.0000	3.079E-02	0.0089	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.813E-03	0.0020
U-238	0.000E+00	0.0000	2.881E-02	0.0084	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.958E-03	0.0020
Total	0.000E+00	0.0000	3.098E+00	0.8986	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.496E-01	0.1014

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 8.675E+00 years

Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Ag-108m	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.535E-04	0.0000
Al-26	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.007E-04	0.0001
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.669E-01	0.1064
Am-243	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.723E-01	0.1080
Cm-243	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.163E-01	0.0627
Cm-244	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.574E-01	0.0456
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.801E-04	0.0001
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.625E-03	0.0005
Eu-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.187E-04	0.0001
Eu-154	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.324E-04	0.0001
Eu-155	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.963E-05	0.0000
Nb-94	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.463E-04	0.0000
Np-237	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.963E-01	0.0569
Pu-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	3.999E-01	0.1160
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.688E-01	0.1360
Pu-240	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.685E-01	0.1359
Pu-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.019E-02	0.0030
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.009E-03	0.0012
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.832E-05	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	6.277E-01	0.1821
U-233	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.272E-02	0.0124
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	4.089E-02	0.0119
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.760E-02	0.0109
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	3.577E-02	0.0104
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	3.448E+00	1.0000

*Sum of all water independent and dependent pathways.

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

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Ag-108m	0.000E+00	0.0000	1.259E-04	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.114E-04	0.0001
Al-26	0.000E+00	0.0000	6.817E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.770E-04	0.0001
Am-241	0.000E+00	0.0000	3.458E-01	0.1013	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.871E-02	0.0084
Am-243	0.000E+00	0.0000	3.461E-01	0.1014	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.885E-02	0.0085
Cm-243	0.000E+00	0.0000	2.457E-01	0.0720	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.130E-02	0.0062
Cm-244	0.000E+00	0.0000	2.019E-01	0.0592	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.692E-02	0.0050
Co-60	0.000E+00	0.0000	1.051E-04	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.587E-04	0.0001
Cs-137	0.000E+00	0.0000	1.388E-04	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.847E-03	0.0005
Eu-152	0.000E+00	0.0000	1.473E-04	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.961E-04	0.0001
Eu-154	0.000E+00	0.0000	1.838E-04	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.764E-04	0.0001
Eu-155	0.000E+00	0.0000	2.321E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.278E-05	0.0000
Nb-94	0.000E+00	0.0000	1.667E-04	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.308E-04	0.0001
Np-237	0.000E+00	0.0000	1.804E-01	0.0529	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.594E-02	0.0047
Pu-238	0.000E+00	0.0000	3.954E-01	0.1158	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.293E-02	0.0096
Pu-239	0.000E+00	0.0000	4.330E-01	0.1269	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.593E-02	0.0105
Pu-240	0.000E+00	0.0000	4.330E-01	0.1269	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.593E-02	0.0105
Pu-241	0.000E+00	0.0000	8.376E-03	0.0025	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.978E-04	0.0002
Sr-90	0.000E+00	0.0000	5.757E-04	0.0002	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.375E-03	0.0013
Tc-99	0.000E+00	0.0000	4.431E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.696E-05	0.0000
Th-232	0.000E+00	0.0000	4.013E-01	0.1176	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.893E-02	0.0114
U-233	0.000E+00	0.0000	3.466E-02	0.0102	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.345E-03	0.0022
U-234	0.000E+00	0.0000	3.394E-02	0.0099	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.030E-03	0.0021
U-235	0.000E+00	0.0000	3.072E-02	0.0090	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.808E-03	0.0020
U-238	0.000E+00	0.0000	2.889E-02	0.0085	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.976E-03	0.0020
Total	0.000E+00	0.0000	3.121E+00	0.9143	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.926E-01	0.0857

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

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Ag-108m	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.373E-04	0.0001
Al-26	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.452E-04	0.0002
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.745E-01	0.1097
Am-243	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.749E-01	0.1098
Cm-243	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.670E-01	0.0782
Cm-244	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.188E-01	0.0641
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.637E-04	0.0002
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.986E-03	0.0006
Eu-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.434E-04	0.0001
Eu-154	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.602E-04	0.0001
Eu-155	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.599E-05	0.0000
Nb-94	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.975E-04	0.0001
Np-237	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.964E-01	0.0575
Pu-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	4.283E-01	0.1255
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.689E-01	0.1374
Pu-240	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.689E-01	0.1374
Pu-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.074E-03	0.0027
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.951E-03	0.0015
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.313E-04	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	4.402E-01	0.1290
U-233	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.200E-02	0.0123
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	4.097E-02	0.0120
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.753E-02	0.0110
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	3.587E-02	0.0105
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	3.413E+00	1.0000

*Sum of all water independent and dependent pathways.

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

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Ag-108m	0.000E+00	0.0000	1.116E-04	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.760E-04	0.0001
Al-26	0.000E+00	0.0000	6.075E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.251E-04	0.0001
Am-241	0.000E+00	0.0000	3.450E-01	0.1010	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.865E-02	0.0084
Am-243	0.000E+00	0.0000	3.458E-01	0.1012	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.883E-02	0.0084
Cm-243	0.000E+00	0.0000	2.398E-01	0.0702	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.079E-02	0.0061
Cm-244	0.000E+00	0.0000	1.944E-01	0.0569	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.629E-02	0.0048
Co-60	0.000E+00	0.0000	9.214E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.021E-04	0.0001
Cs-137	0.000E+00	0.0000	1.357E-04	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.805E-03	0.0005
Eu-152	0.000E+00	0.0000	1.398E-04	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.861E-04	0.0001
Eu-154	0.000E+00	0.0000	1.699E-04	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.555E-04	0.0001
Eu-155	0.000E+00	0.0000	2.018E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.720E-05	0.0000
Nb-94	0.000E+00	0.0000	1.486E-04	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.057E-04	0.0001
Np-237	0.000E+00	0.0000	1.804E-01	0.0528	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.593E-02	0.0047
Pu-238	0.000E+00	0.0000	3.922E-01	0.1148	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.267E-02	0.0096
Pu-239	0.000E+00	0.0000	4.330E-01	0.1267	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.593E-02	0.0105
Pu-240	0.000E+00	0.0000	4.329E-01	0.1267	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.593E-02	0.0105
Pu-241	0.000E+00	0.0000	8.523E-03	0.0025	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.099E-04	0.0002
Sr-90	0.000E+00	0.0000	5.619E-04	0.0002	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.270E-03	0.0012
Tc-99	0.000E+00	0.0000	3.949E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.750E-05	0.0000
Th-232	0.000E+00	0.0000	4.127E-01	0.1208	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.022E-02	0.0147
U-233	0.000E+00	0.0000	3.474E-02	0.0102	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.351E-03	0.0022
U-234	0.000E+00	0.0000	3.393E-02	0.0099	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.028E-03	0.0021
U-235	0.000E+00	0.0000	3.073E-02	0.0090	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.809E-03	0.0020
U-238	0.000E+00	0.0000	2.888E-02	0.0085	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.974E-03	0.0020
Total	0.000E+00	0.0000	3.115E+00	0.9116	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.020E-01	0.0884

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-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Ag-108m	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.876E-04	0.0001
Al-26	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.859E-04	0.0001
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.736E-01	0.1094
Am-243	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.746E-01	0.1096
Cm-243	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.606E-01	0.0763
Cm-244	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.107E-01	0.0617
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.943E-04	0.0001
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.941E-03	0.0006
Eu-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.260E-04	0.0001
Eu-154	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.254E-04	0.0001
Eu-155	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.738E-05	0.0000
Nb-94	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.543E-04	0.0001
Np-237	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.964E-01	0.0575
Pu-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	4.249E-01	0.1244
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.689E-01	0.1372
Pu-240	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.689E-01	0.1372
Pu-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.233E-03	0.0027
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.832E-03	0.0014
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.170E-04	0.0000
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	4.629E-01	0.1355
U-233	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.209E-02	0.0123
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	4.096E-02	0.0120
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.753E-02	0.0110
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	3.586E-02	0.0105
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	3.417E+00	1.0000

*Sum of all water independent and dependent pathways.

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

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Ag-108m	0.000E+00	0.0000	3.766E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.318E-05	0.0000
Al-26	0.000E+00	0.0000	2.154E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.507E-04	0.0000
Am-241	0.000E+00	0.0000	3.377E-01	0.0980	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.804E-02	0.0081
Am-243	0.000E+00	0.0000	3.432E-01	0.0996	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.861E-02	0.0083
Cm-243	0.000E+00	0.0000	1.927E-01	0.0559	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.671E-02	0.0048
Cm-244	0.000E+00	0.0000	1.381E-01	0.0401	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.157E-02	0.0034
Co-60	0.000E+00	0.0000	2.821E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.231E-04	0.0000
Cs-137	0.000E+00	0.0000	1.102E-04	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.466E-03	0.0004
Eu-152	0.000E+00	0.0000	8.756E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.166E-04	0.0000
Eu-154	0.000E+00	0.0000	8.360E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.257E-04	0.0000
Eu-155	0.000E+00	0.0000	5.737E-06	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.057E-05	0.0000
Nb-94	0.000E+00	0.0000	5.267E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.291E-05	0.0000
Np-237	0.000E+00	0.0000	1.803E-01	0.0523	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.593E-02	0.0046
Pu-238	0.000E+00	0.0000	3.653E-01	0.1060	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.043E-02	0.0088
Pu-239	0.000E+00	0.0000	4.328E-01	0.1256	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.592E-02	0.0104
Pu-240	0.000E+00	0.0000	4.325E-01	0.1255	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.589E-02	0.0104
Pu-241	0.000E+00	0.0000	9.521E-03	0.0028	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.920E-04	0.0002
Sr-90	0.000E+00	0.0000	4.515E-04	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.431E-03	0.0010
Tc-99	0.000E+00	0.0000	1.400E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.748E-05	0.0000
Th-232	0.000E+00	0.0000	5.309E-01	0.1540	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.162E-01	0.0337
U-233	0.000E+00	0.0000	3.542E-02	0.0103	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.405E-03	0.0021
U-234	0.000E+00	0.0000	3.386E-02	0.0098	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.011E-03	0.0020
U-235	0.000E+00	0.0000	3.080E-02	0.0089	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.815E-03	0.0020
U-238	0.000E+00	0.0000	2.880E-02	0.0084	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.955E-03	0.0020
Total	0.000E+00	0.0000	3.093E+00	0.8973	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.539E-01	0.1027

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-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Ag-108m	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.308E-04	0.0000
Al-26	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.723E-04	0.0000
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.658E-01	0.1061
Am-243	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.719E-01	0.1079
Cm-243	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.094E-01	0.0608
Cm-244	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.496E-01	0.0434
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.513E-04	0.0000
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.576E-03	0.0005
Eu-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.041E-04	0.0001
Eu-154	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.093E-04	0.0001
Eu-155	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.631E-05	0.0000
Nb-94	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.256E-04	0.0000
Np-237	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.962E-01	0.0569
Pu-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	3.957E-01	0.1148
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.688E-01	0.1360
Pu-240	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.684E-01	0.1359
Pu-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.031E-02	0.0030
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.882E-03	0.0011
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.148E-05	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	6.472E-01	0.1878
U-233	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.283E-02	0.0124
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	4.087E-02	0.0119
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.762E-02	0.0109
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	3.576E-02	0.0104
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	3.447E+00	1.0000

*Sum of all water independent and dependent pathways.

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

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Ag-108m	0.000E+00	0.0000	7.241E-10	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.792E-09	0.0000
Al-26	0.000E+00	0.0000	6.768E-10	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.736E-09	0.0000
Am-241	0.000E+00	0.0000	2.729E-01	0.0931	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.266E-02	0.0077
Am-243	0.000E+00	0.0000	3.189E-01	0.1087	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.658E-02	0.0091
Cm-243	0.000E+00	0.0000	2.203E-02	0.0075	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.908E-03	0.0007
Cm-244	0.000E+00	0.0000	5.553E-03	0.0019	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.645E-04	0.0002
Co-60	0.000E+00	0.0000	2.041E-10	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.908E-10	0.0000
Cs-137	0.000E+00	0.0000	1.377E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.832E-04	0.0001
Eu-152	0.000E+00	0.0000	8.112E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.080E-06	0.0000
Eu-154	0.000E+00	0.0000	6.963E-08	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.047E-07	0.0000
Eu-155	0.000E+00	0.0000	1.976E-11	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.642E-11	0.0000
Nb-94	0.000E+00	0.0000	1.650E-09	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.284E-09	0.0000
Np-237	0.000E+00	0.0000	1.794E-01	0.0612	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.584E-02	0.0054
Pu-238	0.000E+00	0.0000	1.793E-01	0.0611	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.493E-02	0.0051
Pu-239	0.000E+00	0.0000	4.314E-01	0.1471	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.580E-02	0.0122
Pu-240	0.000E+00	0.0000	4.281E-01	0.1460	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.553E-02	0.0121
Pu-241	0.000E+00	0.0000	9.532E-03	0.0033	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.914E-04	0.0003
Sr-90	0.000E+00	0.0000	5.062E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.846E-04	0.0001
Tc-99	0.000E+00	0.0000	4.398E-10	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.632E-10	0.0000
Th-232	0.000E+00	0.0000	6.118E-01	0.2086	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.526E-01	0.0520
U-233	0.000E+00	0.0000	4.216E-02	0.0144	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.935E-03	0.0027
U-234	0.000E+00	0.0000	3.322E-02	0.0113	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.847E-03	0.0023
U-235	0.000E+00	0.0000	3.377E-02	0.0115	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.061E-03	0.0024
U-238	0.000E+00	0.0000	2.803E-02	0.0096	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.768E-03	0.0023
Total	0.000E+00	0.0000	2.596E+00	0.8853	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.362E-01	0.1147

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-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Ag-108m	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.516E-09	0.0000
Al-26	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.413E-09	0.0000
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.956E-01	0.1008
Am-243	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.454E-01	0.1178
Cm-243	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.394E-02	0.0082
Cm-244	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.017E-03	0.0021
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.095E-09	0.0000
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.970E-04	0.0001
Eu-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.891E-06	0.0000
Eu-154	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.743E-07	0.0000
Eu-155	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.617E-11	0.0000
Nb-94	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.934E-09	0.0000
Np-237	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.952E-01	0.0666
Pu-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	1.942E-01	0.0662
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.672E-01	0.1593
Pu-240	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.636E-01	0.1581
Pu-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.032E-02	0.0035
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.353E-04	0.0001
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.303E-09	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	7.643E-01	0.2607
U-233	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.009E-02	0.0171
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	4.007E-02	0.0137
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.083E-02	0.0139
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	3.480E-02	0.0119
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	2.932E+00	1.0000

*Sum of all water independent and dependent pathways.

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

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Ag-108m	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Al-26	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Am-241	0.000E+00	0.0000	3.246E-02	0.0143	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.695E-03	0.0012
Am-243	0.000E+00	0.0000	1.551E-01	0.0685	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.293E-02	0.0057
Cm-243	0.000E+00	0.0000	4.952E-04	0.0002	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.110E-05	0.0000
Cm-244	0.000E+00	0.0000	1.073E-03	0.0005	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.908E-05	0.0000
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Cs-137	0.000E+00	0.0000	1.278E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.701E-13	0.0000
Eu-152	0.000E+00	0.0000	2.319E-15	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.997E-16	0.0000
Eu-154	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Eu-155	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Nb-94	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Np-237	0.000E+00	0.0000	1.702E-01	0.0751	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.505E-02	0.0066
Pu-238	0.000E+00	0.0000	1.557E-04	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.423E-05	0.0000
Pu-239	0.000E+00	0.0000	4.175E-01	0.1843	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.465E-02	0.0153
Pu-240	0.000E+00	0.0000	3.864E-01	0.1706	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.207E-02	0.0142
Pu-241	0.000E+00	0.0000	1.137E-03	0.0005	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.441E-05	0.0000
Sr-90	0.000E+00	0.0000	1.590E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.208E-13	0.0000
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-232	0.000E+00	0.0000	6.116E-01	0.2700	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.525E-01	0.0673
U-233	0.000E+00	0.0000	9.683E-02	0.0427	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.218E-02	0.0054
U-234	0.000E+00	0.0000	2.779E-02	0.0123	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.815E-03	0.0026
U-235	0.000E+00	0.0000	6.070E-02	0.0268	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.146E-03	0.0040
U-238	0.000E+00	0.0000	2.134E-02	0.0094	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.150E-03	0.0023
Total	0.000E+00	0.0000	1.983E+00	0.8753	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.824E-01	0.1247

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-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Ag-108m	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Al-26	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.515E-02	0.0155
Am-243	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.680E-01	0.0742
Cm-243	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.363E-04	0.0002
Cm-244	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.163E-03	0.0005
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.829E-13	0.0000
Eu-152	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.519E-15	0.0000
Eu-154	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Eu-155	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Nb-94	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Np-237	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.853E-01	0.0818
Pu-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	1.699E-04	0.0001
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.521E-01	0.1996
Pu-240	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.185E-01	0.1847
Pu-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.231E-03	0.0005
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.367E-13	0.0000
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.641E-01	0.3373
U-233	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.090E-01	0.0481
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	3.360E-02	0.0148
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.984E-02	0.0308
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	2.649E-02	0.0117
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	2.265E+00	1.0000

*Sum of all water independent and dependent pathways.

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

Parent	Product	Thread	DSR(j,t) At Time in Years	(mrem/yr)/(pCi/g)			
(i)	(j)	Fraction	0.000E+00	1.000E+00	1.000E+01	1.000E+02	1.000E+03
ÄÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ
Ag-108m+D	Ag-108m+D	1.000E+00	4.373E-06	3.876E-06	1.308E-06	2.516E-11	0.000E+00
Al-26	Al-26	1.000E+00	5.452E-06	4.859E-06	1.723E-06	5.413E-11	0.000E+00
Am-241	Am-241	1.000E+00	3.745E-03	3.736E-03	3.658E-03	2.956E-03	3.513E-04
Am-241	Np-237+D	1.000E+00	3.178E-10	9.523E-10	6.594E-09	5.671E-08	2.339E-07
Am-241	U-233	1.000E+00	9.900E-17	6.925E-16	3.248E-14	2.742E-12	1.346E-10
Am-241	Th-229+D	1.000E+00	5.641E-20	8.456E-19	2.600E-16	2.136E-13	1.209E-10
Am-241	äDSR(j)		3.745E-03	3.736E-03	3.658E-03	2.956E-03	3.515E-04
Am-243+D	Am-243+D	1.000E+00	3.749E-03	3.746E-03	3.717E-03	3.441E-03	1.592E-03
Am-243+D	Pu-239	1.000E+00	6.752E-08	2.025E-07	1.412E-06	1.298E-05	8.888E-05
Am-243+D	U-235+D	1.000E+00	1.774E-18	1.241E-17	5.848E-16	5.165E-14	3.623E-12
Am-243+D	Pa-231	1.000E+00	1.518E-22	2.277E-21	7.021E-19	5.936E-16	4.189E-13
Am-243+D	Ac-227+D	1.000E+00	3.532E-24	1.088E-22	2.021E-19	1.025E-15	1.386E-12
Am-243+D	äDSR(j)		3.749E-03	3.746E-03	3.719E-03	3.454E-03	1.680E-03
Cm-243	Cm-243	2.400E-03	6.408E-06	6.254E-06	5.024E-06	5.623E-07	1.735E-16
Cm-243	Am-243+D	2.400E-03	4.192E-10	1.244E-09	7.797E-09	2.992E-08	1.528E-08
Cm-243	Pu-239	2.400E-03	5.043E-15	3.505E-14	1.540E-12	7.610E-11	8.020E-10
Cm-243	U-235+D	2.400E-03	9.948E-26	1.484E-24	4.344E-22	2.350E-19	3.136E-17
Cm-243	Pa-231	2.400E-03	6.819E-30	2.104E-28	3.962E-25	2.222E-21	3.486E-18
Cm-243	Ac-227+D	2.400E-03	1.324E-31	8.268E-30	9.303E-26	3.471E-21	1.150E-17
Cm-243	äDSR(j)		6.408E-06	6.255E-06	5.032E-06	5.923E-07	1.608E-08
Cm-243	Cm-243	9.976E-01	2.663E-03	2.599E-03	2.088E-03	2.337E-04	7.214E-14
Cm-243	Pu-239	9.976E-01	6.683E-08	1.983E-07	1.248E-06	5.045E-06	5.347E-06
Cm-243	U-235+D	9.976E-01	1.759E-18	1.223E-17	5.383E-16	2.712E-14	3.562E-13
Cm-243	Pa-231	9.976E-01	1.508E-22	2.250E-21	6.592E-19	3.613E-16	5.569E-14
Cm-243	Ac-227+D	9.976E-01	3.510E-24	1.077E-22	1.919E-19	6.621E-16	1.885E-13
Cm-243	äDSR(j)		2.664E-03	2.600E-03	2.089E-03	2.388E-04	5.347E-06
Cm-244	Cm-244	1.350E-06	2.954E-09	2.843E-09	2.014E-09	6.422E-11	6.970E-26
Cm-244	Cm-244	4.950E-08	1.083E-10	1.042E-10	7.386E-11	2.355E-12	2.556E-27
Cm-244	Pu-240	4.950E-08	1.215E-14	3.584E-14	2.126E-13	6.237E-13	5.755E-13
Cm-244	äDSR(j)		1.083E-10	1.043E-10	7.407E-11	2.979E-12	5.755E-13
Cm-244	Cm-244	1.000E+00	2.188E-03	2.106E-03	1.492E-03	4.757E-05	5.163E-20
Cm-244	Pu-240	1.000E+00	2.455E-07	7.240E-07	4.296E-06	1.260E-05	1.163E-05
Cm-244	U-236	1.000E+00	1.977E-16	1.369E-15	5.795E-14	2.304E-12	2.488E-11
Cm-244	Th-232	1.000E+00	2.753E-26	4.096E-25	1.166E-22	5.315E-20	7.220E-18
Cm-244	Ra-228+D	1.000E+00	2.378E-28	7.175E-27	1.086E-23	1.591E-20	2.589E-18
Cm-244	Th-228+D	1.000E+00	1.554E-29	9.102E-28	5.791E-24	1.679E-20	2.921E-18
Cm-244	äDSR(j)		2.188E-03	2.107E-03	1.496E-03	6.017E-05	1.163E-05

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

Parent (i)	Product (j)	Thread Fraction	DSR(j,t) At Time in Years (mrem/yr)/(pCi/g) 0.000E+00	1.000E+00	1.000E+01	1.000E+02	1.000E+03
ÄÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ
Co-60	Co-60	1.000E+00	5.637E-06	4.943E-06	1.513E-06	1.095E-11	0.000E+00
Cs-137+D	Cs-137+D	1.000E+00	1.986E-05	1.941E-05	1.576E-05	1.970E-06	1.829E-15
Eu-152	Eu-152	7.208E-01	2.475E-06	2.350E-06	1.471E-06	1.363E-08	6.348E-29
Eu-152	Eu-152	2.792E-01	9.587E-07	9.101E-07	5.699E-07	5.280E-09	2.459E-29
Eu-152	Gd-152	2.792E-01	6.557E-19	1.923E-18	1.079E-17	2.548E-17	2.519E-17
Eu-152	äDSR(j)		9.587E-07	9.101E-07	5.699E-07	5.280E-09	2.519E-17
Eu-154	Eu-154	1.000E+00	4.602E-06	4.254E-06	2.093E-06	1.743E-09	2.799E-40
Eu-155	Eu-155	1.000E+00	6.599E-07	5.738E-07	1.631E-07	5.617E-13	0.000E+00
Nb-94	Nb-94	1.000E+00	3.975E-06	3.543E-06	1.256E-06	3.934E-11	0.000E+00
Np-237+D	Np-237+D	1.000E+00	1.964E-03	1.964E-03	1.962E-03	1.952E-03	1.849E-03
Np-237+D	U-233	1.000E+00	9.175E-10	2.752E-09	1.923E-08	1.810E-07	1.529E-06
Np-237+D	Th-229+D	1.000E+00	6.969E-13	4.878E-12	2.303E-10	2.079E-08	1.795E-06
Np-237+D	äDSR(j)		1.964E-03	1.964E-03	1.962E-03	1.952E-03	1.853E-03
Pu-238	Pu-238	1.840E-09	7.881E-12	7.818E-12	7.281E-12	3.574E-12	2.899E-15
Pu-238	Pu-238	1.000E+00	4.283E-03	4.249E-03	3.957E-03	1.942E-03	1.576E-06
Pu-238	U-234	1.000E+00	5.792E-10	1.731E-09	1.168E-08	7.913E-08	1.121E-07
Pu-238	Th-230	1.000E+00	1.660E-14	1.159E-13	5.350E-12	3.888E-10	9.600E-09
Pu-238	Ra-226+D	1.000E+00	3.443E-19	5.154E-18	1.564E-15	1.132E-12	3.069E-10
Pu-238	Pb-210+D	1.000E+00	8.756E-21	2.696E-19	4.951E-16	2.228E-12	1.179E-09
Pu-238	äDSR(j)		4.283E-03	4.249E-03	3.957E-03	1.942E-03	1.699E-06
Pu-239	Pu-239	1.000E+00	4.689E-03	4.689E-03	4.688E-03	4.672E-03	4.521E-03
Pu-239	U-235+D	1.000E+00	1.848E-13	5.543E-13	3.874E-12	3.651E-11	3.125E-10
Pu-239	Pa-231	1.000E+00	2.109E-17	1.476E-16	6.965E-15	6.250E-13	5.077E-11
Pu-239	Ac-227+D	1.000E+00	6.124E-19	9.121E-18	2.627E-15	1.279E-12	1.723E-10
Pu-239	äDSR(j)		4.689E-03	4.689E-03	4.688E-03	4.672E-03	4.521E-03
Pu-240	Pu-240	4.950E-08	2.321E-10	2.321E-10	2.319E-10	2.295E-10	2.072E-10
Pu-240	Pu-240	1.000E+00	4.689E-03	4.689E-03	4.684E-03	4.636E-03	4.185E-03
Pu-240	U-236	1.000E+00	5.648E-12	1.694E-11	1.184E-10	1.112E-09	9.174E-09
Pu-240	Th-232	1.000E+00	1.046E-21	7.325E-21	3.459E-19	3.127E-17	2.737E-15
Pu-240	Ra-228+D	1.000E+00	1.124E-23	1.644E-22	3.995E-20	9.680E-18	9.820E-16
Pu-240	Th-228+D	1.000E+00	8.742E-25	2.503E-23	2.439E-20	1.035E-17	1.108E-15
Pu-240	äDSR(j)		4.689E-03	4.689E-03	4.684E-03	4.636E-03	4.185E-03

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

Parent (i)	Product (j)	Thread Fraction	DSR(j,t) At Time in Years 0.000E+00	1.000E+00	1.000E+01	1.000E+02 (mrem/yr)/(pCi/g)	1.000E+03
Pu-241	Pu-241	1.000E+00	8.778E-05	8.365E-05	5.424E-05	7.121E-07	1.084E-25
Pu-241	Am-241	1.000E+00	2.957E-06	8.675E-06	4.889E-05	1.025E-04	1.231E-05
Pu-241	Np-237+D	1.000E+00	1.679E-13	1.158E-12	4.745E-11	1.530E-09	7.756E-09
Pu-241	U-233	1.000E+00	3.932E-20	5.835E-19	1.620E-16	6.206E-14	4.362E-12
Pu-241	Th-229+D	1.000E+00	1.795E-23	5.517E-22	9.959E-19	4.187E-15	3.827E-12
Pu-241	äDSR(j)		9.073E-05	9.233E-05	1.031E-04	1.032E-04	1.231E-05
Pu-241+D	Pu-241+D	2.450E-05	2.178E-09	2.076E-09	1.346E-09	1.767E-11	2.691E-30
Pu-241+D	Np-237+D	2.450E-05	7.668E-15	2.252E-14	1.284E-13	3.196E-13	3.052E-13
Pu-241+D	U-233	2.450E-05	2.398E-21	1.656E-20	6.825E-19	2.379E-17	2.477E-16
Pu-241+D	Th-229+D	2.450E-05	1.369E-24	2.033E-23	5.673E-21	2.306E-18	2.847E-16
Pu-241+D	äDSR(j)		2.178E-09	2.076E-09	1.346E-09	1.799E-11	3.058E-13
Sr-90+D	Sr-90+D	1.000E+00	4.951E-05	4.832E-05	3.882E-05	4.353E-06	1.367E-15
Tc-99	Tc-99	1.000E+00	1.313E-06	1.170E-06	4.148E-07	1.303E-11	0.000E+00
Th-232	Th-232	1.000E+00	4.300E-03	4.300E-03	4.300E-03	4.300E-03	4.299E-03
Th-232	Ra-228+D	1.000E+00	9.090E-05	2.588E-04	1.126E-03	1.567E-03	1.566E-03
Th-232	Th-228+D	1.000E+00	1.151E-05	7.061E-05	1.046E-03	1.777E-03	1.777E-03
Th-232	äDSR(j)		4.402E-03	4.629E-03	6.472E-03	7.643E-03	7.641E-03
U-233	U-233	1.000E+00	4.196E-04	4.194E-04	4.183E-04	4.067E-04	3.075E-04
U-233	Th-229+D	1.000E+00	4.781E-07	1.434E-06	1.002E-05	9.417E-05	7.827E-04
U-233	äDSR(j)		4.200E-04	4.209E-04	4.283E-04	5.009E-04	1.090E-03
U-234	U-234	1.000E+00	4.096E-04	4.095E-04	4.084E-04	3.972E-04	3.007E-04
U-234	Th-230	1.000E+00	1.760E-08	5.279E-08	3.690E-07	3.482E-06	3.014E-05
U-234	Ra-226+D	1.000E+00	4.865E-13	3.405E-12	1.605E-10	1.427E-08	1.066E-06
U-234	Pb-210+D	1.000E+00	1.544E-14	2.301E-13	6.641E-11	3.270E-08	4.129E-06
U-234	äDSR(j)		4.097E-04	4.096E-04	4.087E-04	4.007E-04	3.360E-04
U-235+D	U-235+D	1.000E+00	3.752E-04	3.751E-04	3.741E-04	3.639E-04	2.762E-04
U-235+D	Pa-231	1.000E+00	6.424E-08	1.927E-07	1.345E-06	1.251E-05	9.363E-05
U-235+D	Ac-227+D	1.000E+00	2.483E-09	1.722E-08	7.400E-07	3.188E-05	3.286E-04
U-235+D	äDSR(j)		3.753E-04	3.753E-04	3.762E-04	4.083E-04	6.984E-04
U-238	U-238	5.400E-05	1.909E-08	1.908E-08	1.903E-08	1.851E-08	1.405E-08
U-238+D	U-238+D	9.999E-01	3.586E-04	3.585E-04	3.576E-04	3.478E-04	2.640E-04
U-238+D	U-234	9.999E-01	5.806E-10	1.741E-09	1.216E-08	1.132E-07	8.540E-07
U-238+D	Th-230	9.999E-01	1.663E-14	1.164E-13	5.493E-12	4.935E-10	4.065E-08
U-238+D	Ra-226+D	9.999E-01	3.448E-19	5.170E-18	1.595E-15	1.356E-12	1.009E-09
U-238+D	Pb-210+D	9.999E-01	8.767E-21	2.702E-19	5.031E-16	2.606E-12	3.790E-09
U-238+D	äDSR(j)		3.586E-04	3.585E-04	3.576E-04	3.479E-04	2.649E-04

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

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

Nuclide (i)	t= 0.000E+00	1.000E+00	1.000E+01	1.000E+02	1.000E+03
Ag-108m	5.717E+06	6.450E+06	1.911E+07	9.937E+11	*2.609E+13
Al-26	4.586E+06	5.146E+06	1.451E+07	*1.921E+10	*1.921E+10
Am-241	6.675E+03	6.691E+03	6.835E+03	8.458E+03	7.112E+04
Am-243	6.668E+03	6.673E+03	6.723E+03	7.237E+03	1.488E+04
Cm-243	9.364E+03	9.594E+03	1.194E+04	1.044E+05	4.661E+06
Cm-244	1.142E+04	1.187E+04	1.671E+04	4.155E+05	2.150E+06
Co-60	4.435E+06	5.058E+06	1.652E+07	2.283E+12	*1.132E+15
Cs-137	1.259E+06	1.288E+06	1.586E+06	1.269E+07	*8.704E+13
Eu-152	7.280E+06	7.669E+06	1.225E+07	1.322E+09	*1.765E+14
Eu-154	5.432E+06	5.877E+06	1.194E+07	1.434E+10	*2.639E+14
Eu-155	3.788E+07	4.357E+07	1.533E+08	4.451E+13	*4.652E+14
Nb-94	6.289E+06	7.057E+06	1.991E+07	*1.875E+11	*1.875E+11
Np-237	1.273E+04	1.273E+04	1.274E+04	1.281E+04	1.349E+04
Pu-238	5.837E+03	5.884E+03	6.317E+03	1.287E+04	1.472E+07
Pu-239	5.331E+03	5.331E+03	5.333E+03	5.351E+03	5.529E+03
Pu-240	5.331E+03	5.332E+03	5.337E+03	5.392E+03	5.973E+03
Pu-241	2.755E+05	2.708E+05	2.424E+05	2.422E+05	2.030E+06
Sr-90	5.050E+05	5.174E+05	6.440E+05	5.744E+06	*1.365E+14
Tc-99	1.904E+07	2.137E+07	6.027E+07	*1.697E+10	*1.697E+10
Th-232	5.679E+03	5.400E+03	3.863E+03	3.271E+03	3.272E+03
U-233	5.952E+04	5.940E+04	5.837E+04	4.991E+04	2.293E+04
U-234	6.103E+04	6.104E+04	6.116E+04	6.239E+04	7.440E+04
U-235	6.661E+04	6.661E+04	6.646E+04	6.123E+04	3.579E+04
U-238	6.970E+04	6.972E+04	6.991E+04	7.185E+04	9.437E+04

*At specific activity limit

Summed Dose/Source Ratios DSR(i,t) in (mrem/yr)/(pCi/g)
and Single Radionuclide Soil Guidelines G(i,t) in pCi/g
at tmin = time of minimum single radionuclide soil guideline
and at tmax = time of maximum total dose = 8.68 ñ 0.02 years

Nuclide (i)	Initial (pCi/g)	tmin (years)	DSR(i,tmin)	G(i,tmin) (pCi/g)	DSR(i,tmax)	G(i,tmax) (pCi/g)
Ag-108m	1.000E+02	0.000E+00	4.373E-06	5.717E+06	1.535E-06	1.628E+07
Al-26	1.000E+02	0.000E+00	5.452E-06	4.586E+06	2.007E-06	1.246E+07
Am-241	1.000E+02	0.000E+00	3.745E-03	6.675E+03	3.669E-03	6.814E+03
Am-243	1.000E+02	0.000E+00	3.749E-03	6.668E+03	3.723E-03	6.716E+03
Cm-243	1.000E+02	0.000E+00	2.670E-03	9.364E+03	2.163E-03	1.156E+04
Cm-244	1.000E+02	0.000E+00	2.188E-03	1.142E+04	1.574E-03	1.589E+04
Co-60	1.000E+02	0.000E+00	5.637E-06	4.435E+06	1.801E-06	1.388E+07
Cs-137	1.000E+02	0.000E+00	1.986E-05	1.259E+06	1.625E-05	1.538E+06
Eu-152	1.000E+02	0.000E+00	3.434E-06	7.280E+06	2.187E-06	1.143E+07
Eu-154	1.000E+02	0.000E+00	4.602E-06	5.432E+06	2.324E-06	1.076E+07
Eu-155	1.000E+02	0.000E+00	6.599E-07	3.788E+07	1.963E-07	1.274E+08
Nb-94	1.000E+02	0.000E+00	3.975E-06	6.289E+06	1.463E-06	1.709E+07
Np-237	1.000E+02	0.000E+00	1.964E-03	1.273E+04	1.963E-03	1.274E+04
Pu-238	1.000E+02	0.000E+00	4.283E-03	5.837E+03	3.999E-03	6.252E+03
Pu-239	1.000E+02	0.000E+00	4.689E-03	5.331E+03	4.688E-03	5.333E+03
Pu-240	1.000E+02	0.000E+00	4.689E-03	5.331E+03	4.685E-03	5.337E+03
Pu-241	1.000E+02	40.06 ñ 0.08	1.135E-04	2.203E+05	1.019E-04	2.454E+05
Sr-90	1.000E+02	0.000E+00	4.951E-05	5.050E+05	4.009E-05	6.236E+05
Tc-99	1.000E+02	0.000E+00	1.313E-06	1.904E+07	4.832E-07	5.174E+07
Th-232	1.000E+02	103.9 ñ 0.2	7.643E-03	3.271E+03	6.277E-03	3.983E+03
U-233	1.000E+02	1.000E+03	1.090E-03	2.293E+04	4.272E-04	5.852E+04
U-234	1.000E+02	0.000E+00	4.097E-04	6.103E+04	4.089E-04	6.115E+04
U-235	1.000E+02	1.000E+03	6.984E-04	3.579E+04	3.760E-04	6.649E+04
U-238	1.000E+02	0.000E+00	3.587E-04	6.970E+04	3.577E-04	6.989E+04

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

Nuclide (j)	Parent (i)	THF(i)	DOSE(j,t), mrem/yr t= 0.000E+00	1.000E+00	1.000E+01	1.000E+02	1.000E+03
ÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ
Ag-108m	Ag-108m	1.000E+00	4.373E-04	3.876E-04	1.308E-04	2.516E-09	0.000E+00
Al-26	Al-26	1.000E+00	5.452E-04	4.859E-04	1.723E-04	5.413E-09	0.000E+00
Am-241	Am-241	1.000E+00	3.745E-01	3.736E-01	3.658E-01	2.956E-01	3.513E-02
Am-241	Pu-241	1.000E+00	2.957E-04	8.675E-04	4.889E-03	1.025E-02	1.231E-03
Am-241	äDOSE(j)		3.748E-01	3.745E-01	3.706E-01	3.058E-01	3.636E-02
Np-237	Am-241	1.000E+00	3.178E-08	9.523E-08	6.594E-07	5.671E-06	2.339E-05
Np-237	Np-237	1.000E+00	1.964E-01	1.964E-01	1.962E-01	1.952E-01	1.849E-01
Np-237	Pu-241	1.000E+00	1.679E-11	1.158E-10	4.745E-09	1.530E-07	7.756E-07
Np-237	Pu-241	2.450E-05	7.668E-13	2.252E-12	1.284E-11	3.196E-11	3.052E-11
Np-237	äDOSE(j)		1.964E-01	1.964E-01	1.962E-01	1.952E-01	1.850E-01
U-233	Am-241	1.000E+00	9.900E-15	6.925E-14	3.248E-12	2.742E-10	1.346E-08
U-233	Np-237	1.000E+00	9.175E-08	2.752E-07	1.923E-06	1.810E-05	1.529E-04
U-233	Pu-241	1.000E+00	3.932E-18	5.835E-17	1.620E-14	6.206E-12	4.362E-10
U-233	Pu-241	2.450E-05	2.398E-19	1.656E-18	6.825E-17	2.379E-15	2.477E-14
U-233	U-233	1.000E+00	4.196E-02	4.194E-02	4.183E-02	4.067E-02	3.075E-02
U-233	äDOSE(j)		4.196E-02	4.194E-02	4.183E-02	4.069E-02	3.090E-02
Th-229	Am-241	1.000E+00	5.641E-18	8.456E-17	2.600E-14	2.136E-11	1.209E-08
Th-229	Np-237	1.000E+00	6.969E-11	4.878E-10	2.303E-08	2.079E-06	1.795E-04
Th-229	Pu-241	1.000E+00	1.795E-21	5.517E-20	9.959E-17	4.187E-13	3.827E-10
Th-229	Pu-241	2.450E-05	1.369E-22	2.033E-21	5.673E-19	2.306E-16	2.847E-14
Th-229	U-233	1.000E+00	4.781E-05	1.434E-04	1.002E-03	9.417E-03	7.827E-02
Th-229	äDOSE(j)		4.781E-05	1.434E-04	1.002E-03	9.419E-03	7.845E-02
Am-243	Am-243	1.000E+00	3.749E-01	3.746E-01	3.717E-01	3.441E-01	1.592E-01
Am-243	Cm-243	2.400E-03	4.192E-08	1.244E-07	7.797E-07	2.992E-06	1.528E-06
Am-243	äDOSE(j)		3.749E-01	3.746E-01	3.717E-01	3.441E-01	1.592E-01
Pu-239	Am-243	1.000E+00	6.752E-06	2.025E-05	1.412E-04	1.298E-03	8.888E-03
Pu-239	Cm-243	2.400E-03	5.043E-13	3.505E-12	1.540E-10	7.610E-09	8.020E-08
Pu-239	Cm-243	9.976E-01	6.683E-06	1.983E-05	1.248E-04	5.045E-04	5.347E-04
Pu-239	Pu-239	1.000E+00	4.689E-01	4.689E-01	4.688E-01	4.672E-01	4.521E-01
Pu-239	äDOSE(j)		4.689E-01	4.690E-01	4.690E-01	4.690E-01	4.616E-01
U-235	Am-243	1.000E+00	1.774E-16	1.241E-15	5.848E-14	5.165E-12	3.623E-10
U-235	Cm-243	2.400E-03	9.948E-24	1.484E-22	4.344E-20	2.350E-17	3.136E-15
U-235	Cm-243	9.976E-01	1.759E-16	1.223E-15	5.383E-14	2.712E-12	3.562E-11
U-235	Pu-239	1.000E+00	1.848E-11	5.543E-11	3.874E-10	3.651E-09	3.125E-08
U-235	U-235	1.000E+00	3.752E-02	3.751E-02	3.741E-02	3.639E-02	2.762E-02
U-235	äDOSE(j)		3.752E-02	3.751E-02	3.741E-02	3.639E-02	2.762E-02
Pa-231	Am-243	1.000E+00	1.518E-20	2.277E-19	7.021E-17	5.936E-14	4.189E-11
Pa-231	Cm-243	2.400E-03	6.819E-28	2.104E-26	3.962E-23	2.222E-19	3.486E-16
Pa-231	Cm-243	9.976E-01	1.508E-20	2.250E-19	6.592E-17	3.613E-14	5.569E-12
Pa-231	Pu-239	1.000E+00	2.109E-15	1.476E-14	6.965E-13	6.250E-11	5.077E-09

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

Nuclide (j)	Parent (i)	THF(i)	DOSE(j,t), mrem/yr t= 0.000E+00	1.000E+00	1.000E+01	1.000E+02	1.000E+03
Pa-231	U-235	1.000E+00	6.424E-06	1.927E-05	1.345E-04	1.251E-03	9.363E-03
Pa-231	äDOSE(j)		6.424E-06	1.927E-05	1.345E-04	1.251E-03	9.363E-03
Ac-227	Am-243	1.000E+00	3.532E-22	1.088E-20	2.021E-17	1.025E-13	1.386E-10
Ac-227	Cm-243	2.400E-03	0.000E+00	7.624E-28	9.303E-24	3.471E-19	1.150E-15
Ac-227	Cm-243	9.976E-01	3.510E-22	1.077E-20	1.919E-17	6.621E-14	1.885E-11
Ac-227	Pu-239	1.000E+00	6.124E-17	9.121E-16	2.627E-13	1.279E-10	1.723E-08
Ac-227	U-235	1.000E+00	2.483E-07	1.722E-06	7.400E-05	3.188E-03	3.286E-02
Ac-227	äDOSE(j)		2.483E-07	1.722E-06	7.400E-05	3.188E-03	3.286E-02
Cm-243	Cm-243	2.400E-03	6.408E-04	6.254E-04	5.024E-04	5.623E-05	1.735E-14
Cm-243	Cm-243	9.976E-01	2.663E-01	2.599E-01	2.088E-01	2.337E-02	7.214E-12
Cm-243	äDOSE(j)		2.670E-01	2.606E-01	2.093E-01	2.343E-02	7.231E-12
Cm-244	Cm-244	1.350E-06	2.954E-07	2.843E-07	2.014E-07	6.422E-09	6.970E-24
Cm-244	Cm-244	4.950E-08	1.083E-08	1.042E-08	7.386E-09	2.355E-10	2.556E-25
Cm-244	äDOSE(j)		3.062E-07	2.947E-07	2.088E-07	6.658E-09	7.226E-24
Pu-240	Cm-244	4.950E-08	1.215E-12	3.584E-12	2.126E-11	6.237E-11	5.755E-11
Pu-240	Pu-240	4.950E-08	2.321E-08	2.321E-08	2.319E-08	2.295E-08	2.072E-08
Pu-240	äDOSE(j)		2.321E-08	2.321E-08	2.321E-08	2.301E-08	2.077E-08
Cm-244	Cm-244	1.000E+00	2.188E-01	2.106E-01	1.492E-01	4.757E-03	5.163E-18
Pu-240	Cm-244	1.000E+00	2.455E-05	7.240E-05	4.296E-04	1.260E-03	1.163E-03
U-236	Cm-244	1.000E+00	1.977E-14	1.369E-13	5.795E-12	2.304E-10	2.488E-09
U-236	Pu-240	1.000E+00	5.648E-10	1.694E-09	1.184E-08	1.112E-07	9.174E-07
U-236	äDOSE(j)		5.648E-10	1.694E-09	1.184E-08	1.114E-07	9.199E-07
Th-232	Cm-244	1.000E+00	2.753E-24	4.096E-23	1.166E-20	5.315E-18	7.220E-16
Th-232	Pu-240	1.000E+00	1.046E-19	7.325E-19	3.459E-17	3.127E-15	2.737E-13
Th-232	Th-232	1.000E+00	4.300E-01	4.300E-01	4.300E-01	4.300E-01	4.299E-01
Th-232	äDOSE(j)		4.300E-01	4.300E-01	4.300E-01	4.300E-01	4.299E-01
Ra-228	Cm-244	1.000E+00	2.378E-26	7.175E-25	1.086E-21	1.591E-18	2.589E-16
Ra-228	Pu-240	1.000E+00	1.124E-21	1.644E-20	3.995E-18	9.680E-16	9.820E-14
Ra-228	Th-232	1.000E+00	9.090E-03	2.588E-02	1.126E-01	1.567E-01	1.566E-01
Ra-228	äDOSE(j)		9.090E-03	2.588E-02	1.126E-01	1.567E-01	1.566E-01
Th-228	Cm-244	1.000E+00	1.554E-27	9.102E-26	5.791E-22	1.679E-18	2.921E-16
Th-228	Pu-240	1.000E+00	8.742E-23	2.503E-21	2.439E-18	1.035E-15	1.108E-13
Th-228	Th-232	1.000E+00	1.151E-03	7.061E-03	1.046E-01	1.777E-01	1.777E-01
Th-228	äDOSE(j)		1.151E-03	7.061E-03	1.046E-01	1.777E-01	1.777E-01
Co-60	Co-60	1.000E+00	5.637E-04	4.943E-04	1.513E-04	1.095E-09	0.000E+00
Cs-137	Cs-137	1.000E+00	1.986E-03	1.941E-03	1.576E-03	1.970E-04	1.829E-13

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

Nuclide (j)	Parent (i)	THF(i)	DOSE(j,t), mrem/yr t= 0.000E+00	1.000E+00	1.000E+01	1.000E+02	1.000E+03
Eu-152	Eu-152	7.208E-01	2.475E-04	2.350E-04	1.471E-04	1.363E-06	6.348E-27
Eu-152	Eu-152	2.792E-01	9.587E-05	9.101E-05	5.699E-05	5.280E-07	2.459E-27
Eu-152	âDOSE(j)		3.434E-04	3.260E-04	2.041E-04	1.891E-06	8.806E-27
Gd-152	Eu-152	2.792E-01	6.557E-17	1.923E-16	1.079E-15	2.548E-15	2.519E-15
Eu-154	Eu-154	1.000E+00	4.602E-04	4.254E-04	2.093E-04	1.743E-07	0.000E+00
Eu-155	Eu-155	1.000E+00	6.599E-05	5.738E-05	1.631E-05	5.617E-11	0.000E+00
Nb-94	Nb-94	1.000E+00	3.975E-04	3.543E-04	1.256E-04	3.934E-09	0.000E+00
Pu-238	Pu-238	1.840E-09	7.881E-10	7.818E-10	7.281E-10	3.574E-10	2.899E-13
Pu-238	Pu-238	1.000E+00	4.283E-01	4.249E-01	3.957E-01	1.942E-01	1.576E-04
Pu-238	âDOSE(j)		4.283E-01	4.249E-01	3.957E-01	1.942E-01	1.576E-04
U-234	Pu-238	1.000E+00	5.792E-08	1.731E-07	1.168E-06	7.913E-06	1.121E-05
U-234	U-234	1.000E+00	4.096E-02	4.095E-02	4.084E-02	3.972E-02	3.007E-02
U-234	U-238	9.999E-01	5.806E-08	1.741E-07	1.216E-06	1.132E-05	8.540E-05
U-234	âDOSE(j)		4.096E-02	4.095E-02	4.084E-02	3.974E-02	3.016E-02
Th-230	Pu-238	1.000E+00	1.660E-12	1.159E-11	5.350E-10	3.888E-08	9.600E-07
Th-230	U-234	1.000E+00	1.760E-06	5.279E-06	3.690E-05	3.482E-04	3.014E-03
Th-230	U-238	9.999E-01	1.663E-12	1.164E-11	5.493E-10	4.935E-08	4.065E-06
Th-230	âDOSE(j)		1.760E-06	5.279E-06	3.690E-05	3.482E-04	3.019E-03
Ra-226	Pu-238	1.000E+00	3.443E-17	5.154E-16	1.564E-13	1.132E-10	3.069E-08
Ra-226	U-234	1.000E+00	4.865E-11	3.405E-10	1.605E-08	1.427E-06	1.066E-04
Ra-226	U-238	9.999E-01	3.448E-17	5.170E-16	1.595E-13	1.356E-10	1.009E-07
Ra-226	âDOSE(j)		4.865E-11	3.405E-10	1.605E-08	1.428E-06	1.068E-04
Pb-210	Pu-238	1.000E+00	8.756E-19	2.696E-17	4.951E-14	2.228E-10	1.179E-07
Pb-210	U-234	1.000E+00	1.544E-12	2.301E-11	6.641E-09	3.270E-06	4.129E-04
Pb-210	U-238	9.999E-01	8.767E-19	2.702E-17	5.031E-14	2.606E-10	3.790E-07
Pb-210	âDOSE(j)		1.544E-12	2.301E-11	6.641E-09	3.270E-06	4.134E-04
Pu-240	Pu-240	1.000E+00	4.689E-01	4.689E-01	4.684E-01	4.636E-01	4.185E-01
Pu-241	Pu-241	1.000E+00	8.778E-03	8.365E-03	5.424E-03	7.121E-05	1.084E-23
Pu-241	Pu-241	2.450E-05	2.178E-07	2.076E-07	1.346E-07	1.767E-09	2.454E-28
Pu-241	âDOSE(j)		8.778E-03	8.365E-03	5.424E-03	7.121E-05	1.084E-23
Sr-90	Sr-90	1.000E+00	4.951E-03	4.832E-03	3.882E-03	4.353E-04	1.367E-13
Tc-99	Tc-99	1.000E+00	1.313E-04	1.170E-04	4.148E-05	1.303E-09	0.000E+00
U-238	U-238	5.400E-05	1.909E-06	1.908E-06	1.903E-06	1.851E-06	1.405E-06
U-238	U-238	9.999E-01	3.586E-02	3.585E-02	3.576E-02	3.478E-02	2.640E-02
U-238	âDOSE(j)		3.587E-02	3.586E-02	3.576E-02	3.478E-02	2.640E-02

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

Individual Nuclide Soil Concentration
Parent Nuclide and Branch Fraction Indicated

Nuclide (j)	Parent (i)	THF(i)	S(j,t), pCi/g t= 0.000E+00	1.000E+00	1.000E+01	1.000E+02	1.000E+03
Ag-108m	Ag-108m	1.000E+00	1.000E+02	8.863E+01	2.992E+01	5.753E-04	0.000E+00
Al-26	Al-26	1.000E+00	1.000E+02	8.912E+01	3.160E+01	9.929E-04	0.000E+00
Am-241	Am-241	1.000E+00	1.000E+02	9.976E+01	9.766E+01	7.893E+01	9.379E+00
Am-241	Pu-241	1.000E+00	0.000E+00	1.564E-01	1.257E+00	2.737E+00	3.286E-01
Am-241	âS(j):		1.000E+02	9.992E+01	9.892E+01	8.166E+01	9.708E+00
Np-237	Am-241	1.000E+00	0.000E+00	3.235E-05	3.200E-04	2.875E-03	1.191E-02
Np-237	Np-237	1.000E+00	1.000E+02	9.999E+01	9.994E+01	9.940E+01	9.418E+01
Np-237	Pu-241	1.000E+00	0.000E+00	2.554E-08	2.208E-06	7.747E-05	3.949E-04
Np-237	Pu-241	2.450E-05	0.000E+00	7.747E-10	6.296E-09	1.627E-08	1.554E-08
Np-237	âS(j):		1.000E+02	9.999E+01	9.994E+01	9.941E+01	9.419E+01
U-233	Am-241	1.000E+00	0.000E+00	7.076E-11	7.018E-09	6.473E-07	3.206E-05
U-233	Np-237	1.000E+00	0.000E+00	4.372E-04	4.365E-03	4.293E-02	3.643E-01
U-233	Pu-241	1.000E+00	0.000E+00	3.738E-14	3.347E-11	1.462E-08	1.039E-06
U-233	Pu-241	2.450E-05	0.000E+00	1.707E-15	1.485E-13	5.635E-12	5.901E-11
U-233	U-233	1.000E+00	1.000E+02	9.997E+01	9.969E+01	9.694E+01	7.329E+01
U-233	âS(j):		1.000E+02	9.997E+01	9.969E+01	9.698E+01	7.365E+01
Th-229	Am-241	1.000E+00	0.000E+00	2.228E-15	2.214E-12	2.079E-09	1.192E-06
Th-229	Np-237	1.000E+00	0.000E+00	2.065E-08	2.062E-06	2.033E-04	1.771E-02
Th-229	Pu-241	1.000E+00	0.000E+00	8.848E-19	8.096E-15	4.065E-11	3.774E-08
Th-229	Pu-241	2.450E-05	0.000E+00	5.396E-20	4.857E-17	2.250E-14	2.809E-12
Th-229	U-233	1.000E+00	0.000E+00	9.442E-03	9.424E-02	9.254E-01	7.726E+00
Th-229	âS(j):		0.000E+00	9.442E-03	9.425E-02	9.256E-01	7.743E+00
Am-243	Am-243	1.000E+00	1.000E+02	9.991E+01	9.915E+01	9.179E+01	4.245E+01
Am-243	Cm-243	2.400E-03	0.000E+00	2.226E-05	1.992E-04	7.971E-04	4.076E-04
Am-243	âS(j):		1.000E+02	9.991E+01	9.915E+01	9.179E+01	4.245E+01
Pu-239	Am-243	1.000E+00	0.000E+00	2.879E-03	2.867E-02	2.755E-01	1.895E+00
Pu-239	Cm-243	2.400E-03	0.000E+00	3.219E-10	2.989E-08	1.611E-06	1.710E-05
Pu-239	Cm-243	9.976E-01	0.000E+00	2.839E-03	2.550E-02	1.075E-01	1.140E-01
Pu-239	Pu-239	1.000E+00	1.000E+02	1.000E+02	9.996E+01	9.964E+01	9.642E+01
Pu-239	âS(j):		1.000E+02	1.000E+02	1.000E+02	1.000E+02	9.843E+01
U-235	Am-243	1.000E+00	0.000E+00	1.418E-12	1.413E-10	1.363E-08	9.645E-07
U-235	Cm-243	2.400E-03	0.000E+00	1.059E-19	1.001E-16	6.182E-14	8.349E-12
U-235	Cm-243	9.976E-01	0.000E+00	1.403E-12	1.305E-10	7.174E-09	9.486E-08
U-235	Pu-239	1.000E+00	0.000E+00	9.847E-08	9.832E-07	9.682E-06	8.322E-05
U-235	U-235	1.000E+00	1.000E+02	9.997E+01	9.969E+01	9.698E+01	7.361E+01
U-235	âS(j):		1.000E+02	9.997E+01	9.969E+01	9.698E+01	7.361E+01
Pa-231	Am-243	1.000E+00	0.000E+00	1.000E-17	9.965E-15	9.629E-12	6.888E-09
Pa-231	Cm-243	2.400E-03	0.000E+00	5.608E-25	5.357E-21	3.593E-17	5.732E-14
Pa-231	Cm-243	9.976E-01	0.000E+00	9.917E-18	9.385E-15	5.873E-12	9.160E-10
Pa-231	Pu-239	1.000E+00	0.000E+00	1.042E-12	1.040E-10	1.019E-08	8.351E-07

Individual Nuclide Soil Concentration
Parent Nuclide and Branch Fraction Indicated

Nuclide (j)	Parent (i)	THF(i)	S(j,t), pCi/g t= 0.000E+00	1.000E+00	1.000E+01	1.000E+02	1.000E+03
Pa-231	U-235	1.000E+00	0.000E+00	2.115E-03	2.109E-02	2.050E-01	1.541E+00
Pa-231	âS(j):		0.000E+00	2.115E-03	2.109E-02	2.050E-01	1.541E+00
Ac-227	Am-243	1.000E+00	0.000E+00	7.907E-20	7.446E-16	4.516E-12	6.208E-09
Ac-227	Cm-243	2.400E-03	0.000E+00	3.554E-27	3.260E-22	1.524E-17	5.148E-14
Ac-227	Cm-243	9.976E-01	0.000E+00	7.852E-20	7.090E-16	2.922E-12	8.446E-10
Ac-227	Pu-239	1.000E+00	0.000E+00	1.097E-14	1.019E-11	5.666E-09	7.719E-07
Ac-227	U-235	1.000E+00	0.000E+00	3.331E-05	3.023E-03	1.420E-01	1.473E+00
Ac-227	âS(j):		0.000E+00	3.331E-05	3.023E-03	1.420E-01	1.473E+00
Cm-243	Cm-243	2.400E-03	2.400E-01	2.342E-01	1.882E-01	2.106E-02	6.500E-12
Cm-243	Cm-243	9.976E-01	9.976E+01	9.736E+01	7.821E+01	8.754E+00	2.702E-09
Cm-243	âS(j):		1.000E+02	9.760E+01	7.840E+01	8.775E+00	2.708E-09
Cm-244	Cm-244	1.350E-06	1.350E-04	1.299E-04	9.206E-05	2.935E-06	3.186E-21
Cm-244	Cm-244	4.950E-08	4.950E-06	4.764E-06	3.375E-06	1.076E-07	1.168E-22
Cm-244	âS(j):		1.400E-04	1.347E-04	9.543E-05	3.043E-06	3.302E-21
Pu-240	Cm-244	4.950E-08	0.000E+00	5.149E-10	4.358E-09	1.330E-08	1.227E-08
Pu-240	Pu-240	4.950E-08	4.950E-06	4.949E-06	4.944E-06	4.894E-06	4.418E-06
Pu-240	âS(j):		4.950E-06	4.950E-06	4.949E-06	4.907E-06	4.430E-06
Cm-244	Cm-244	1.000E+00	1.000E+02	9.624E+01	6.819E+01	2.174E+00	2.360E-15
Pu-240	Cm-244	1.000E+00	0.000E+00	1.040E-02	8.804E-02	2.686E-01	2.479E-01
U-236	Cm-244	1.000E+00	0.000E+00	1.549E-10	1.385E-08	6.000E-07	6.516E-06
U-236	Pu-240	1.000E+00	0.000E+00	2.960E-06	2.954E-05	2.899E-04	2.403E-03
U-236	âS(j):		0.000E+00	2.960E-06	2.955E-05	2.905E-04	2.410E-03
Th-232	Cm-244	1.000E+00	0.000E+00	2.556E-21	2.349E-18	1.221E-15	1.677E-13
Th-232	Pu-240	1.000E+00	0.000E+00	7.301E-17	7.292E-15	7.201E-13	6.360E-11
Th-232	Th-232	1.000E+00	1.000E+02	1.000E+02	1.000E+02	1.000E+02	9.997E+01
Th-232	âS(j):		1.000E+02	1.000E+02	1.000E+02	1.000E+02	9.997E+01
Ra-228	Cm-244	1.000E+00	0.000E+00	7.535E-23	5.753E-19	1.000E-15	1.648E-13
Ra-228	Pu-240	1.000E+00	0.000E+00	2.847E-18	2.223E-15	6.102E-13	6.251E-11
Ra-228	Th-232	1.000E+00	0.000E+00	1.136E+01	6.998E+01	9.982E+01	9.979E+01
Ra-228	âS(j):		0.000E+00	1.136E+01	6.998E+01	9.982E+01	9.979E+01
Th-228	Cm-244	1.000E+00	0.000E+00	5.173E-24	2.623E-19	9.304E-16	1.639E-13
Th-228	Pu-240	1.000E+00	0.000E+00	2.417E-19	1.164E-15	5.751E-13	6.219E-11
Th-228	Th-232	1.000E+00	0.000E+00	1.864E+00	5.640E+01	9.982E+01	9.979E+01
Th-228	âS(j):		0.000E+00	1.864E+00	5.640E+01	9.982E+01	9.979E+01
Co-60	Co-60	1.000E+00	1.000E+02	8.768E+01	2.684E+01	1.942E-04	0.000E+00
Cs-137	Cs-137	1.000E+00	1.000E+02	9.772E+01	7.937E+01	9.918E+00	9.209E-09

Individual Nuclide Soil Concentration
Parent Nuclide and Branch Fraction Indicated

Nuclide (j)	Parent (i)	THF(i)	S(j,t), pCi/g t= 0.000E+00	1.000E+00	1.000E+01	1.000E+02	1.000E+03
ÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ	ÄÄÄÄÄÄÄÄÄ
Eu-152	Eu-152	7.208E-01	7.208E+01	6.843E+01	4.285E+01	3.969E-01	1.849E-21
Eu-152	Eu-152	2.792E-01	2.792E+01	2.650E+01	1.660E+01	1.538E-01	7.160E-22
Eu-152	äS(j):		1.000E+02	9.493E+01	5.944E+01	5.507E-01	2.565E-21
Gd-152	Eu-152	2.792E-01	0.000E+00	1.746E-13	1.397E-12	3.421E-12	3.382E-12
Eu-154	Eu-154	1.000E+00	1.000E+02	9.242E+01	4.548E+01	3.788E-02	6.081E-33
Eu-155	Eu-155	1.000E+00	1.000E+02	8.696E+01	2.472E+01	8.512E-05	0.000E+00
Nb-94	Nb-94	1.000E+00	1.000E+02	8.912E+01	3.159E+01	9.896E-04	0.000E+00
Pu-238	Pu-238	1.840E-09	1.840E-07	1.826E-07	1.700E-07	8.344E-08	6.769E-11
Pu-238	Pu-238	1.000E+00	1.000E+02	9.921E+01	9.240E+01	4.535E+01	3.679E-02
Pu-238	äS(j):		1.000E+02	9.921E+01	9.240E+01	4.535E+01	3.679E-02
U-234	Pu-238	1.000E+00	0.000E+00	2.823E-04	2.721E-03	1.925E-02	2.737E-02
U-234	U-234	1.000E+00	1.000E+02	9.997E+01	9.969E+01	9.696E+01	7.340E+01
U-234	U-238	9.999E-01	0.000E+00	2.834E-04	2.826E-03	2.749E-02	2.084E-01
U-234	äS(j):		1.000E+02	9.997E+01	9.970E+01	9.700E+01	7.364E+01
Th-230	Pu-238	1.000E+00	0.000E+00	1.273E-09	1.242E-07	9.857E-06	2.454E-04
Th-230	U-234	1.000E+00	0.000E+00	9.000E-04	8.988E-03	8.860E-02	7.706E-01
Th-230	U-238	9.999E-01	0.000E+00	1.276E-09	1.273E-07	1.250E-05	1.039E-03
Th-230	äS(j):		0.000E+00	9.001E-04	8.988E-03	8.862E-02	7.718E-01
Ra-226	Pu-238	1.000E+00	0.000E+00	1.839E-13	1.802E-10	1.491E-07	4.095E-05
Ra-226	U-234	1.000E+00	0.000E+00	1.949E-07	1.944E-05	1.888E-03	1.423E-01
Ra-226	U-238	9.999E-01	0.000E+00	1.842E-13	1.837E-10	1.785E-07	1.346E-04
Ra-226	äS(j):		0.000E+00	1.949E-07	1.944E-05	1.888E-03	1.425E-01
Pb-210	Pu-238	1.000E+00	0.000E+00	1.420E-15	1.323E-11	7.117E-08	3.827E-05
Pb-210	U-234	1.000E+00	0.000E+00	2.004E-09	1.867E-06	1.049E-03	1.341E-01
Pb-210	U-238	9.999E-01	0.000E+00	1.423E-15	1.343E-11	8.317E-08	1.230E-04
Pb-210	äS(j):		0.000E+00	2.004E-09	1.867E-06	1.050E-03	1.342E-01
Pu-240	Pu-240	1.000E+00	1.000E+02	9.999E+01	9.989E+01	9.887E+01	8.925E+01
Pu-241	Pu-241	1.000E+00	1.000E+02	9.530E+01	6.179E+01	8.113E-01	1.235E-19
Pu-241	Pu-241	2.450E-05	2.450E-03	2.335E-03	1.514E-03	1.988E-05	3.027E-24
Pu-241	äS(j):		1.000E+02	9.530E+01	6.179E+01	8.113E-01	1.235E-19
Sr-90	Sr-90	1.000E+00	1.000E+02	9.760E+01	7.842E+01	8.792E+00	2.761E-09
Tc-99	Tc-99	1.000E+00	1.000E+02	8.912E+01	3.160E+01	9.926E-04	0.000E+00
U-238	U-238	5.400E-05	5.400E-03	5.398E-03	5.383E-03	5.237E-03	3.975E-03
U-238	U-238	9.999E-01	9.999E+01	9.996E+01	9.969E+01	9.698E+01	7.361E+01
U-238	äS(j):		1.000E+02	9.997E+01	9.969E+01	9.698E+01	7.361E+01
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THF(i) is the thread fraction of the parent nuclide.

RESCALC.EXE execution time =   5.56 seconds

Appendix F

Disposal of Debris and Equipment from CSII and CSIII Sites

F.1.0 Debris and Equipment Disposal

F.1.1 Background

During preliminary investigation activities at the CSII and CSIII sites in 2012, several containers and surface debris were identified within the CA fences at both sites. An inventory of the items at both sites is presented in Table F.1-1. At CSII, the materials inventory included one wooden shed containing plastic debris, a HEPA vacuum, a table, and one 55-gallon (gal) metal drum; two metal cargo containers with various debris inside (two 55-gal metal drums, one 5-gal metal bucket with no lid, small machine parts, tables, chairs, plastic sheeting); and loose surface debris, including wood, cables, metal scrap, and one 55-gal metal drum, located near the northwest CA fence line. Figures F.1-1 through F.1-3 are photographs of the debris at the CSII site. At CSIII, the materials inventory included two sample coolers filled with soil and water samples dated 1998; three plastic buckets filled with concrete cores; one 55-gal drum; and various surface debris (metal scrap, wood). Limited surveys of these items were conducted in 2012, and much of the surface debris and the exterior of some of the 55-gal metal drums had elevated levels of radioactivity. Figure F.1-4 presents photographs of the debris at the CSIII site.

It is likely that most of the heavy equipment and other items were moved from the CSI site after soil removal activities in 1997. Other items may be left over from the 1998 technology demonstration project. The samples in coolers found at the CSIII site were soil and QC samples collected at CSI and were staged at that time for future disposal. The origin of the other surface debris at CSIII is not known.

F.1.2 Waste Characterization and Disposal

The debris waste generated at the CSII and CSIII sites was characterized based on process knowledge, visual inspection, and analytical results. The process knowledge used to characterize this waste consisted of site reconnaissance and a review of previous CAI activity reports to identify the types of debris present and to identify PSM. A detailed visual inspection was completed to identify the types of manufactured items and debris present. The waste was visually inspected as generated to identify evidence of hazardous/chemical contamination. Industrial hygiene samples for suspect debris items (e.g., insulation, paint) were collected and analyzed for possible asbestos, lead, and beryllium

Table F.1-1
Inventory of Equipment and Debris at CSII and CSIII Sites

Item	Number of Items	Location	Estimated Volume	Description
Cargo Containers (10 x 8 x 20 ft)	2	CSII Inside CA Fence	120 yd^3	Cargo #1 contains two 55-gal open-top steel drums (one with 10-gal metal drum and 10-gal plastic bucket), wood and metal debris, two engines, and decontamination pad liner material. Cargo #2 contains wood and metal scrap, decontamination pad liner material, office furniture (table and chairs), 10-gal steel drum, drum scale, and electrical cable.
Mobile Shaker Plant	1		237 yd^3	Approximately 40 by 20 ft in size, internal and external surfaces contaminated.
Wood Shack	Multiple		64 yd^3	Wood shed contains one air-conditioning unit; HEPA vacuum; cables; wood and metal scrap; power tools; bagged PPE; office furniture (desks, table, chairs); 55-gal open-top drum; typewriter; electrical panel; and breaker box.
Debris	Multiple		50 yd^3	Cables, metal and wood scrap, structural steel beams and plates, concrete pieces, and metal sheets.
Drum	1		7.4 ft^3	55-gal steel open-top drum with padlock.
Debris	Multiple	CSII Outside CA Fence	20 yd^3	Cable spools with cable, coiled cables on ground, wood and metal scrap, metal pipe, wood loading platform, metal frames, and metal screening.
Metal Boxes	3		Empty	Empty B-12 metal boxes.
Sample Coolers	2	CSIII Inside CA Fence	5 yd^3	Sample cooler 1 contains sample containers (i.e., 1-liter poly, 1-liter amber glass jars, and 40-milliliter glass volatile organic analysis vials) and a chain of custody. No elevated radiological readings. Sample cooler 2 contains sample jars (some broken inside), plastic bags, and bubble wrap. Some sample jars were intact. No documentation was found inside this cooler. No elevated radiological readings.
5-gal Plastic Buckets	3		1.8 ft^3	5-gal plastic buckets contain concrete cores. No elevated radiological readings.
Drum	1		7.4 ft^3	55-gal steel drum contains two 5-gal metal buckets. One bucket was opened and contained metal tongs, spray bottle, and plastic material. The second 5-gal bucket was not opened due to elevated radiological readings on the exterior of the bucket.
Debris Pile	1		20 yd^3	Miscellaneous metal and wood scrap, one large piece of contaminated metal, electrical wire, and barbed wire.

ft^3 = Cubic foot

Figure F.1-1
Photographs of Wood Shed at CSII

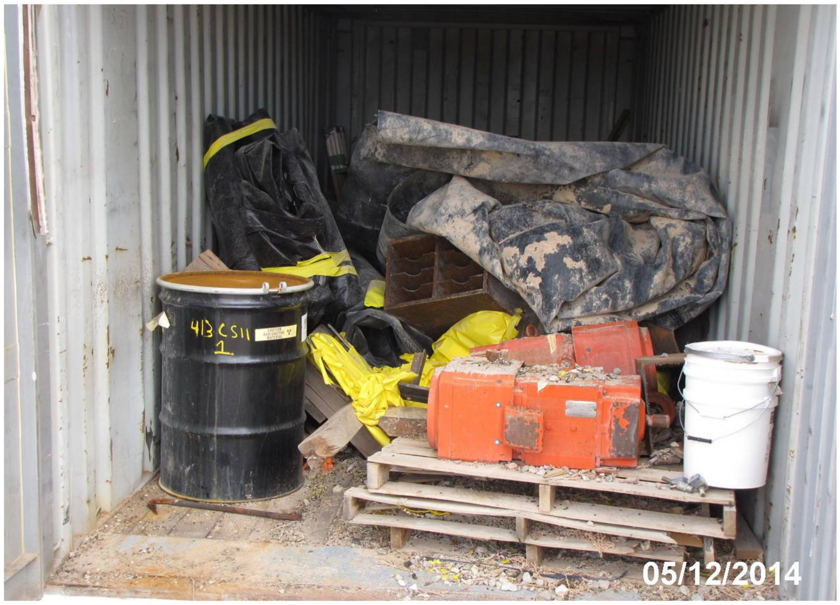

Figure F.1-2
Photographs of Cargo Container Contents at CSII

Figure F.1-3
Photographs of Equipment and Loose Debris at CSII

Figure F.1-4
Photographs of Debris at CSIII

contamination. In addition to process knowledge, radiological field-screening surveys and *in situ* radiological measurements using a portable gamma spectrometer were completed to fully characterize the waste for radiological contamination.

The equipment and debris was characterized as low-level radioactive waste with beryllium contamination. The debris waste was packaged into four 36-cubic-meter cargo containers and overpacked into type industrial package (IP)-1 soft-sided packages. The packages were issued the unique container identification numbers 413A02, 413A03, 413A04, and 413A05 to track the waste characterization and disposal process from point of generation until final disposal. In addition, one oversized trailer unit was packaged into a U.S. Department of Transportation-certified IP-1 soft-sided package and assigned the unique container number 413A06. A waste container tracking log was created that documents the contents and volume of the waste packaged into each container. Each waste container log includes an addendum form that provides an itemized inventory, radiological field-screening measurements, and weight measurements for all the waste that was packaged into each container.

The equipment and debris waste was transported to the NNSS for disposal at the Area 5 Radioactive Waste Management Complex. The certificate of disposal for the five containers is presented in Attachment F-1.

Attachment F-1

Certificate of Disposal

(5 Pages)

Certificate of Disposal

This is to certify that the Waste Stream No. LITN-000000006, Revision 16, shipment number ITL15003 with container number 413A02 was shipped and received at the Nevada National Security Site Radioactive Waste Management Complex in Area 5 for disposal as stated below.

Mark Heser	NI	Waste Coordinator
Shipped by	Organization	Title
Signature on file		12/2/14
Signature		Date
Stephan G Wolf	NSTec	Waste Specialist
Received by	Organization	Title
Signature on file		12-03-14
Signature		Date

Certificate of Disposal

This is to certify that the Waste Stream No. LITN-000000006, Revision 16, shipment number ITL15004 with container number 413A03 was shipped and received at the Nevada National Security Site Radioactive Waste Management Complex in Area 5 for disposal as stated below.

Mark Heser	NI	Waste Coordinator
Shipped by	Organization	Title
Signature on file		12/2/14
Signature		Date
Stephanie E Wolf	NSTec	Waste Specialist
Received by	Organization	Title
Signature on file		12-03-14
Signature		Date

Certificate of Disposal

This is to certify that the Waste Stream No. LITN-000000006, Revision 16, shipment number ITL15005 with container number 413A04 was shipped and received at the Nevada National Security Site Radioactive Waste Management Complex in Area 5 for disposal as stated below.

Mark Heser	NI	Waste Coordinator
Shipped by	Organization	Title
Signature on file		12/2/04
Signature		Date
Stephen C Wolf	NStec	Waste Specialist
Received by	Organization	Title
Signature on file		12-03-14
Signature		Date

Certificate of Disposal

This is to certify that the Waste Stream No. LITN-000000006, Revision 16, shipment number ITL15006 with container number 413A05 was shipped and received at the Nevada National Security Site Radioactive Waste Management Complex in Area 5 for disposal as stated below.

Mark Heser	NI	Waste Coordinator
Shipped by	Organization	Title
Signature on file		12/2/14
Signature		Date
Stephon E. Wolf	NStec	Waste
Received by	Organization	Title
Signature on file		12-03-14
Signature		Date

Certificate of Disposal

This is to certify that the Waste Stream No. LITN-000000006, Revision 16, shipment number ITL15007 with container number 413A06 was shipped and received at the Nevada National Security Site Radioactive Waste Management Complex in Area 5 for disposal as stated below.

Mark Heser	NI	Waste Coordinator
Shipped by	Organization	Title
/s/ Signature on file		12/2/14
Signature		Date
Stephen E. Wolf	NSTec	Waste Specialist
Received by	Organization	Title
/s/ Signature on file		12-03-14
Signature		Date

Appendix G

Evaluation of Personnel Dose as a Result of Wound Exposure from Contaminated Soils

(7 Pages)

Evaluation of Personnel Dose as a Result of Wound Exposure from Contaminated Soils

Introduction

The National Council on Radiation Protection and Measurements (NCRP) report No. 156, *Development of a Biokinetic Model for Radionuclide Contaminated Wounds and Procedures for Their Assessment, Dosimetry and Treatment,* presents a biokinetic model for intakes of radionuclides via contaminated wounds. The report states that “radionuclide-contaminated wounds have potentially serious health consequences because a natural barrier to radionuclide penetration has been breached. As a result, the contaminating radionuclide has direct access to blood and extracellular fluids, and ultimately, to internal tissues and organs.”

The companion paper “Dose Coefficients for Intakes of Radionuclides via Contaminated Wounds” provides the results of coupling the NCRP wound model with the International Commission on Radiological Protection (ICRP) systemic biokinetic models for 22 commonly encountered elements to generate tables of dose coefficients 38 radionuclides. These dose coefficients can be used to determine doses to personnel from radioactive materials deposited in wounds.

Discussion

Discussions with the U.S. Air Force (USAF) have resulted in an interest in calculating doses to military personnel that may result from wounds obtained during field exercises inadvertently conducted in radiologically contaminated areas on the Nevada Test and Training Range/Tonopah Test Range (NTTR/TTR). These areas have uranium and transuranic materials as the primary contaminants. The NTTR Small Boy site had a low fission yield; and the NTTR/TTR Double Tracks site and Clean Slate I, II, and III sites were safety experiments with no fission yield. The *Health Physics* journal article “Radionuclide Transport from Soil to Air, Native Vegetation, Kangaroo Rats and Grazing Cattle on the Nevada Test Site” reports that in areas where fission occurred, most of the radionuclides were incorporated into particles of silicate glass. The radioactivity occurred as either spherical glass particles (usually solid) or glass coatings (often containing gas voids) on sand particles or silicate glass that were sponge-like, highly porous, and very fragile. At sites where the nonfission explosions did not yield sufficiently high temperatures to produce silicate glass particles, the radioactivity occurred predominately as high-density oxide particles. The USAF has selected a Construction Worker scenario for the Double Tracks and Clean Slate II sites; and a Ground Troops scenario for the Clean Slate I, III, and Small Boy sites.

This evaluation will present information concerning the dose that personnel may receive from exposure to radioactive contamination in soil through a wound. The following are relevant excerpts from NCRP Report 156 that give some understanding of the process for calculating personnel doses from radioactive materials deposited in a wound:

- The vast majority of contaminated wounds have occurred in facilities involved in the production, fabrication, or maintenance of components for nuclear weapons; and the contaminants involved have been actinides (uranium, plutonium, and americium).

- More than 90% of wounds have occurred in the hands and arms, primarily the fingers.
- Almost 90% of wounds have involved mechanical damage, mostly punctures; chemical burns from acid solutions account for almost all the others, with relatively few thermal burns reported.

- Because of the high radiotoxicity of the transuranics in particular, the vast majority of workers who have experienced wounds contaminated with these radionuclides have undergone prompt medical intervention to minimize systemic uptake of the radionuclide. These interventions include surface decontamination such as scrubbing with various agents; surgical debridement or excision of the wound site; and therapy with appropriate chelating or blocking agents to increase the excretion rate of absorbed radionuclides and consequently reduce the radiation dose delivered to internal organs and tissues.
- The uptake of activity into the systemic circulation from a wound site is highly variable, depending on the physical and chemical form of the radionuclide, the depth of the wound and extent of tissue injury, the treatment given, and the time elapsed between injury and treatment. For example, for most wounds, excision (often repeated) can remove >90% of the initial activity from the wound site.
- In almost all cases of wounds contaminated with transuranics, the chelating agent zinc- or calcium-diethylene triamine pentaacetate acid (DTPA) is administered; it is effective for enhancing the excretion of soluble forms (e.g., nitrates) of these radionuclides from the body, **but is essentially ineffective in removing less-soluble forms such as oxides** (emphasis added).
- The general trend of radionuclide absorption from the abraded skin is the same as was observed for those same radionuclides applied to skin incisions or deposited in puncture wounds. The amounts of the individual radionuclides absorbed from an undisturbed skin abrasion are nearly the same as from a deeper cut (laceration). Therefore, the default fractions of early radionuclide absorption from a puncture wound, suggested for application to contaminated lacerations, can reasonably be applied to the case of contaminated abraded skin.
- Modeling the retention and translocation of radioelements deposited in wound sites as initially insoluble materials is more difficult than for soluble materials, because there are few suitable datasets from which model parameter estimates can be obtained. The consequence of this lack of data for deposited colloids, precipitates, particles, and fragments is that it is impractical to consider developing default groupings of radionuclides based on their chemical properties, such as was done with the radionuclides injected in initially soluble forms. The several wound retention equations predict that, if those solids were allowed to remain undisturbed for 10 years, the fractional amounts of actinide translocated from a wound site would be 3% of the implanted depleted uranium (DU) metal, 1.4% of the implanted plutonium metal, 0.25% of the plutonium and americium associated with the implanted fallout particles composed mainly of structural materials, and 0.13% of the plutonium and americium contained in the implanted fallout particles composed mainly of UO_2 or soil constituents.
- The wound model (Figure 4.4) was used to obtain sets of intercompartmental transfer rates that described wound retention and systemic absorption of actinides implanted as solid fragments (1 mm diameter) in simulated wounds in animals. Those transfer rates are recommended for use as analytical tools in investigations of accidental woundings with fragments of uranium or DU metal, plutonium metal, or minispheres of structural materials such as aluminum or steel contaminated with radionuclides.

The paper “Dose Coefficients for Intakes of Radionuclides via Contaminated Wounds” takes a further step of coupling the NCRP wound model with the ICRP systemic biokinetic models for 22 commonly encountered elements to generate tables of dose coefficients for 38 radionuclides. It includes examples for using the dose coefficients to generate derived reference guides and clinical decision guides. Effective dose coefficients are shown for the relevant radionuclidesfor all wound model categories as described. These values may be used to generate guides for wound intakes that will produce an effective or organ equivalent dose equal to some limit if no attempts are made to reduce the radionuclide content at the wound site or to accelerate radionuclide excretion.

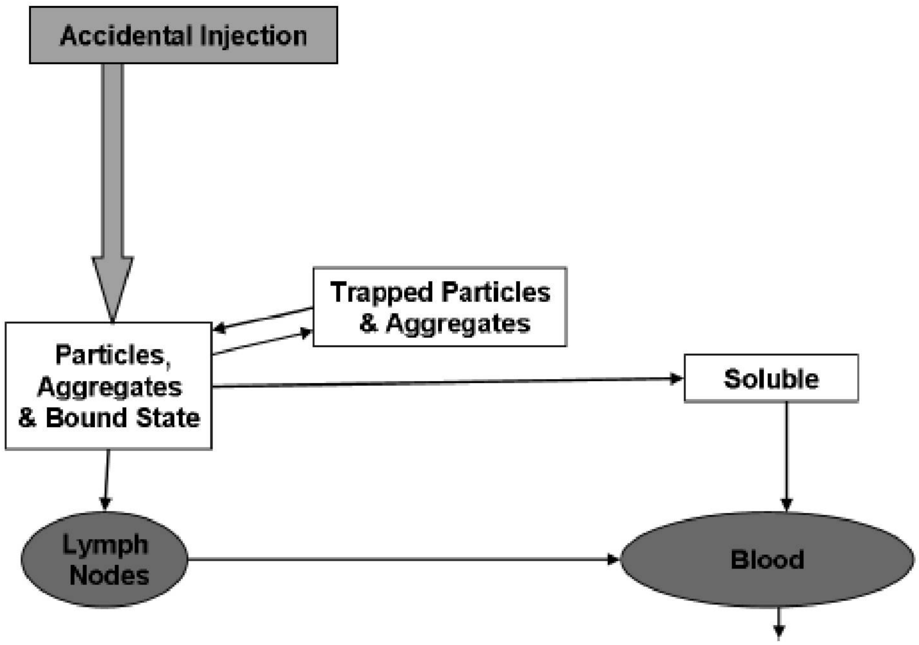

Fig. 4.4. Wound model for injection of particles into the PABS compartment.

Assumptions

Wound Scenario

As stated in the Discussion section, most wounds occur in the hands or arms. In industrial activities, puncture wounds to hands and fingers are the most likely. For field activities, lacerations and abrasions to hands and arms also seem likely. The size of the wound has a direct effect on the surface area where contaminated soil could be retained and thus be available for transport into the blood. For this evaluation, it is assumed that the wound site is a small cut or abrasion on an extremity such as a hand, forearm, foot, or lower leg.

It is presumed that initial first aid will remove visible debris from the wound, but there will be no excision of tissue. It is also assumed that no chelating agents will be administered.

The mass of material remaining in the wound is assumed to be 1 µg. The mass of 1 µg was chosen to facilitate scaling of the results when a different source mass is used. The NCRP Report 156 includes some discussion of individuals with imbedded DU fragments with masses in the 100s of mg range. Because any visible fragments (presumably with masses in the mg and greater range) are removed, the mass of soil remaining in the wound would be in the µg range.

Radionuclides

Radionuclides that contribute significantly to internal dose typically emit α radiation. The relevant nuclides that are present in tests conducted at the NTTR/TTR by the DOE include ^{241}Am, ^{238}Pu, ^{239}Pu, ^{241}Pu, ^{234}U, ^{235}U, and ^{238}U.

Wound Model

The assumed wound model as stated in the Discussion section and shown in Figure 4.4 is for injected insoluble particles of silicate glass; glass coatings on sand particles; and/or high-density oxides, which are the most likely radioactive materials encountered at the NTTR/TTR.

Dose Determination

Dose conversion factors from “Dose Coefficients for Intakes of Radionuclides via Contaminated Wounds” are shown in Table 1. Column 3 of Table 1 shows a conversion of the coefficients from $Sv\cdot Bq^{-1}$ to $mrem\cdot pCi^{-1}$.

Table 1: Dose Conversion Factors for the Particle Wound Model

Radionuclide	Effective Dose Coefficient ($Sv\cdot Bq^{-1}$)	Effective Dose Coefficient ($mrem\cdot pCi^{-1}$)
^{234}U	1.92E-06	7.10E-03
^{235}U	1.78E-06	6.59E-03
^{238}U	1.73E-06	6.40E-03
^{238}Pu	3.36E-04	1.24E+00
^{239}Pu	3.90E-04	1.44E+00
^{241}Pu	9.23E-06	3.42E-02
^{241}Am	3.23E-04	1.20E+00

The *Federal Facility Agreement and Consent Order* (FFACO) dose of interest is 25 mrem/yr. Using the dose conversion factors from Table 1, an intake activity that would result in a 25-mrem dose was calculated using Equation 1, and the results are shown in Table 2.

$$Intake\ activity = \frac{E_{50}}{EDC} \qquad \textit{Equation 1}$$

Where:
E_{50} = Effective dose (25 mrem)
EDC = Effective dose coefficient ($mrem\cdot pCi^{-1}$)

Table 2: Intake Activity Resulting in 25-mrem E_{50}

Radionuclide	Intake Activity (pCi)
^{234}U	3.52E+03
^{235}U	3.80E+03
^{238}U	3.91E+03
^{238}Pu	2.01E+01
^{239}Pu	1.73E+01
^{241}Pu	7.32E+02
^{241}Am	2.09E+01

Using the assumptions from above, the soil concentration that could produce a 25-mrem dose from 1 µg of soil for each radionuclide is calculated using Equation 2.

$$Soil\ Concentration = \frac{E_{50} * CF}{EDC * mass} \qquad \textit{Equation 2}$$

Where:
E_{50} = Effective dose (25 mrem)
CF = 1E+06 (unit conversion factor)
EDC = Effective dose coefficient ($mrem \cdot pCi^{-1}$)
mass = soil in wound (assumed 1 µg)

Table 3 shows the calculated soil concentrations that could produce an E_{50} of 25 mrem and has a comparison with the Construction Worker and Ground Troops scenarios residual radioactive material guidelines (RRMGs). Note that the soil concentration is inversely proportional to the mass of soil retained in the wound. If a larger mass is assumed, then the soil concentration would be reduced, For example, if 1 mg were retained in the wound, the resulting soil concentration for ^{239}Pu would be reduced to 1.73E+04 $pCi \cdot g^{-1}$, which would be approximately 3 times the Construction Worker and Ground Troops scenario RRMGs.

The Construction Worker scenario assumes primarily outdoor construction activities that may include road construction/maintenance, underground utilities excavation, and/or target or other structure placement. A typical construction worker is anticipated to spend a maximum of 120 days per year at the site, and will spend an average of 6 hours outdoors and 2 hours indoors during the work day. In this scenario, soil may be disturbed up to a depth of 0.45 meters below the ground surface to account for the placement of structure footers and/or building foundations.

The Ground Troops scenario assumes 100 percent outdoor activities that may include performing light, moderate, and hard physical labor and periods at rest. This scenario assumes that the troops bivouac at the site. The maximum amount of time an individual ground troop could be deployed during any single mission or operation is 14 days, 24 hours per day, and will participate in 3 such deployments a year. This results in a total of 1,008 hours per year of potential exposure.

Table 3: Soil Concentration Resulting in 25-mrem E_{50}, and the Construction Worker and Ground Troops Scenario Internal Dose RRMGs

Radionuclide	Soil Concentration ($pCi\ g^{-1}$)	Construction Worker Internal Dose RRMG ($pCi\ g^{-1}$)	Ground Troops Internal Dose RRMG ($pCi\ g^{-1}$)
^{234}U	3.52E+09	6.12E+04	2.89E+04
^{235}U	3.80E+09	6.68E+04	3.00E+04
^{238}U	3.91E+09	6.99E+04	2.96E+04
^{238}Pu	2.01E+07	5.86E+03	5.21E+03
^{239}Pu	1.73E+07	5.35E+03	4.77E+03
^{241}Pu	7.32E+08	2.77E+05	2.46E+05
^{241}Am	2.09E+07	6.70E+03	5.98E+03

Table 4 shows the calculated effective dose using Equation 3 that would result from a wound that was contaminated with 1 µg of the maximum measured soil concentrations at the Double Tracks and Clean Slate III locations.

$$E_{50} = SC * mass * EDC * CF \qquad \textit{Equation 3}$$

Where:
E_{50} = Effective dose
SC = Soil concentration ($pCi \cdot g^{-1}$)
mass = Soil in wound (assumed 1 µg)
EDC = Effective dose coefficient ($mrem \cdot pCi^{-1}$)
CF = 1E-06 (unit conversion factor)

Table 4: Calculated E_{50} for a Wound Contaminated with the Maximum Soil Concentrations at Double Tracks and Clean Slate III

Radionuclide	Double Tracks Soil Concentration ($pCi\ g^{-1}$)[a]	Double Tracks E_{50} (mrem)	Clean Slate III Soil Concentration ($pCi\ g^{-1}$)[b]	Clean Slate III E_{50} (mrem)
^{234}U	1.45	1.0E-08	18.5	1.3E-07
^{235}U	ND[c]	NA[d]	6.8	4.5E-08
^{238}U	1.25	8.0E-09	31.1	2.0E-07
^{238}Pu	8.7	1.1E-05	93	1.2E-04
^{239}Pu	1,380	2.0E-03	27,700	4.0E-02
^{241}Pu	ND[c]	NA[d]	ND[c]	NA[d]
^{241}Am	65	7.8E-05	1,540	1.8E-03

[a]Maximum values for radionuclides at Double Tracks from sampling conducted in 2012.
[b]Maximum values for radionuclides at Clean Slate III from the sampling conducted in the late 1990s.
[c]Not detected
[d]Not applicable

Summary and Conclusions

At the request of the CAU 413 stakeholders, the impact a wound may have on total dose to a receptor was evaluated. The evaluation used conservative assumptions, including a 1 µg deposition of radioactive material in the wound and the maximum concentrations of radionuclides detected in soil at (1) a previously remediated site (DT) and (2) a site that has not been remediated (CSIII). The E_{50} from maximum known soil concentrations at the Double Tracks and Clean Slate III sites are insignificant as compared to the 25-mrem FFACO dose of interest. That is, the additional dose a potential receptor would receive from a wound imbedded with contaminated soil from either a remediated or non-remediated site was insignificant when compared to the 25-mrem/yr action level.

The dose to an individual from a wound contaminated with radioactive soils is directly dependent on the amount of material remaining after first-aid measures have been completed. The soil concentration that would result in a dose of 25 mrem is inversely proportional to the mass of soil remaining in the wound. The Construction Worker and Ground Troops scenario RRMGs for the radionuclides of concern would be 3 to 5 orders of magnitude smaller than the soil concentrations that would result in a 25-mrem E_{50} from a wound based on a 1-µg deposition.

References

National Council on Radiation Protection and Measurements. *Development of a Biokinetic Model for Radionuclide-Contaminated Wounds and Procedures for Their Assessment, Dosimetry and Treatment*, NCRP Report No. 156. Bethesda, MD.

Toohey, R.E., L. Bertelli, S.L. Sugarman, A.L. Wiley, and D. M. Christensen. 2011. “Dose Coefficients for Intakes of Radionuclides via Contaminated Wounds.” In *Health Physics*, Vol. 100(5): pp. 508–514.

Gilbert, R.O., J.H. Shinn, E.H. Essington, T. Tamura, E.M. Romney, K.S. Moore, and T.P. O’Farrell. 1988. “Radionuclide Transport from Soil to Air, Native Vegetation, Kangaroo Rats and Grazing Cattle on the Nevada Test Site.” In *Health Physics*, Vol. 55(6): pp. 869–887.

Federal Facility Agreement and Consent Order. 1996 (as amended March 2010). Agreed to by the State of Nevada; U.S. Department of Energy, Environmental Management; U.S. Department of Defense; and U.S. Department of Energy, Legacy Management.

Appendix H

Nevada Division of Environmental Protection Comments

(22 Pages)

1. Document Title/Number: CAIP for CAU 413: Clean Slate II			2. Document Date: December 2015
3. Revision Number: 1			4. Originator/Organization: Nevada Division of Environmental Protection
5. Responsible DOE NNSA/NFO Activity Lead: T. Lantow			6. Date Comments Due:
7. Review Criteria:			
8. Reviewer/Organization Phone No.: NDEP			9. Reviewer's Signature:

10. Comment Number/Location		11. Type[a]	12. Comment	13. Comment Response
1.	1.1, Page 1, Paragraph 1		1st sentence: after "contaminants .." insert: "have been released and"	Editorial comments were adopted as appropriate.
2.	1.1.2, Page 3, Paragraph 3		Change FAL to PAL since FALs are established as part of the corrective action alternative evaluation process (Reference the Soils Risk-Based Corrective Action Evaluation Process, Revision 0, and Soils Activity Quality Assurance Plan, Revision 0)	The intent of this paragraph is to define a COC, not establish the FALs for CAU 413. No revisions were made to the document.
3.	1.1.2, Page 4, Paragraph 3		CAIP does not identify the type (simple random, stratified random, etc.) of probabilistic sampling design that will be used for this investigation. The CAIP references generically "A probabilistic sampling design will be used...", throughout the document. State explicitly or provide a reference to the chosen probabilistic sampling design, the conditions of use, the limitations, and discuss the statistical basis.	The CAIP identifies the type of probabilistic sampling design used in the investigation in Sections 4.2.5 and A.8.1.2. The following was added after the last sentence of the sixth paragraph in Section 1.1.2: "Implementation of the probabilistic sampling design is described in Section A.8.1.2." In addition, the RBCA document reference "(NNSA/NFO, 2014)" was added to Section A.8.1.2 at the end of the second sentence of the second paragraph.
4.	2.1.1, Page 8, Figure 2-1		Add TTR/Sandia Land Use Permit Area boundary as it occurs within extent of this figure.	Figure 2-1 was revised to include the TTR boundary.

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10. Comment Number/Location		11. Type[a]	12. Comment	13. Comment Response
5.	2.1.3, Page 10, Paragraph 1		Last sentence: identify the three wells closest to CSII, show the location on a Figure, and describe any monitoring for radionuclides in groundwater on the Tonopah Test Range or state that no such monitoring occurs.	The location of wells in the vicinity of CAU 413 are presented in a figure in the N-I, 2013b reference cited in this paragraph. Groundwater monitoring data for wells in the vicinity of CAU 413 are not relevant as there are no CAU 413 releases that have the potential to impact groundwater. This was established and agreed to in the CAU 413 DQOs. No changes were made to Section 2.1.3; however, clarification was added to Section A.2.2.6, *Migration Pathways*, as follows: The fourth paragraph was deleted and replaced with, "Percolation of infiltrated precipitation serves as a driving force for downward migration of contaminants. However, very little of the infiltrated precipitation is available for percolation due to the high evaporative demand (PET of 58 to 69 inches per year [in./yr]) and the limited amount of annual precipitation for this region (6 in./yr) (French, 1983 and 1985). Therefore, percolation of infiltrated precipitation at the CSII site does not provide a significant mechanism for vertical migration of any contaminant to groundwater. In addition, as the major contaminants at the CSII site (Pu and Am) are highly adsorptive to the soil (Section A.2.2.5) and have been shown not to have migrated more than a few inches in the last 50 years (Section 2.5), there is no potential for groundwater to be impacted by CSII releases. Therefore, migration to groundwater is not considered to be a viable pathway in the CSM." The last sentence of the last paragraph of Section A.2.2.6 was revised to read, "In general…are expected to be found relatively close (horizontally and vertically) to release points. That is, these contaminants tend to adhere to soil and do not readily move."

6.	2.1.4, Page 11, Paragraph 1		Add text that presents data on the potential for dust devils to disperse radionuclides from the site; or indicate that even with the presence of dust devils there has been no detection of radionuclides migrating from the site via wind.	This section presents the physical setting of CAU 413 and is not meant to include the evaluation of potential contaminant transport. Dust devils are a component of wind that is evaluated in the CSM (Appendix A). No changes were made to Section 2.1.4; however, clarification was added to Section A.2.2.6, *Migration Pathways*. The second paragraph was deleted and replaced with, "The CSII test resulted in the airborne dispersal and deposition of contaminants on the surface soil around CSII. Wind events (including dust devils) entrain, mix, and disperse soil particles within their path. As the areas affected by these events are much larger than the area impacted by CSII releases, soil from the entire affected area (both uncontaminated and contaminated) is mixed and dispersed. This results in slightly lower contaminant concentrations across the contaminated area and slightly higher contaminant concentrations in the uncontaminated areas. The net effect of this phenomenon is that the area where contamination exceeds the FAL could become slightly smaller. This CSM element assumption is supported by several studies monitoring airborne particles in the vicinity of the CS release sites (Section 2.5.10). These studies have not detected any significant concentrations of contaminants originating from the release sites." In addition, the following was added before the first paragraph of Section 2.5.10 to summarize other air monitoring data applicable to CAU 413: "From 1996 to 1997, the TTR maintained a continuous air monitoring station in Area 3 of the TTR to determine compliance with federal regulations for hazardous air pollutants. Area 3 of the TTR is approximately 4.5 mi northwest of the closest CS site, CSIII. This year-long study estimated a dose of 0.024 millirem per year (mrem/yr) to an individual from the diffuse sources of Pu and Am attributed to the CS sites (Culp et al., 1998). Air monitoring at a single location north of the CA fence at the CSII site was conducted by the NNSS contractor from 1998 through 2000 (Black and Townsend, 1999; Townsend and Grossman, 2000 and 2001). Data were analyzed for gross alpha, gross beta, beryllium, and Pu. Because this monitoring station was included as part of a wide network of air samplers on NNSS, the data were reported in summary tables and were not evaluated on a site-specific basis. The highest Pu-238 and Pu-239/240 values detected over this three-year period were 9.1 x 10^{-19} microcuries per milliliter (µCi/mL) and 1.4 x 10^{-16} µCi/mL. In 1997, the Desert Research Institute (DRI) published the results of Pu analyses of ambient airborne particulate matter from the CS sites (Bowen, 1997). A single air monitoring station located approximately 5.5 mi west of the CSII site was operated from 1996 through 1997. Filter samples from the station were composited over three month periods and analyzed for Pu. Of the four composite samples, one sample (February through April 1996) had Pu-239/240 detected above the detection limit. The estimated committed effective dose equivalent for inhaled Pu-239/240 was estimated at 0.26 millirem (mrem) per 91 days for this sample."

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7. Review Criteria:				
8. Reviewer/Organization Phone No.: NDEP				9. Reviewer's Signature:
10. Comment Number/Location		11. Type[a]	12. Comment	13. Comment Response
7.	2.2, Page 13, Paragraph 1, 2		Sentence beginning with, "At some point...": estimate a year range for inner fence construction based on best available information. Based on the photos, it appears that the two 'engines' should be identified as motors.	The second to last sentence of the fifth paragraph of Section 2.2 was changed to replace "At some point" with "Between 1969 and 1973". Editorial comments were adopted as appropriate.
8.	2.4, Page 14, Paragraph 1		Without the presence of the Underground Test Area (UGTA) program, this paragraph should address potential contamination to groundwater (similar to text in Section A.2.2.5 and travel time analysis) and whether any testing of groundwater has occurred.	See response to comment #5.
9.	2.4.1, Page 15, Paragraph 1, 2		Does the extent of Study Group 1 comprise all land areas inside the CA fence exclusive of other SGs indicated by legend in Fig 2-2? Show extent of SG 1 on this Fig. Describe in this section or Section 4.0 a field investigation that will/could be performed to verify that lateral migration will dominate over vertical migration of surface water.	The extent of SG1 is not defined, since it addresses a conceptual release discussed in the CSM. SG1 conceptually includes all areas impacted by the atmospheric release, but undisturbed since the CSII test. These undisturbed areas are located inside and outside the fence and are exclusive of the areas defined by other SGs. To clarify, the first sentence of Section 2.4.1 was revised to read, "…by post-test operations, exclusive of the areas defined by other study groups." The current CAI will not verify vertical migration as this has already been accomplished by the NAEG studies reported in Section 2.5.3 and the 1996 Initial CAI reported in Section 2.5.5. Both these studies collected depth profile samples that demonstrate a strong pattern of contamination decreasing with depth and limited to a few inches. This CSM component and the resulting sampling strategy were presented and agreed to in the CAU 413 DQO meeting. No revisions were made to the document.
10.	2.4.3, Page 16, Paragraph 1		Other than drainage channels, the location/extent of SG 3 sedimentation areas are not indicated on Fig. 2-2. Suggest add.	The following note was added to Figure 2-2,"Note: Drainage channels will be investigated during the CAI to identify sedimentation areas within SG3."
11.	2.4.4, Page 18, Paragraph 1		1st sentence: add the approximate distance in meters between " ... is located" and "northwest ..."	The first sentence of Section 2.4.4 was revised to read, "The Former Staging Area is located approximately 100 m northwest of GZ and …".

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10. Comment Number/Location		11. Type[a]	12. Comment	13. Comment Response
12.	2.4.5, Page 19, Paragraph 1		4th sentence: "...debris and soil were buried ..."	Editorial comments were adopted as appropriate.
13.	2.4.5, Page 20, Figure 2-3		To make comparison with other figures easier, please add boundary of "Staging Area".	The focus of this figure is SG5 and SG7. The drainages, GZ, and fence are shown for reference. No revisions were made to the document.
14.	2.4.6, Page 21, Paragraph 1		Is the material and debris described in Appendix F classified as PSM IAW with the definition in this section? Clarify.	Yes, some of the material would be considered PSM in accordance with these definitions. However, the material and debris discussed in Appendix F were removed from the CSII site and disposed of in 2014. Therefore, this material is not included in SG6, PSM. No revisions were made to the document.
15.	2.4.6, Page 21, Paragraph 2		End of paragraph: extensive measurements have been made on this debris; provide examples of measurement ranges encountered for 'plated' vs. 'unplated' concrete. Please add to a figure the approx. extent of the contaminated concrete and metal debris field removed at 100+ locations inside and outside the CA fence and up to 2500 ft. from GZ.	The results of the CAI will be presented in the CAU 413 CADD. No revisions were made to the document.
16.	2.4.6, Page 22, Figure 2-4		If available, please add add'l photos illustrating the size range of debris, both 'plated and 'unplated'.	The existing photographs provide an adequate example of the type of material found in the debris investigation. The results of the CAI will be presented in the CAU 413 CADD. No revisions were made to the document.
17.	2.4.6, Page 23, Paragraph 2		Suggest move this paragraph to p.21, insert/merge with 1st paragraph.	The fourth paragraph of Section 2.4.6 was moved to the end of the first paragraph, as suggested.
18.	2.4.7, Page 23, Paragraph 1		Perhaps images (like those of the concrete) of soil mounds should also be included, given the extensive discussion.	Images of the soil mounds were added to Section 2.4.7.
19.	2.5.1, Page 26, Paragraph 1		Last sentence: add brief descriptions of what each photograph depicts.	The following was added after the last sentence of the first paragraph of Section 2.5.1: "Figure 2-6 presents the test bunker viewed from the south (top photograph) and west (bottom photograph). The top photograph also includes a view of the arming and firing building. Figure 2-7 shows two post-test views of the test bunker looking west. The top figure also shows the collapsed instrument tower, sandbagged instruments, and the remains of the arming and firing building."

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20.	2.5.1, Page 29, Paragraph 1		Please review "0peration Roller Coaster Project Officers Report - Project 2.6a Special Particulate Characteristics" (hyperlink downloads document) for applicability to site characterization and closure. This report provides the distribution of mass and gamma activity among dry and wet-sieved particle- size fractions of fallout from the CS-II event. These data should be evaluated for potential impact to internal dose calculation and possible dose conversion factor correction in accordance with ICRP methodology to account for particle size distributions other than the assumed 1 micron size in RESRAD.	Data in the referenced report could potentially contribute to a decision to use less conservative DCFs in the calculation of RRMGs. DOE does not intend to adopt less conservative DCFs based on particle size in the development of RRMGs for CAU 413. No revisions were made to the document.
21.	2.5.1, Page 29, Paragraph 2		Describe how the graded approach was applied to each reviewed dataset (the Soils Activity QAP provides a circular reference to the graded approach that does not define how the process is used).	To avoid confusion, the text "graded approach described in the" was deleted from the first sentence of the last paragraph of Section 2.5.1.
22.	2.5.1, Page 29, Paragraph 2		Because the graded approach in the QAP is not explicitly defined in that document, how is the quality of a dataset evaluated to determine its intended use: informational, decision supporting or decisional.	The graded approach is discussed in Section 1.0 of the QAP. The quality required of a dataset is defined based on its intended use, which is discussed in Sections 2.5, 2.6, and 2.7 of the QAP. The quality of decisional data is evaluated in the DQA appendix of the CADD (see Section 4.3 of the QAP). No revisions were made to the document.
23.	2.5.2, Page 29, Paragraph 1		2nd sentence: "...current radiological conditions ..."; it is confusing to use a word which means 'present-day' in this context. Last sentence: avoid the hackneyed phrase, "it should be noted"	Editorial comments were adopted as appropriate.

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24.	2.5.2, Page 29, Paragraph 2		1st sentence: does this refer to the 1996 CAI? Last sentence: what will these data be specifically used for?	This specific reference is to the CAI governed by this CAIP, not the 1996 CAI. To clarify, the following was added to the end of Section 2.5.5, "In order to distinguish between the 1996 CAI and the CAI governed by this CAIP, the previous CAI will be referred to as the "1996 CAI" in the remainder of this document." In addition, the document will be revised throughout to reference the "1996 CAI" where appropriate. The first sentence of the second paragraph of Section 2.5.2 was revised to read, "The alpha radiation survey maps were used in the design of the CAI to identify the general area (i.e., east of GZ) to be investigated for the presence of ejected debris."
25.	2.5.3, Page 29, Paragraph 1		1st sentence: Identify NAEG by name in this sentence.	NAEG was defined in Table 2-1. No revisions were made to the document.
26.	2.5.3, Page 30, Paragraph 2		Sentence beginning with, "At the five sample locations...": does this mean that Pu accounted for these percentages by volume, weight, concentration, etc.? Clarify. Last sentence: how were the data specifically used?	To simplify the discussion, this sentence and the next sentence were deleted and replaced with the following, "This study demonstrated that the highest concentrations of Pu were in the top 5 cm of soil and that Pu activity generally decreased with depth. These data were considered when determining a suitable depth for sample collection during the CAI." Note: The percentage was based on Pu concentration (i.e., the proportion of total Pu activity down to 25 cm).
27.	2.5.3, Page 30, Paragraph 1, 2		Recognizing these data were not directly used in the development of the CAI sample design, further define what the NAEG report identifies as the percentage of Pu in the top 5 centimeters from the five locations or consider eliminating discussion.	See response to comment #26.
28.	2.5.4, Page 30, Paragraph 3		Given the generalities and uncertainties presented in this section, state specifically how the TTR sampling results will be used.	The third paragraph of Section 2.5.4 was revised to read, "The majority of the TTR sample data were collected from a single location at the CSII site, limiting the data's usefulness for site characterization. As such, the TTR sample data were not directly used in the design of the CAI and serve as informational data."

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29.	2.5.5, Page 31, Paragraph 1,3		The 200 pCi/g activity (DOE/NV, 1996) is not a site cleanup level but rather the starting activity to define the area of contamination. A risk analysis using RESRAD to include future land use was proposed to be used as the basis for proposed CS-II cleanup levels. Revise to reflect submitted questions, and responses in DOE/NV-456, UC-700, Clean Slate Corrective Action Investigation Plan, Revision 0, May 1996. "Due to the high variability in soil samples collected at the DT and CSI sites, the characterization approach at CSII relied heavily on in situ radiation surveys." Because CSII has the same variability, how does this affect the calculation of the number of probabilistic samples? Replace "initial" with "1996" or the actual age when the data were collected. Global comment.	The second and third sentences of the first paragraph of Section 2.5.5 are unnecessary and were deleted. The Soils RBCA document addresses the issue of high variability in soil at Soils sites and defines the use of sample plots (probabilistic approach) to mitigate this variability. The RBCA document also requires that minimum sample size be evaluated in the CADD. No revisions were made to the document. See response to comment #24.
30.	2.5.5.1, Page 32, Paragraph 1, 2		2nd sentence: use of the phrase, "non-contiguous" implies areas of detached or non-adjoining radiation distribution, which does not seem to describe Fig. 2-7. Clarify.2nd sentence: "downwind": it has been stated that the CSII plume trajectory resulted primarily from orientation and construction of low resistance bunker construction features like doors. Clarify. State how the KIWI data were qualified as decision-supporting.	The second sentence of the second paragraph of Section 2.5.5.1 was revised to read, "The KIWI survey results show a radioactivity distribution in the area around GZ where some areas close to GZ appear less contaminated than areas farther from GZ." The first sentence of the last paragraph in Section 2.5.5.1 was revised by replacing "are considered" with "meet the definition of". Note: The "plume trajectory" noted in the comment is believed to be the path for ejected debris (metal, concrete) from the explosion. As evidenced in the aerial and KIWI surveys, the airborne contaminant plume followed a southeasterly direction blowing with the prevailing winds at the time of the CSII test. See also Section A.2.2.2 of the CSM.

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31. 2.5.5.2, Page 32, Paragraph 1, 2		Sentence beginning with "Contamination was detected": if the data is available, it must be added to Table 2-2 for informational purposes. Last sentences: "GZ mound area" and "depth of GZ mound ...": Sec.2.4.7 makes no mention of a "GZ mound" and Fig. 2-3 does not show a "GZ mound". Clarify. Last sentence: it's inappropriate to speculate about depth-of-burial at the CSII GZ based on a 20 year old CAI and simple comparison to related CAUs. State how the Soil Profile data were qualified as informational.	The sentence was revised as follows, "Contamination was detected up to 8 in. at one depth profile location (D6) in the vicinity of GZ (Table 2-2)." The last two sentences of the first paragraph of Section 2.5.5.2 were revised to read, "This location, however, is close to the GZ burial area and may not be representative of the contaminant plume outside the GZ area (NNSA/NSO, 2004). Depth profile sampling in the vicinity of GZ was not conducted during the 1996 CAI." The assumption of a 5 ft depth of burial was reported in the 2004 CAU 413 CADD. Because it is not directly relevant to this CAI, the assumption was deleted. The text "potential radiological conditions in the shallow subsurface at CAU 413" was replaced with "a suitable depth at which to collect soil samples during the CAI" in the last sentence of Section 2.5.5.2.
32. Table 2-2, Page 35, Paragraph 1		Table 2-2 indicates that net values are presented, but there is no accompanying discussion on background determination or instrument MDA (background and MDA is variable with soil type and depth). Provide a statement on how data was used as informational including how and where background was determined and what the instrument MDA was.	The informational data in Table 2-2 was included to highlight the general trend of decreasing activity with increasing soil depth at the CSII site. Information regarding the collection of background measurements or the MDA of the instrument was not presented because it was not contained in the data reference document. No revisions were made to the document. See also response to comment #31.

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33.	2.5.5.3, Page 37, Paragraph 2, 3, 5		4th, 5th sentences: 8 samples locations shown in Fig. 2-9 appear to have been biased toward drainage channels. Clarify. Explain at the end of the 3rd paragraph why the dataset suggests the uranium detected in soil samples is of natural isotopic composition. Depth profile soil samples were collected under several campaigns spanning many years at CSII. How were these data qualified as decision-supporting (i.e., QA/QC controls in place at that time; effectiveness of sample collection; material slough in). State how soil sample data were qualified as decision-supporting.	This section summarizes information from a previously published report, which does not suggest that drainages were used to bias sample locations. However, because the rationale for sample location selection from a previous sampling effort is not relevant to this CAI, the fourth and fifth sentences of the second paragraph of Section 2.5.5.3 were deleted. In addition, the second sentence of the paragraph was revised to read, "The first phase included the collection of a total of 11 samples from the locations shown in Figure 2-10." This sentence was deleted since it is not relevant to the discussion of previous sampling efforts or the CAI design. The use of the depth profile soil sample results as informational data is discussed in response to comment #31. The last sentence of Section 2.5.5.3 was revised to read, "The soil sample data collected in the 1996 CAI were classified as decision-supporting data because they were used to guide the selection of sample locations for this CAI.
34.	2.5.5.4, Page 39, Paragraph 2		What role, if any, will these geophysical data play?	The following was added after the first sentence of the second paragraph of Section 2.5.5.4, "The geophysical data from the 1996 CAI will be used to confirm the extent of the buried debris."
35.	2.5.6, Page 41, Paragraph 2		What role, if any, will the information related to the demonstration project play?	The second paragraph of Section 2.5.6 was revised to read, "The data collected in the technology demonstration project were used to support CSM assumptions for SG2, Disturbed Areas; and SG7, Soil Mounds. These data are considered informational data..."
36.	2.5.7, Page 41, Paragraph 3		State how aerial radiation survey data were qualified as decision- supporting.	The third paragraph of Section 2.5.7 was deleted and replaced with "The data from the 2006 aerial radiation survey meet the definition of decision-supporting data, as defined in the Soils Activity QAP (NNSA/NSO, 2012b). The radiation survey data were considered in the selection of sampling locations for the CAI."

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37. 2.5.7, Page 41, Paragraph 3		Aerial radiation surveys were deemed decision-supporting data yet there is no discussion on how the data were applied in the selection of sample locations and in the definition of corrective action boundaries. State how these data were used to select sample locations and demarcate corrective action boundaries.	See response to comment #36. Note: The reference to the use of aerial survey data in defining corrective action boundaries was deleted, as this will be discussed in the CAU 413 CADD.
38. 2.5.8, Page 43, Paragraph 1, 2		As specified in the QAP, provide the QA/QC techniques used in the "Stomp and Tromp" methodology that justify use of the data as decisional. Para. 1, sentence beginning with, "The removable contamination surveys...": in addition to the "center line" two survey lines perpendicular to the center line were also surveyed. Address these lines' purpose/significance for CA non-posting criteria. Sentence beginning with, "The results of the removable ...": While it is not required to reproduce the entirety of the removable and in- situ measurement data from NSTec, 2011, it is required that additional quantitative summary level detail be presented to support the conclusions reached in this section and further describe how each data set will be used.1st sentence, para 2: name the "instrument" (ISOCS?)	This section summarizes information from a previously published report. The perpendicular lines are not specifically addressed in the referenced report. The removable contamination survey data were incorrectly classified as decisional data in the CAIP. This data will be used as informational data. The text beginning with "Although these data..." through the end of the paragraph was deleted and replaced with the following, "The removable contamination data collected in the posting compliance investigation are informational data. These data were used to assess the removable contamination conditions outside the CA fence at the site." The first sentence of the second paragraph of Section 2.5.8 was revised to read, "The *in situ* data were collected using an *In Situ* Object Counting System that measures radioactivity..."
39. 2.5.8, Page 44, Figure 2-12		Legend: replace "Survey Location" with "2010Removable Contamination Survey Location"	Legend was changed to read, "2010 Survey Location."

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40.	2.5.9, Page 45, Paragraph 2		Preliminary investigation data was collected in 2012. State how the preliminary investigation data were qualified as decision-supporting.	The removable contamination data from the preliminary investigation were incorrectly categorized as decision-supporting data. To correct this, the second paragraph of Section 2.5.9 was deleted and the data use was defined in the subsections for each dataset, as indicated below. The following was added to the end of Section 2.5.9.1, "The radiological survey data collected in the preliminary investigation meet the definition of decision-supporting data, as defined in the Soils Activity QAP (NNSA/NSO, 2012b). The FIDLER data were used to guide the selection of sample locations for the CAU 413 CAI, specifically to locate areas of elevated radioactivity and/or radioactive debris." The following was added to the end of Section 2.5.9.2, "The removable contamination survey data are categorized as informational data. These data were used to assess the removable contamination conditions at select locations inside and outside the CA fence."
41.	2.5.9.1, Page 45, Paragraph 4		FIDLER Survey provides no data qualification status or how it was used in the DQO process. State how data were qualified and used during the DQO process.	See response to comment #40.
42.	2.5.9.2, Page 45, Paragraph 1		Suggest add the RC survey locations to a new or existing figure. Removable Contamination Survey provides a discussion on results yet does not state how the data were qualified or used in the DQO process. State the qualification of the data and how it was used during the DQO process.	See response to comment #40.
43.	2.5..9.3, Page 47, Paragraph 2		Is it appropriate to add contaminated concrete debris in Sec. 2.4.6 to this bullet list?	This section summarizes information from a previously published report. Concrete debris was not identified in the visual surveys completed at CSII during the preliminary investigation. No revisions were made to the document.

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44.	2.5.10, Page 48, Paragraph 1, 2		A review of "*DOE/NV/0000939-19, Radiological and Environmental monitoring at the Clean Slate I and III sites, with Emphasis on the Implications for Off-site Transport*", (Mizell et al.,2014) shows that for the entire sampling campaign samples were only analyzed by gross alpha and not by alpha spectroscopy. On page 103 of this report, it is recommended that a selection of air particulate samples be submitted for alpha spectroscopy and that the saltation samplers be used to assess transport of coarse-sized particles. This is in alignment with the particle characterization study that was performed at the site during the event. Correct the text in this section to align with the conclusions and recommendations of the cited publication. What role if any will these met data play?	The fifth and sixth sentences of the first paragraph of Section 2.5.10 were revised to read, "With the exception…the gamma spectroscopy analyses of airborne particulates detected only naturally occurring radionuclides. The report concludes there is no indication that wind is transporting gamma-emitting radionuclides from the CS sites." The second paragraph of Section 2.5.10 was revised to read, "These air monitoring data are considered informational data and were used to support the CSM premise that wind transport is not a significant migration pathway. These data were not used in the development of the CAI sampling design."
45.	3.1.1, Page 49, Paragraph 1		Name the stakeholders and whether Sandia National Laboratories was or was not considered a stakeholder.	Sandia is not considered a stakeholder with regard to site closure. The first sentence in Section 3.1.1 was revised to read, "In consultation with USAF and NDEP, a CW...".

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46.	3.1.1, Page 50, Paragraph 1, 2		State if dermal exposure from soil and debris to face, hands, and forearms was included in the TED estimate for the maximally exposed worker. Provide the basis for the "1 microgram deposition of radioactive material in the wound" assumption and why this is conservative. If 1 microgram deposition is an assumption, provided for comparison to the 25mrem/yr action level for Construction Worker and Ground Troop Internal Dose RRMG, then provide the basis as to why 1 microgram is appropriate as a conservative deposition amount. The wound dose calculation is an estimate that is not based on particle characteristics of the CSII experiment. Consider providing wound dose calculation as a range of values based on particle characteristics of the CSII experiment rather than a homogenous soil mixture.	The following sentence in the first paragraph of Section 3.1.1 was revised to read, "The worker receives an internal dose through…and an external dose by external irradiation." The following sentence was added to the Assumptions section, third paragraph of Appendix G, "The mass of 1 microgram was chosen to facilitate scaling of the results when a different source mass is used." The second paragraph of Section 3.1.1 following the first sentence was deleted and added to Appendix G. The first sentence was revised to read, "At the request…was evaluated and is presented in Appendix G."
47.	3.1.3, Page 51, Paragraph 2, 3		2nd sentence: provide the figure reference. Include a discussion on particle size isotopic ratio fractionation as a possible explanation for non-contiguous contamination. See "*POR-2506 Operation Roller Coaster Project Officers Report - Project 2.6a Special Particulate Characteristics*".	A schematic drawing of the orientation of the bunker is found in the cited Myers 1963 reference. This drawing is not reproduced in the CAIP. The CAU 413 CADD will present a figure of the results of the debris investigation. No revisions were made to the document. No revisions were made to the document per the DOE/NDEP comment resolution meeting held on April 6, 2016.

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48.	3.1.3, Page 52, Paragraph 1		Sentence beginning with, "The CSM assumes ...": this piece of the CSM may rely too much on vague historical operational assumptions ("premise", "assumption", "would have been"), especially for subsurface/burial conditions near GZ. We suggest at least some subsurface (i.e.,"" 5+ feet) investigation should be considered to validate.	The CSM assumption in the subject sentence is only applicable to SG2, Disturbed Areas. There is no similar assumption for the buried debris in SG5, Buried Debris. To clarify, a new paragraph was started with the subject sentence and the sentence was revised to read, "Based on soil profile data from previous investigations, including data presented in Table 2-2, the CSM assumes that subsurface…".The following sentence was added at the end of this new paragraph, "Investigation of the SG2 release mechanism is discussed in Section A.8.2.1."
49.	3.1.4, Page 52, Paragraph 2		3rd sentence: Revise as follows (or similar): "Throughout the monitoring period, the only non-naturally occurring radionuclides detected were cesium-134 and -137. These were identified in two samples from each monitoring station in the weeks following the destruction of the nuclear power reactor in Fukushima, Japan on March 11, 2011. Gross alpha values from CSI and CSII monitoring stations were higher than those from other stations off the TTR. However, because Am-241 was not detected by gamma spectroscopy at the on-site stations, this suggests plutonium is likely not the source of the higher gross alpha contamination. These data suggest there is no off-site airborne migration of radionuclide-contaminated soil particles from the CSI or CSIII sites (Mizell et al., 2014). While comparable data are not directly available from the CSII site, conclusions reached for CSI and CSII may be relevant for CSII because of similar site conditions. " Mizell et al., 2014 states "Gamma spectroscopy typically identified only naturally occurring radionuclides." Gamma spectroscopy is not sensitive enough to detect Pu or U isotopes in airborne soil particulate samples at low levels.	See response to comment #44. The third sentence of the second paragraph of Section 3.1.4 was revised to read, "With the exception of cesium (Cs)-134 and -137 attributed to the 2011 Fukushima event, the gamma spectroscopy analyses only detected naturally occurring radionuclides in airborne soil particulate samples throughout the monitoring period (Mizell et al., 2014)."

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50.	3.1.4, Page 53, Paragraph 2, 3		Add approx. depth to groundwater in this discussion. In the absence of an UGTA program, describe whether analytical results have been obtained to confirm that contaminants have not migrated to groundwater.	The following was added at the end of the fourth paragraph of Section 3.1.4, "The average depth to groundwater at the CSII site is 390 ft bgs (N-I, 2013b)." See response to comment #5.
51.	3.2, Page 55, Paragraph 1, 2		CSII contained 19 devices, 1actual and 18 simulated. The simulated material was 99 weight percent U-238 (DU). Explain how U isotopes are not anticipated to contribute to the total dose at CAU 413. 2nd sentence: repeats content from sentence in para. 1, p 54.	The calculation of uranium and plutonium contributions to dose is based on the uranium to plutonium ratios and relative abundances of the uranium and plutonium isotopes published in Menker, 1966. Even though uranium accounts for 99% of the combined mass, uranium will provide less than 0.02 percent of the dose. The second and third sentences of the paragraph immediately following the bullets in Section 3.2 were deleted. The third and fourth sentences of the first paragraph of Section 3.2 were deleted.
52.	3.3, Page 55, Paragraph 1		1st sentence: Spell out RBCA here.	RBCA was defined on Page 1, and the acronym has been used extensively throughout the document. No revisions were made to the document.
53.	4.1, Page 62, Paragraph 1		This assumes a uniform contaminant distribution. Section 2.5.5 states "Due to the high variability in soil samples collected at the OT and CSI sites, the characterization approach at CSII relied heavily on in situ radiation surveys." Provide detail on how probabilistic sampling locations will be determined in areas of non-uniform contaminant distribution.	This specifically assumes a non-uniform contaminant distribution. The Soils RBCA document addresses the issue of high variability in soil at Soils sites and defines the use of sample plots (probabilistic approach) to mitigate this variability. No revisions were made to the document.
54.	4.1, Page 62, Paragraph 2		Include the DQI's for TED (TLDs) and radiological surveys. These are decisional data sets and need data quality indicators.	The data limitations and an explanation of data quality for TLD decisional data will be presented in the CAU 413 CADD. In addition, the next version of the Soils RBCA document will contain further discussion of TLD data quality. The radiation survey data meet the definition of decision-supporting data in the Soils QAP and do not require the evaluation of DQIs. See also response to comment #36 (aerial surveys) and #40 (FIDLER surveys).

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55.	4.1, Page 62, Page 2		The correlation is performed using a linear fitting of radiation survey data (unit of multiples of background) versus TED (unit of mrem/yr). TED is a summation of the internal dose contribution and the external dose contribution. The radiological survey instruments can only detect gamma emitting radionuclides (source of external dose). It appears that the linear fit is comparing surface gamma emissions detected by survey instruments against TLD measurements which only measure surface gamma emissions. Clarify why internal dose is not being discounted or underestimated. Insert a discussion on the data limitations and explanation of data quality for the decision-supporting radiological survey data used in the correlation (i.e., rad survey plan).	Internal dose is not being discounted or underestimated as the surveys are not being correlated to TLD measurements but, rather, to TED. Therefore, the survey values are being used as a surrogate for TED. This correlation is heavily biased towards the highest TEDs and assumes a constant internal/external dose ratio. However, as this ratio decreases with decreasing TED, TED could be overestimated at lower contamination levels and possibly result in a slightly conservative definition of the corrective action boundary. No revisions were made to the document. See response to comments #36 and #40.
56.	4.2.2, Page 63, Paragraph 1		Include a discussion on applicable DQIs and process control for radiation survey design and collection to ensure DQO criteria are being met.	The radiation survey data are classified as decision-supporting data and do not require the evaluation of DQIs. No revisions were made to the document. See also response to comments #36 and #40.
57.	4.2.4.2, Page 65, Paragraph 2		This is computed by taking the TLD dose and dividing by the RESRAD calculated external dose. The RESRAD calculation is based on corresponding surface soil sample data. Please define and justify the RESRAD parameters used for the RESRAD-calculated external dose from surface samples and provide a DQI correlation coefficient for acceptable data use similar to the radiation survey versus TED correlation.	The RESRAD input parameters are discussed in Appendix C of the CAIP; these parameters were used to calculate all RRMGs (total and internal dose). No correlations are used in the calculation of external dose, therefore a correlation coefficient does not apply. No revisions were made to the document.
58.	4.2.4.3, Page 66, Paragraph 1		State the DQIs for the FIDLER survey to ensure DQOs are being met.	The FIDLER survey data are classified as decision-supporting data and do not require the evaluation of DQIs. See also response to comment #40.

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59.	4.2.4.3, Page 66, Paragraph 1		State the reasoning for placement of one TLD is sufficient to characterize the external dose field at these locations.	A single TLD is considered three data points (samples) because it contains three separate elements that measure dose independently. The variability of the readings is evaluated to determine if three data points are sufficient. The results of this evaluation will be presented in the CAU 413 CADD. No revisions were made to the document.
60.	4.2.4.3, Page 66, Paragraph 2		Internal dose is calculated by dividing a sample result in (pCi/g) by the RRMG in (mrem/yr)/(pCi/g). The RRMG is calculated using RESRAD. RESRAD is limited to only one layer of contamination and is further constrained by the 5 cm thickness of contaminated zone. Provide a justification on the subsurface internal dose calculation and subsequent TLD-equivalent external dose calculation using RESRAD values that may not model the full vertical soil contamination layer profile and thickness of contaminated zone.	The following was added at the end of the last paragraph of Section A.2.2.6, "Based on historical soil profile data collected in the 1970s (Essington et al., 1976; Gilbert et al., 1975) and 1990s (NNSA/NSO, 2004), it is estimated that 90 percent of the Pu activity is present in the top 5 cm of soil at CAU 413."
61.	6.0, Page 74, Paragraph 1		A review of the QAP and RBCA did not identify rigorous data quality requirements for TLDs or radiological surveys. TLDs are provided and processed by the M&O contractor with the only provision that the M&O contractor maintain a DOECAP accreditation and follow their internal procedures. There is no reference to a validation/verification process similar to the one applied to analytical data. There are no stated minimum physical parameters for the TLDs (e.g., energy response, ruggedness, shielding upon collection to prevent erroneous data prior to annealing...) similar for rad surveys. State the data quality requirements for TLDs and radiological surveys.	See response to comment #54.

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62.	A.2.2.5, Page A-13, Paragraph 2		Include data or further discussion and conclusions from "*Water and Solute Travel Time Analysis for Soils Corrective Action Units 375, 411, 412, 413, 414, and 415*" (Navarro-Intera, 2014) that demonstrate that radionuclides are highly adsorbed on the alluvial materials and generally do not move with the groundwater.	See response to comment #5.
63.	A.2.2.5, Page A-13, Paragraph 2		State if and how this literature determined Kd values were applied to the CW RESRAD run for CSII.	The following was added to the end of the first paragraph of Section A.2.2.5, "However, the more conservative default K_d values for Pu and Am were used in the RESRAD modeling to establish the CAU 413 RRMGs."
64.	A.2.2.6, Page A-14, Paragraph 1		See previous comments on Mizell reference.	The second paragraph of Section A.2.2.6 (i.e., the Mizell reference and associated text) was deleted and replaced in accordance with the response to comment #6.
65.	A.2.2.7, Page A-15, Paragraph 1		The exposure frequency for the Construction Worker was determined to be 120 days/yr. This assumes 5 days per week for 24 weeks. The Soils Project RBCA does not address the Construction Worker Scenario. Provide a reference or logic statement to justify the 120 day/yr exposure frequency for the Construction Worker.	The Construction Worker scenario was developed in consultation with the USAF. The USAF determined the CW scenario was applicable to the CSII site in a 2014 letter referenced in Section 3.1.1 of the CAIP. This exposure duration was presented and approved during the DQO process. No revisions were made to the document.
66.	A.2.2.7, Page A-15, Paragraph 1		The RESRAD parameter for the thickness of the contaminated zone is limited to 5 cm. The CW exposure scenario in A.2.2.7 states surface and subsurface soil to 0.45 m bgs. Explain the difference in the conceptual model versus the RESRAD parameter used.	There is no discrepancy between the CSM and the RESRAD parameter values. The CW scenario only provides dose from exposure to the surface of the soil which received the atmospheric deposition of radionuclides from the test release. The thickness of the contaminated zone reflects this original deposition with minimal migration. This is different from the potential depth of exposure by the CW, which is the depth of the soil mixing layer used in RESRAD. See Sections C.2.8 and C.2.3 of the CAIP. See also response to comment #60. No revisions were made to the document.

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67.	C.1.0, Page C-1, Paragraph 1		Include an input parameter discussion on radionuclide source term and concentrations input into RESRAD for the CW model.	The value of the radionuclide source term and concentrations in soil are irrelevant for RRMG determination. The first paragraph of Section C.1.0 was revised to read, "All RESRAD input parameters for the internal dose pathway were identified and reviewed to ensure that appropriate values would be used in the development of the RRMGs. The RESRAD output files in Appendix E contain all of the input parameter values used to develop the CAU 413 RRMGs. Those input parameters specific to the CW exposure scenario are presented in Table C.1-1 with the RESRAD default values."
68.	Table C.1-1, Page C-1,Line 18		The mass loading is defined as 600 micrograms per cubic meter for inhalation, yet the quantity of potential deposition in a wound is 1 microgram. These values of 600 micrograms in a cubic meter of air vs. 1 microgram deposited in a wound seem inconsistent. Provide the basis for 1 microgram as an appropriate and conservative wound deposition amount.	See response to comment #46.
69.	C.2.3.2, Page C-7, Paragraph 1		"RESRAD assumes that the soil to the depth of contamination is uniformly contaminated. This assumption can lead to overestimation of dose for sites where contaminant contributions decrease with depth. A value of 5 cm (0.05 m) for the thickness of the contaminated zone was used for CAU 413." This methodology may underestimate the exposure potential. The vertical contamination profile should be established after sampling. Several RESRAD models should then be run. Each model is a specific slice (piece wise) representation of the whole. The doses and dose to source ratios can then be summed. Please consider using multiple RESRAD models to piece wise approximate each layer of contaminated soil if the characterization indicates that contamination is present at depths greater than 5 cm.	Modeling a surface soil veneer of less than 5 cm with RESRAD can be unrealistic with more than minimal surface soil deposition and erosion, biota surface disturbances, and human traffic. The 5-cm depth is an agreed-upon surface depth from previous discussions in the development of the Soils RBCA and DQO meetings. While there is a potential that the soil surface could have higher (or lower) activities than the average activity, this potential error is small in comparison to the potential overestimation of dose due to the many conservative assumptions used in calculating dose. No revisions were made to the document. For a discussion on using less conservative estimates of dose at greater depths, see response to comment #60.

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70.	C.2.5.2, Page C-9, Table C.2-2		Provide a reference or logic basis for the Average Time Spent per Day at This Activity Level.	The RESRAD input parameters for the CW scenario were developed with the USAF. No revisions were made to the document.
71.	C.2.7.2, Page C-11, Paragraph 1		Include the Exposure Frequency of 120 days in the paragraph.	The following was added to the end of the first sentence of Section C.2.7.2, "at the site, for a total of 120 days per year."
72.	C.2.8.2, Page C-12, Paragraph 1		Increasing the depth of the mixing layer will underestimate the dose since RESRAD assumes that layer contains clean soil. A better approximation would be to run several model runs as a piece wise representation of the vertical soil profile and sum the doses.	Although this will allow for dilution of contaminated soil with uncontaminated soil in the model, the RRMGs were based on a time zero dose (the time of maximum dose) when there was no mixing. No revisions were made to the document.
73.	Table D.1-1, Page D-1, Paragraph 1		State why RRMGs for isotopes not associated with CSII source term are included in the TED and Internal Dose RRMG tables.	The list of potential radionuclides is justified in Appendix B of the Soils RBCA document. This list is intended to include any radionuclide that may be encountered at any Soils site. RRMGs are developed for the entire list in case any of these radionuclides are detected during the CAI. No revisions were made to the document.
74.	Table D.1-2, Page D-2, Paragraph 1		Two RESRAD models were run to get the TED and Internal RRMGs. The first model reflects the parameters in the preceding text. The second model suppresses external dose. Include a statement explaining why two RESRAD models were run to get TED and Internal Dose RRMGs.	Only one model was used with two separate runs to calculate the RRMGs. The same input parameters were used in each run. The only difference is that the internal dose RRMG run has the external pathway turned off. No revisions were made to the document.
75.	Appendix E		Separate the two RESRAD model outputs using a divider page and designate them E-1 and E-2. Include with these outputs on the cover/divider pages explanatory text about the purpose and nature of the model runs.	Divider pages were added as follows: "Attachment E-1, Total Dose for CW Exposure Scenario" and "Attachment E-2, Internal Dose for CW Exposure Scenario".

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76. Appendix G, Page 1, Paragraph 1		Please include a wound exposure calculation from a hot particle(s).	Appendix G is specifically related to determining the internal effective dose from a fixed amount of activity that can be scaled if needed. It does not matter if the source of the activity is a hot particle or soil. No revisions were made to the document.

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