



June 1, 2012

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U.S. Nuclear Regulatory Commission
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**RE: Ford Nuclear Reactor – Technical Specification Amendment Request
Decommissioning Plan – Revised Section 4.0 (Final Status Survey)
Docket 50-2 / License R-28**

Licensing Branch:

The University of Michigan (U-M) is requesting an amendment to the Ford Nuclear Reactor (FNR) Decommissioning Plan that was submitted to the Commission in a correspondence dated January 10, 2006. Section 4.0 ('Final Status Survey') of the Decommissioning Plan has been revised in accordance with recent discussions with the Nuclear Regulatory Commission (NRC) – Decommissioning Branch staff.

A copy of the most recently revised Final Status Survey (FSS) Plan is enclosed with this correspondence and the specific changes to the FSS Plan are noted below.

Changes Made to the Final Status Survey Plan (Complete Section 4.0 Enclosed)

1.0 Section 4.3 ('Rad Contaminants & Criteria') / Page 4 / 1st Paragraph / 3rd Sentence

- **Read:** 'Potential contaminants in both soil and structural surfaces are ...'
- **Revised:** 'Potential contaminants in both *surface* soil and structural surfaces ...'

2.0 Section 4.3 ('Rad Contaminants & Criteria') / Page 10 / Last Paragraph / 4th Sentence

- **Read:** 'Ag-110m, which was present on surfaces was not detected at ...'
- **Revised:** 'Concentrations of Eu-152 were well below its surface soil Default Screening Value of 8.67 pCi/g; however, C-14 was present in one sample located near the foundation drain at a concentration near the Default Screening Value of 11.6 pCi/g. All other subsurface soil samples exhibited C-

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14 concentrations below 5 pCi/g. In anticipation of possible C-14 residual contamination in this location, a DCGL for C-14 in subsurface soil was developed for likely scenarios, using RESRAD. Appendix E describes the DCGL development process, including the exposure scenarios evaluated and modeling parameters. The resulting DCGL for C-14 in subsurface soil is 2500 pCi/g. Default Screening Values will be used as criteria for other radionuclides in subsurface soils.'

3.0 Section 4.5.7 ('Survey Instrumentation') / Page 22 / 1st Paragraph

- Read: 'Table 4-3 is a list of radiological survey instrumentation that will be used to implement the FNR FSS.'
- Revised: 'The radiological survey instrumentation listed in Table 4-3 or similar instrumentation capable of meeting the Data Quality Objectives will be used to implement the FNR FSS.'

4.0 Section 4.5.7 ('Survey Instrumentation') / Page 22 / 2nd Paragraph

- Read: 'These instruments are maintained and calibrated in accordance with UM procedures HP-211 and HP-402.'
- Revised: 'These instruments will be maintained and calibrated in accordance with UM procedures HP-211 and HP-402 or equivalent procedures that meet the established Data Quality Objectives.'

5.0 Section 4.5.7 ('Survey Instrumentation') / Page 23 / Table 4-3 / Column 6 / 'Scanning' / 44-10 NaI Detector

- Read: 'Scanning Sensitivity for the 44-10 NaI detector is 2.62 pCi/g Co-60; DCGL = 3.8 pCi/g.'
- Revised: 'Scanning Sensitivity for the 44-10 NaI detector is 1.85 pCi/g Co-60¹; DCGL = 3.8 pCi/g' [The (1) footnote reads: '1.85 pCi/g Co-60 assumes a scan speed of 0.25 m/sec instead of the typical 0.5 m/sec scan speed for large outside open areas.']

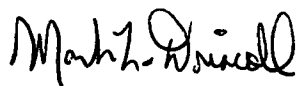
6.0 Appendix E ('DCGL for C-14 in Subsurface Soil') / Page 40

- Read: 'DCGL for Subsurface Soil at the Former FNR Site' ... potential contaminants: Ag-108m, C-14, Co-60, Cs-137, and Eu-152'
- Revised: 'DCGL for C-14 in Subsurface Soil at the Former FNR Site ... only contaminant indicated in Section E is now C-14 ... Default Screening Values will be used as criteria for other radionuclides in subsurface soils.'

7.0 RESRAD Computer Runs for C-14 Subsurface Soil DCGL (Version 6.5) -
Enclosed

Thank you for your time, effort, and consideration with respect to this FNR license (R-28) amendment. Please do not hesitate to contact me at OSEH / Radiation Safety Service [(734) 647-2251] should you have any questions or comments regarding the revised Final Status Survey Plan. We look forward to your approval so we can initiate the final status survey of the FNR facility.

Sincerely,



Mark L. Driscoll
Director / Radiation Safety Officer
Radiation Safety Service / OSEH

MLD/TGA/mld
NRCFNR-28AmendmentD&DFSSPlanSec4060112.doc

cc: Terry Alexander, Executive Director, OCS
Mark Banaszak Holl, Associate Vice President, OVPR
Robert Blackburn, Manager, Laboratory Operations, MMPP
Theodore Smith, FNR Project Manager, NRC Headquarters (Mailstop T-8F5)
Jeremy Tapp, Health Physicist, NRC Region III
FNR Decommissioning File

4.0 Final Status Survey Plan

4.1 Introduction

The Ford Nuclear Reactor (FNR) at the University of Michigan (UM) was a light-water cooled and moderated open-pool design reactor. The reactor was licensed (License R-28, Docket 50-2) by the US Nuclear Regulatory Commission (NRC) to operate at a power level of 2 Megawatt (MW) thermal. The reactor began operation in 1957 and provided neutron and gamma irradiation services, neutron beam port experimental facilities, and training facilities for use by faculty, students, and researchers from the UM, other universities, and industrial organizations. In July 2003, the reactor was shut down. Fuel was removed from the facility in December 2003, followed closely by initiation of decommissioning activities. These decommissioning activities are described in *University of Michigan Decommissioning Plan for the Ford Nuclear Reactor*, Revision 1, January 5, 2006 (Decommissioning Plan). The objective of the decommissioning is to remove radiological materials and equipment associated with the FNR-licensed operations, such that radiological conditions satisfy NRC criteria for future unrestricted use of the facility and thus permit termination of the NRC license. A Final Status Survey (FSS) will be performed to demonstrate that these NRC criteria have been satisfied. This document describes the FSS Plan.

This Plan replaces the “Proposed Final Status Survey Plan” (Chapter 4.0) of the January 2006 Decommissioning Plan. It was prepared in accordance with the guidelines and recommendations presented in NUREG-1757, *Consolidated NMSS Decommissioning Guidance*, and NUREG-1575, *Multi-Agency Radiation Survey and Site Investigation Manual* (MARSSIM). The process emphasizes the use of Data Quality Objectives (DQOs) and Data Quality Assessment (DQA), along with a quality assurance/quality control program. The graded approach concept will be followed to assure that survey efforts are maximized in those areas having the greatest potential for residual contamination or the highest potential for adverse impacts of residual contamination.

This Plan incorporates project-specific information, relative to post-remediation facility conditions and potential radiological contaminants, guidelines for residual building surface and soil contamination levels, sampling and measurement methods, survey unit identification and classification, and data evaluation techniques. A Quality Assurance Project Plan, (QAPjP), applicable to the FSS activities, has also been prepared.

4.2 Facility Description

The Ford Nuclear Reactor is located at 2301 Bonisteel Boulevard on the North Campus of the University of Michigan, approximately 1.3 miles northeast of the central business district of Ann Arbor, Michigan. The FNR building is a windowless, reinforced concrete structure with brick veneer. Internal walls are of concrete block. The footprint of the building is approximately 70 feet (21.3 m) long and 68 feet (20.7 m) wide; the building height is approximately 69 feet (21.0 m) of which about 14 feet (4.3 m) and 23 feet (7.0 m) are below grade on the east and west sides, respectively. During operation, the facility consisted of four levels – reactor access and control (3rd floor), maintenance and other support facilities and systems (2nd floor), beamport experimental area (1st floor), and liquid cooling and waste systems (basement). There was a cooling tower above the reactor pool level. FNR is contiguous with the Michigan Memorial Phoenix Project (MMPP). Some systems, including exhaust ventilation ducts from the beamport floor and neutron activation laboratory, piping to liquid waste retention tanks, access ports to the MMPP hot cells, and neutron activation pneumatic transfer systems were shared by the two buildings. The portions of piping, leading to liquid waste retention tanks in MMPP will be retained and used under the UM broad scope NRC license.

The FNR utilized low-enriched uranium Material Test Reactor heterogeneous plate-type fuel. The reactor core was suspended about 20 feet below the surface of the 10 feet x 20 feet x 27 feet deep pool, containing approximately 5.0×10^4 gallons of deionized water. The pool was lined with ceramic tile and surrounded by a biological shield of barytes concrete. Spent fuel, reactor handling tools, and miscellaneous experimental equipment were stored in the pool. Pool water was purified by a deionizer system. The primary cooling system was a closed loop and included a heat exchanger and associated piping. The secondary cooling system was a counter-flow heat exchanger, and heat was dissipated to the atmosphere through an evaporative cooling tower on the building roof. The deionizer and heat exchanger systems were located on the basement level. Treated water and water from seepage and leaks was collected and pumped to retention tanks in the adjacent Michigan Memorial Phoenix Project.

General reactor building exhaust was through the FNR facility stack. Localized exhausts for the experimental areas, source storage ports, and laboratory hoods were filtered through HEPA units and discharged through the MMPP ventilation systems. The FNR was serviced by sanitary and storm liquid waste systems, but potentially contaminated liquids were not discharged through these systems. There is a French drain system external to the foundation of the FNR building.

Fifty storage ports extended through the west wall of the first floor of the facility, into the soil external to the building. These ports were used to store irradiated

components and one of the ports housed two PuBe neutron sources, which are licensed on SNM-179. The sources have been relocated to a storage facility in the MMPP facility, where control and oversight are conducted under the University's Radiation Safety Service/OSEH.

Chapter 2 of the Decommissioning Plan describes the Ford Nuclear Reactor (FNR) facility, its operational history, and the radiological status, prior to remediation and decontamination actions. In addition to the removal and disposition of reactor core assembly and miscellaneous reactor operating materials and tools, remedial actions included extensive removal, disposition and/or decontamination of the following potentially contaminated equipment, components, building areas, and materials:

- Biosafety shield,
- Hold-up tank & pipes,
- Primary pumps & pipes,
- Secondary heat exchanger & pumps,
- Hot & cold DI system,
- Floor drains and drain piping,
- Hot & cold sumps (including overflow pit),
- Transfer chute,
- Thermal column door and trench,
- Underground storage ports (west side of building) and surrounding soil,
- Beam port floor janitor closet tub / drain & water lines,
- Supply & exhaust ventilation system,
- Heating system,
- Electrical (including exposed conduit and most wire),
- Men's & women's rest room (toilets / sinks / water),
- 1st and 2nd floor janitor's closet (water & drains),
- Primary water treatment room,
- Reactor bridge (removed, but saved for historical purposes),
- Control room (saved control console),
- Counting room,
- Pneumatic transfer system and tube room / lab, and
- Fuel vault.

Large sections of the concrete structure with a potential for containing volumetric contamination, due to its location relative to the reactor core, were removed and sampling was performed to demonstrate that volumetric contamination is not present in the remaining concrete. Also, sections of cracked concrete foundation and slab were removed to assure that leakage did not result in contamination of sub-floor soil. Paint and floor/wall coverings have been removed from building surfaces, considered to be potentially contaminated, and

the surfaces smoothed to facilitate surveys. Surfaces have been vacuumed and wiped down to remove loose contamination; routine radiological control surveys have demonstrated the absence of removable activity.

Municipal water supply and sanitary, and storm drain systems remain.

Figures 4-1 through 4-5 are floor plans of the FNR facility, illustrating the as-left conditions.

4.3 Radiological Contaminants and Criteria

Samples of construction materials and soil were obtained and analyzed during the remediation process and after remediation was completed to identify radiological contaminants that might remain at the time of the final status survey. The process, whereby the residual potential contaminants was determined, is described in Appendices A and D. Potential contaminants in both surface soil and structural surfaces are:

- Co-60
- Ag-108m
- Ag-110m
- Cs-137

Future uses of the former FNR facility have not yet been completely defined; however, it is likely that the facility will continue being used in some capacity for University of Michigan academic programs. For these reasons the most restrictive exposure scenarios, i.e., building occupancy and residential farmer are

FORD NUCLEAR REACTOR BASEMENT

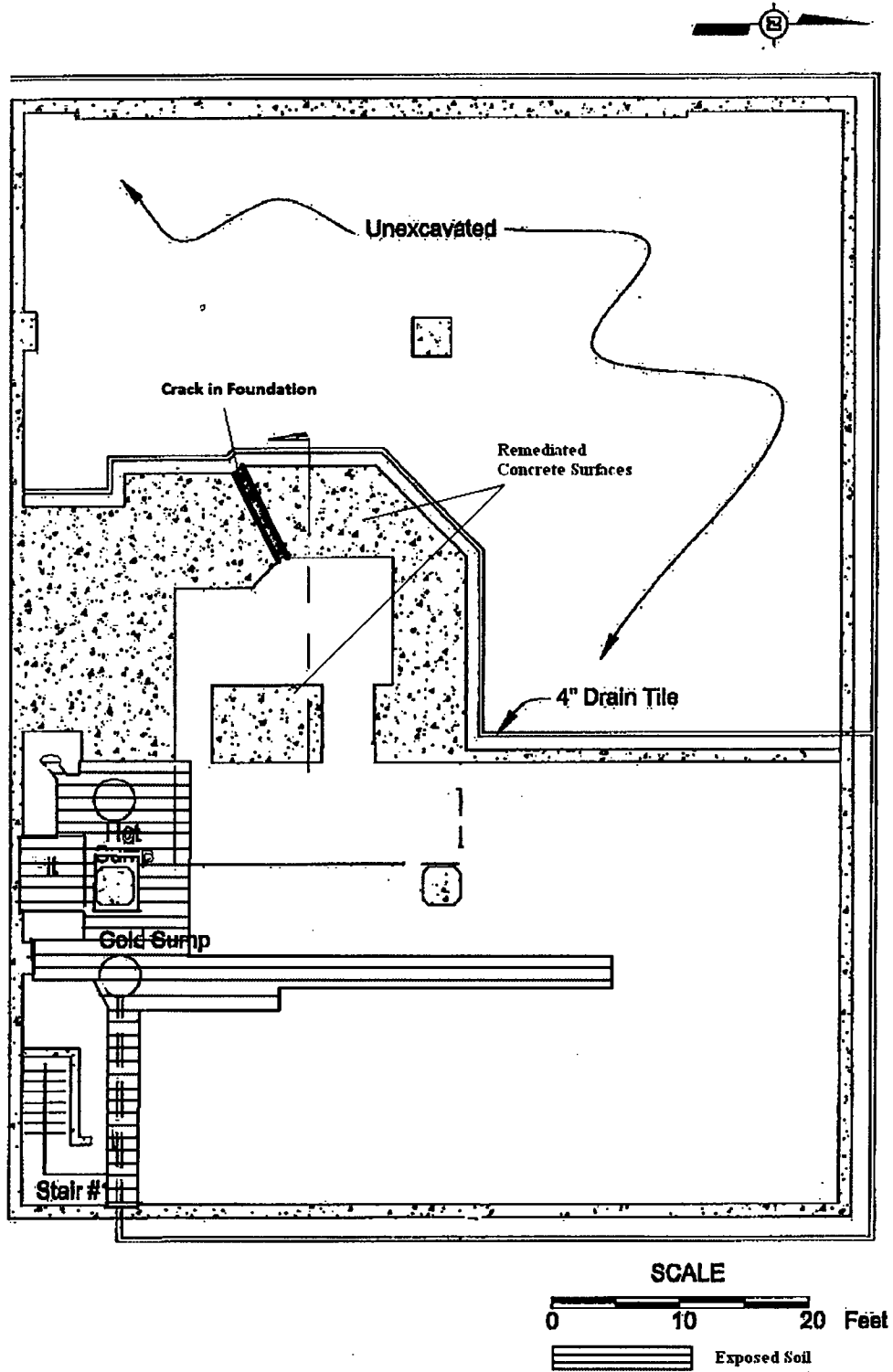


Figure 4.1 Floor Plan of the Ford Nuclear Reactor Building Basement

FORD NUCLEAR REACTOR FIRST FLOOR

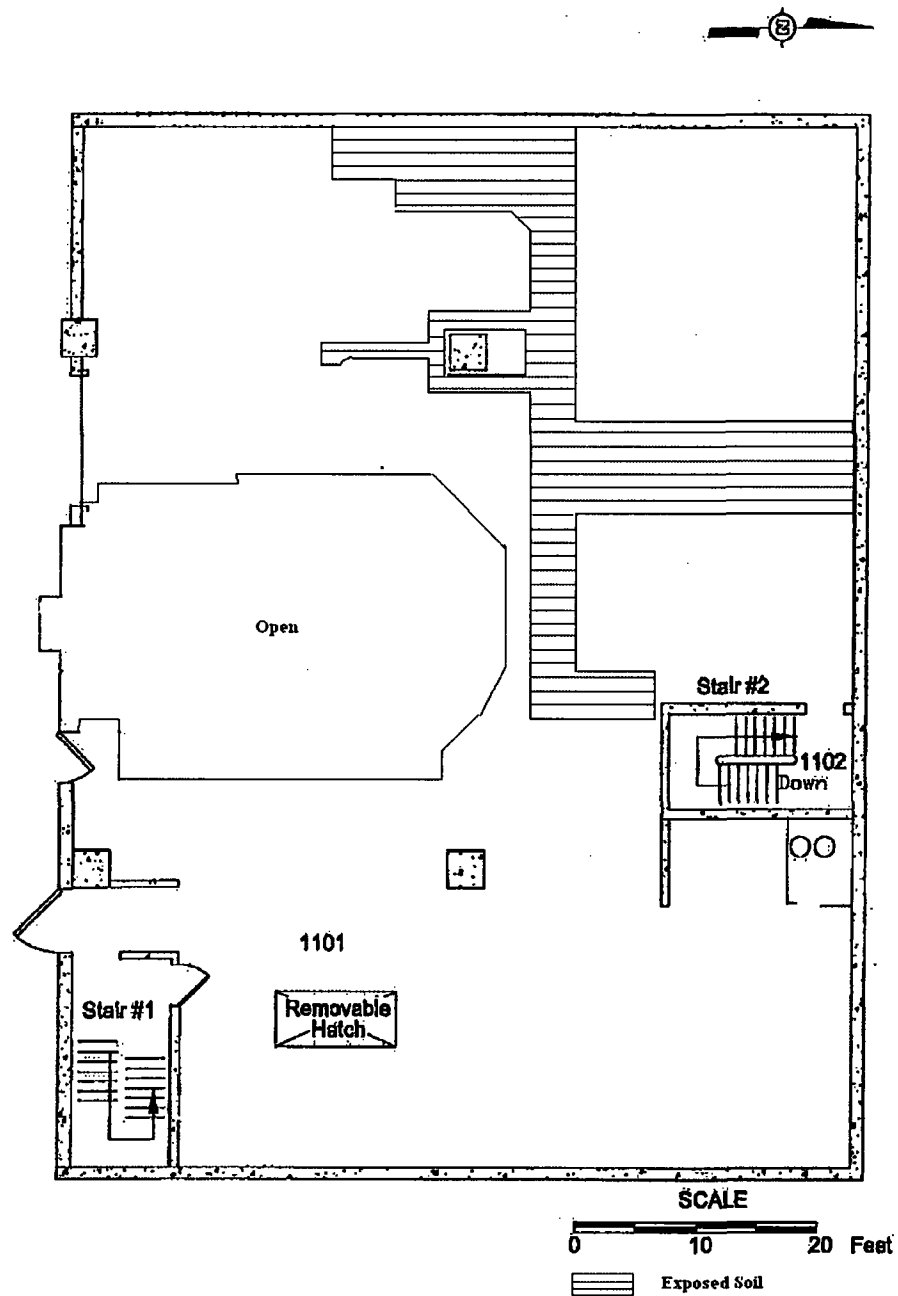


Figure 4-2 Floor Plan of the Ford Nuclear Reactor First Floor

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FORD NUCLEAR REACTOR 2ND FLOOR

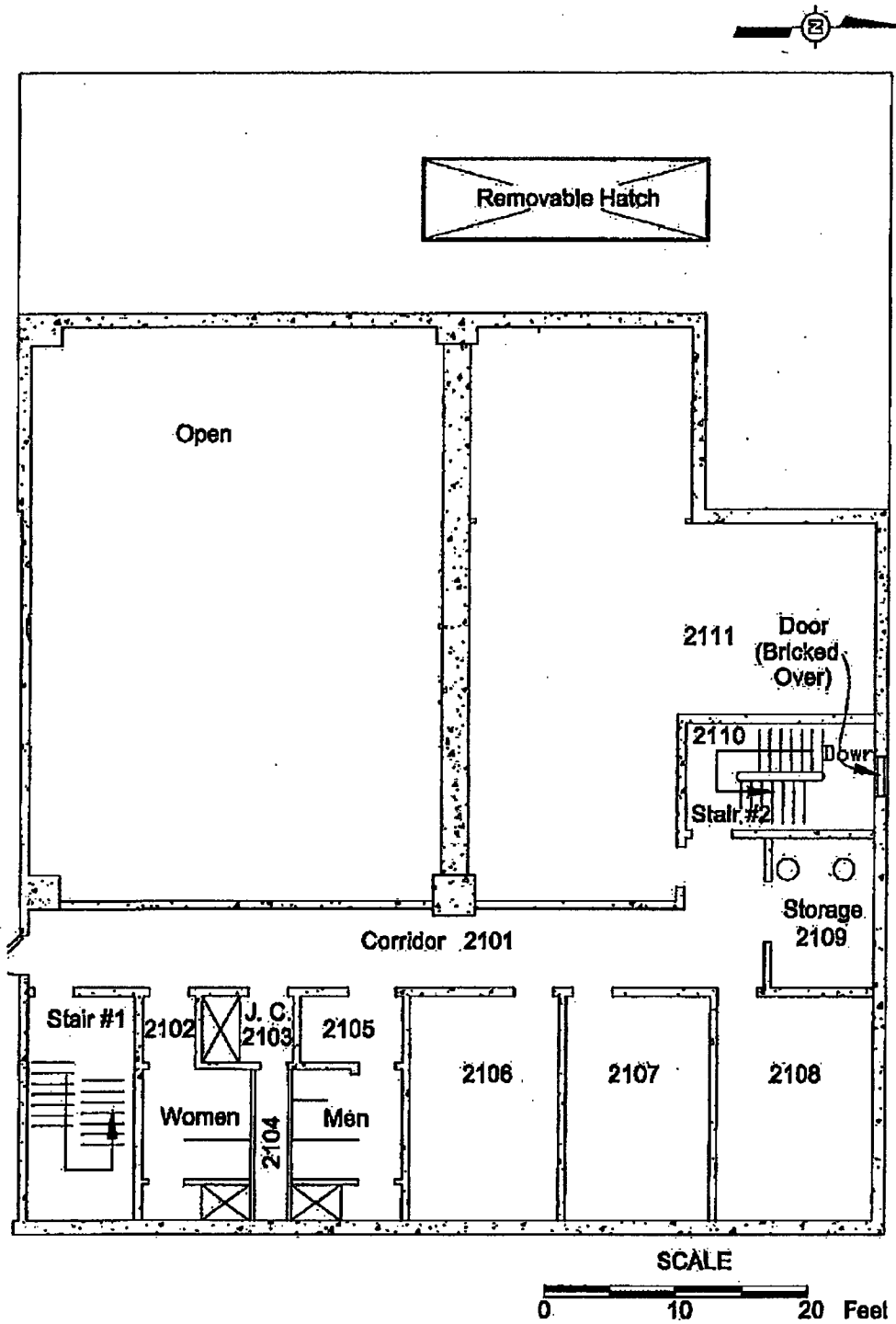


Figure 4-3 Floor Plan of the Ford Nuclear Reactor Second Floor

FORD NUCLEAR REACTOR THIRD FLOOR

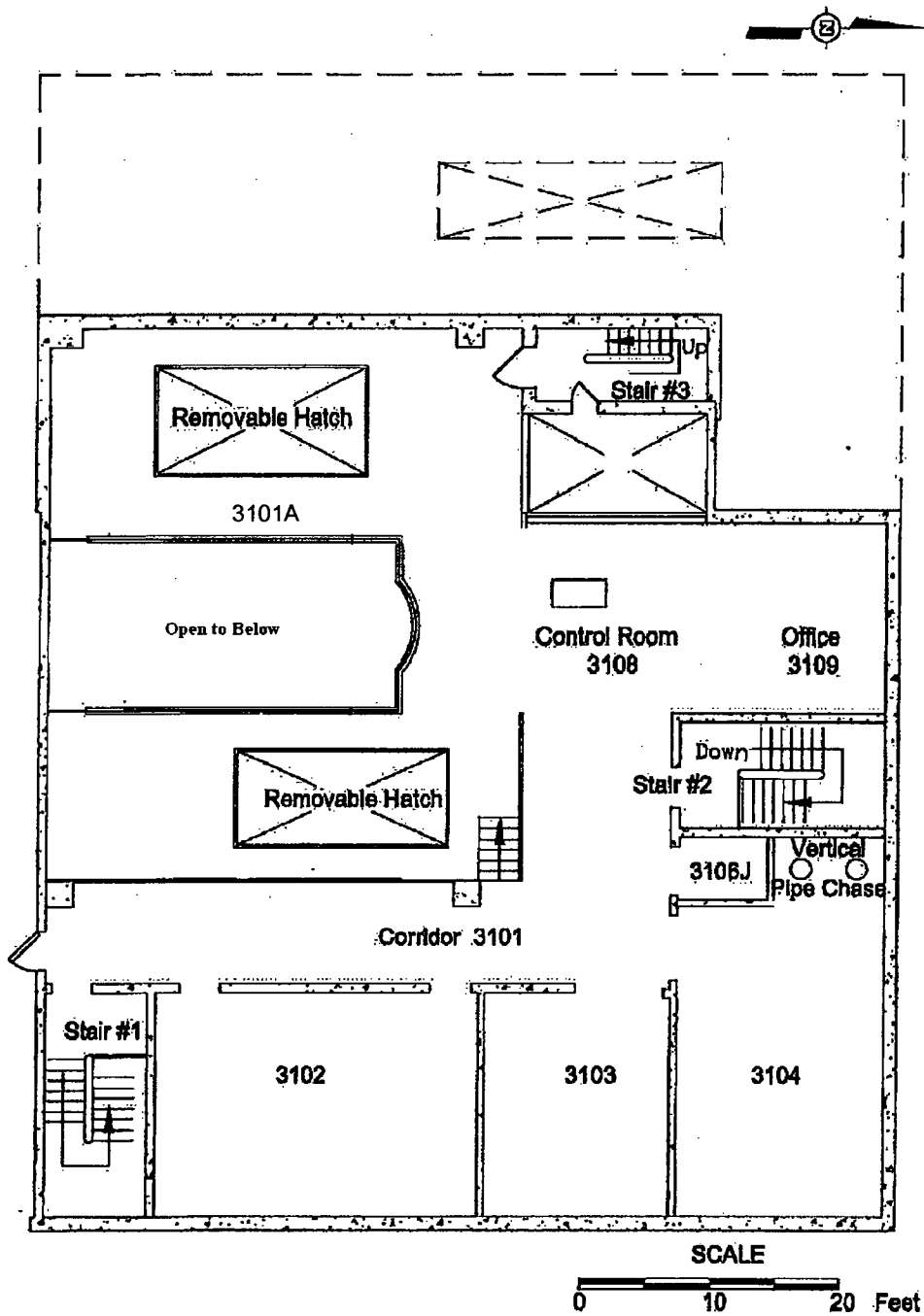


Figure 4-4 Floor Plan of the Ford Nuclear Reactor Third Floor

FORD NUCLEAR REACTOR 4TH FLOOR

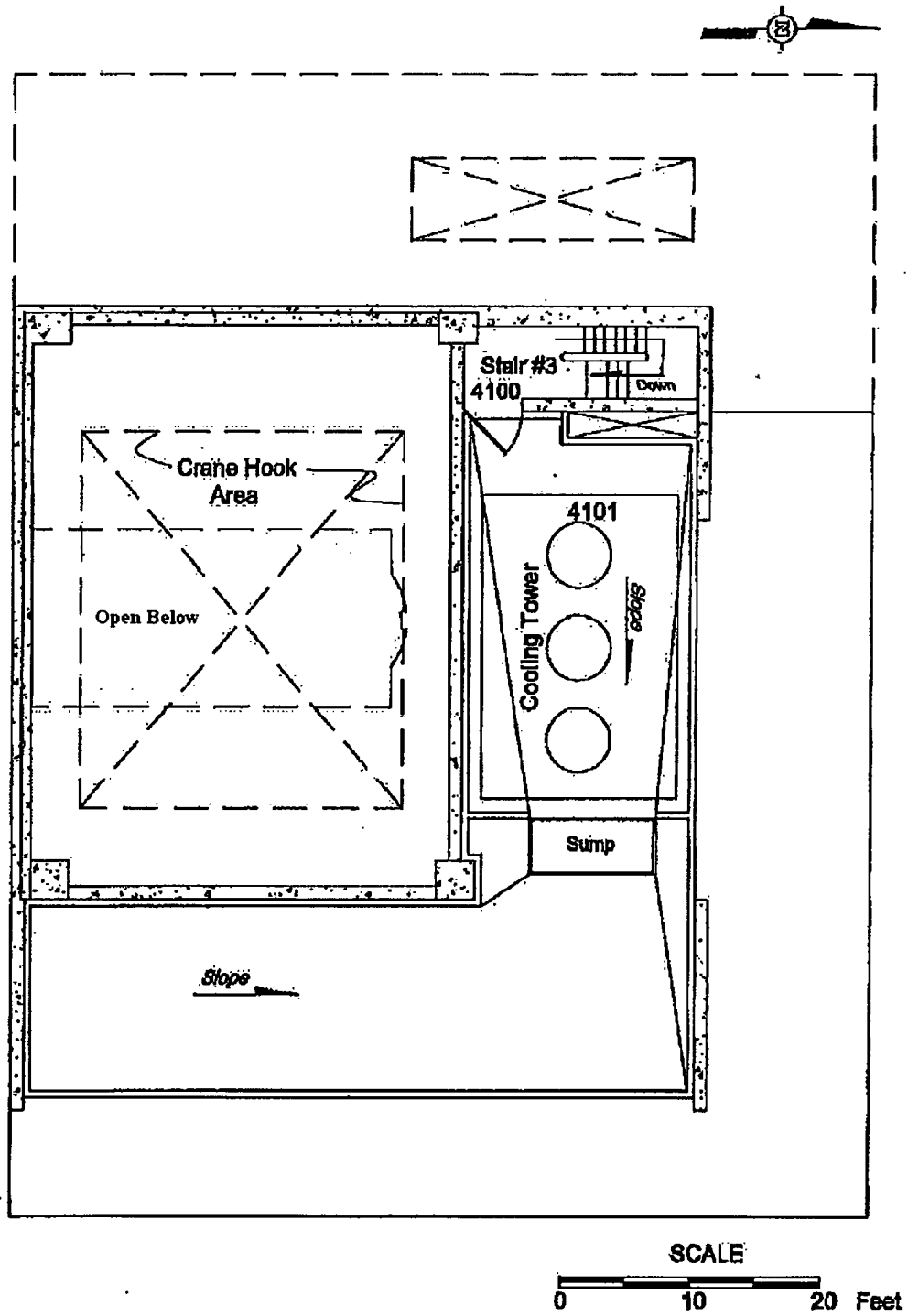


Figure 4-5 Floor Plan of the Ford Nuclear Reactor Fourth Floor

assumed for potential future exposure to residual surface contamination and soil contamination, respectively. It has been decided that use of Default Screening Values for residual levels of radiological contamination on structure surfaces and in soil will provide a conservative approach to assuring that the annual NRC dose criteria of 25 mrem from residual contamination in this facility is not exceeded. Appendix B presents the justification for use of Default Screening Values. Based on this justification, the conservative Default Screening Values (NUREG/CR-5512, Vol 3) for the potential radionuclide contaminants have been selected as acceptable final status criteria (i.e., DCGLs). An exception is Ag-108m, for which Default Screening Values are not provided. The DandD software was therefore used to develop Default Screening Values for Ag-108m, based on the relative dose factors of Ag-110m and Ag-108m, as presented in Federal Radiation Guides #11 and #12. The DCGL development process for Ag-108m is described in further detail in Appendix C. Default Screening values for surface soil are as follows:

Radionuclide	Default Screening Value for Surface Soil (pCi/g)
Co-60	3.8
Ag-108m	8.2
Ag-110m	4.92
Cs-137	11.0

During the latter stages of remediation, three locations of potentially impacted subsurface soil were identified. These locations are:

- 1) Surrounding the foundation drain piping outside the east wall of the FNR building Basement.
- 2) Beneath the 1st Floor slab at the freight door between the FNR to the MMPP buildings.
- 3) Beneath a crack in the reactor support foundation on the Basement level.

The total volume of impacted soil at these three locations is estimated to be less than 50 m³. Potential contaminants included several radionuclides, which were not identified on surfaces or in the exposed surface soil. These were C-14 and Eu-152. Concentrations of Eu-152 were well below its surface soil Default Screening Value of 8.67 pCi/g; however, C-14 was present in one sample located

near the foundation drain at a concentration near the Default Screening Value of 11.6 pCi/g. All other subsurface soil samples exhibited C-14 concentrations below 5 pCi/g. In anticipation of possible C-14 contamination in this location, a DCGL for C-14 in subsurface soil was developed for likely scenarios using RESRAD. Appendix E describes the DCGL development process, including the exposure scenarios evaluated and modeling parameters. The resulting DCGL for C-14 in subsurface soil is 2500 pCi/g. Default Screening Values will be used as criteria for other radionuclides in subsurface soils.

Satisfying surface contamination criteria will be demonstrated by measurement of gross beta activity. Appendix D describes development of a gross beta criterion for the FNR. The resulting gross-beta DCGL is 5125 dpm/100 cm².

Satisfying soil contamination criteria will be demonstrated by the sum-of-ratios approach. The sum of ratios (SOR) of gamma contaminant concentrations to their respective Default Screening Values or subsurface soil DCGL's must therefore be \leq Unity (i.e., ≤ 1.0).

Section 4.6.4 provides details on the approaches to demonstrate that criteria have been met.

4.4 Quality Assurance Program

A Final Status Survey Quality Assurance Project Plan (QAPjP), appropriate for implementing the final status survey and developing associated documentation, has been developed. That QAPjP incorporates the appropriate regulatory requirements applicable to the planning and conduct of radiological surveys necessary for the termination of the FNR license and the release of the site for unrestricted use.

4.5 Final Status Survey Approach

The objective of the FSS is to demonstrate that remedial actions have been effective in removal/reduction of radiological materials and contamination, and that as-left radiological conditions satisfy the NRC-approved criteria for termination of the FNR License and for future use of the FNR facility without radiological restrictions. The FSS will be performed in accordance with guidelines and recommendations presented in NUREG-1757 and MARSSIM. FSS activities will be performed by trained and qualified personnel, using properly calibrated equipment, sensitive to the potential contaminants, and following documented operating procedures. Appendix A of the QAPjP contains a list of the procedures, applicable to this FSS.

4.5.1 Classification by Contamination Potential

For the purposes of guiding the degree and nature of final status survey coverage, areas are first classified as *impacted*, i.e., areas that may have residual radioactivity from licensed activities, or *non-impacted*, i.e., areas that are considered unlikely to have residual radioactivity from licensed activities. Non-impacted areas do not require further evaluation. For impacted areas MARSSIM identifies three classifications of areas, according to contamination potential.

- Class 1 – Areas that have, or had prior to remediation, a potential for radioactive contamination (based on site operating history) or known contamination (based on previous radiation surveys) above the DCGL. Examples include: site areas previously subjected to remedial actions; locations where leaks or spills are known to have occurred; and former waste storage areas.
- Class 2 – Areas that have, or had prior to remediation, a potential for radioactive contamination or known contamination, but are not expected to exceed the DCGL. Examples include: locations where radioactive materials were present in unsealed form; potentially contaminated transport routes; areas handling low concentrations of radioactive materials; and areas on the perimeter of former contamination control areas.
- Class 3 – Any impacted areas that are not expected to contain any residual radioactivity, or are expected to contain levels of residual radioactivity at a small fraction of the DCGL, based on site operating history and previous radiation surveys. Examples include: buffer zones around Class 1 and Class 2 areas, and areas with a very low potential for residual contamination, but having insufficient information to justify a non-impacted classification.

Facility history (including the Historical Site Assessment and radiological monitoring conducted during characterization) and remedial activities are the bases for classification.

Following NRC approval of the Final Status Survey Plan, the UM may make changes to the classification of an area as long as the classification is changed to one of higher contamination potential. A license amendment pursuant to 10 CFR 50.90 shall be obtained if the change would decrease an area classification (i.e., impacted to non-impacted, Class 1 to Class 2, Class 2 to Class 3, or Class 1 to Class 3).

4.5.2 Identification of Survey Units

Impacted areas are divided into survey units for implementing the FSS. A survey unit is a portion of a facility with common contaminants and contamination potential and contiguous surfaces or areas. Table 4-1 lists the

survey unit areas suggested by MARSSIM for application at the FNR facility. The area of individual survey unit will follow these suggested maximum sizes. Per guidance in MARSSIM Section 4.6, special consideration will be provided for survey units with structure survey areas $\leq 10 \text{ m}^2$ and land survey areas $\leq 100 \text{ m}^2$. Because the number of data points for statistical tests (refer to Section 4.5.4 of this Plan) is unnecessarily large and not appropriate for smaller survey unit areas, a minimum of 4 measurements (or samples) will be obtained from such areas, based on judgment, and compared individually with the DCGL's.

TABLE 4-1. MARSSIM – RECOMMENDED SURVEY UNIT AREAS

Class	Recommended Survey Unit Area	
	Structures	Land
1	up to 100 m^2	up to 2000 m^2
2	100 to 1000 m^2	2000 to $10,000 \text{ m}^2$
3	no limit	no limit

m^2 – square meter

Based on a historical assessment, preliminary survey data obtained in November 2002, the characterization survey in April 2003, and radiological monitoring conducted during remedial activities, a listing of facility areas that are currently expected to be included in the final status survey, is presented in Table 4-2, along with the estimated areas, anticipated contamination potential classifications, and the projected number of survey units within each area. This list of survey units differs slightly from the initial list, provided in the Decommissioning Plan; differences are primarily due to deletion of some survey units (e.g., pool walls, pits and sumps, and ventilation equipment), which were removed during remediation. Classifications and survey unit boundaries may change, based on results as the final status survey progresses. In accordance with Appendix 2 of NUREG-1700, changes in classification, resulting in a decrease in survey rigor, require NRC concurrence. Changes in survey unit classification or boundaries, will require that the survey of the affected area be redesigned and that the survey and data evaluation be repeated.

TABLE 4-2. FNR SURVEY AREAS AND FINAL STATUS SURVEY CLASSIFICATIONS

Room or Area	Description	Class	Approx Surface Area (m²)	No. of Survey Units	Comments	Reference
FNR Basement						
Basement	Floor North	1	100	1	EW Ceiling Beam Serves as Divisor	HSA - Sec 6.1 and Sec 5.2.1.1
Basement	Floor South	1	60	1	EW Ceiling Beam Serves as Divisor (Excludes Sumps & Pits)	HSA - Sec 6.1 and Sec 5.2.1.1
Basement	Hold-up Tank Sump, Floor Sumps & Pits	1	95	1		HSA - Sec 6.1, Sec 5.2.1.1, and Characterization Pkg SP-020
Basement	North End - Walls (N, E & W) and Columns	1	89	1		HSA - Sec 6.1, Sec 5.2.1.1; Sec 6.2, and Sec 5.2.2.1
Basement	South End - Walls (S, E & W) and Columns	1	60	1		HSA - Sec 6.2, Sec 5.2.2.1, and Survey 2007-2439
Basement	Ceilings (North & South)	2	236	1	EW Ceiling Beam Divides North & South Ceilings	HSA - Sec 6.1, Sec 5.2.1.1, Surveys 2007-2356, 2007-2439, and 2007-2462
FNR First Floor						
1101	Floor - SW Quadrant	1	102	1		HSA - Sec 6.1 and Sec 5.2.1.2
1101	Floor - NW Quadrant	1	102	1		HSA - Sec 6.1 and Sec 5.2.1.2
1101	Floor - NE Quadrant	1	96	1		HSA - Sec 6.1 and Sec 5.2.1.2
1101	Floor - SE Quadrant	1	84	1	Hatch Cover Included	HSA - Sec 6.1 and Sec 5.2.1.2
1101	SW Quadrant West of Pool - Upper & Lower Walls + Column 3	1	95	1	Wall Remediation (Includes SW Freight Door & Some of Storage Port Wall)	HSA - Sec 6.1 and Sec 5.2.1.2

Room or Area	Description	Class	Approx Surface Area (m ²)	No. of Survey Units	Comments	Reference
1101	NW Quadrant West of North Stairwell - Upper & Lower Walls	1	88	1	Wall Remediation (Includes Some of Storage Port Wall)	HSA - Sec 6.1, Sec 5.2.1.2, Survey 2007-2379, and Survey 2007-2388
1101	North Stairwell Enclosure - External Upper & Lower Walls + Pipe Chase	1	82	1		HSA - Sec 6.1 and Sec 5.2.1.2
1101	NE Quadrant - Upper & Lower Walls	1	79	1		HSA - 6.1 and Sec 5.2.1.2
1101	SE Quadrant - Upper & Lower Walls + Column 4	1	89	1		HSA - Sec 6.1 and Sec 5.2.1.2
1101	South Wall East of Pool / West of PML/FNR Metal Door - Upper & Lower Walls	1	57	1	Includes Blue Freight Door Between FNR & PML Hot Cell Area – Remediated	HSA - Sec 6.1 and Sec 5.2.1.2
1103	Janitor's Closet	2	31	1		Survey 2007-2385
1101	South Pool Wall	1	52	1		HSA - Sec 6.1 and Sec 5.2.1.2
1101	Reactor Pool Footprint	1	75	1		HSA - Sec 6.1
1101	Upper Pool Support Beams Facing Pool (3 beams)	2	148	1		HSA - Sec 6.2 and Sec 5.2.2.2
1101	Ceiling & Beams Not Facing Pool	2	620	1		HSA - Sec 6.2 and Sec 5.2.2.2
1101	North Pool Support Beam Bottom Façade	1	24	1	Remediated	Surveys 2007-2272 and 2007-2450
1101	E & W Pool Floor Hatch Covers (Bottom Sides)	1	26	1		Survey 2007-2273
1101	Outside BP Floor Hatch Cover Bottom	2	13	1	No Remediation Required	Surveys 2007-2335 and 2007-2336
FNR Second Floor						

Room or Area	Description	Class	Approx Surface Area (m ²)	No. of Survey Units	Comments	Reference
2101	Hallway / Corridor (All Surfaces)	2	189	1		HSA - Sec 6.2, Sec 5.2.2.3, and Survey 2007-2191
2111	Equipment Room – Floor	1	87	1		HSA - Sec 6.1, Sec 5.2.1.3, and Survey 2007-2456
2111	Equipment Room – Lower Walls	1	90	1	Wall Remediation	HSA - Sec 6.1, Sec 5.2.1.3, and Survey 2007-2456
2111	Equipment Room - Upper Walls & Ceilings	2	225	1		HSA - Sec 6.2, Sec 5.2.2.3, and Survey 2007-2456
2109	All Surfaces	2	115	1		HSA - Sec 6.2 and Sec 5.2.2.3, and Survey 2007-2248
2108	All Surfaces	2	110	1		HSA - Sec 6.2, Sec 5.2.2.3, and Survey 2007-2044
2107	Floor & Lower Walls	1	50	1	Room Used as Sample Handling & Counting Room	HSA - Sec 6.1 and Sec 5.2.1.3
2107	Upper Walls & Ceiling	2	55	1		HSA - Sec 6.1 and Sec 5.2.1.3
2106	All Surfaces	2	114	1		HSA - Sec 6.2, Sec 5.2.2.3, and Survey 2007-2347
2105	Men's Restroom (All Surfaces)	2	94	1		HSA - Sec 6.2, Sec 5.2.2.3, and Survey 2007-2263
2104	Pipe Chase (All Surfaces)	3	58	1		Survey 2007-2337
2103	Janitor's Closet (All Surfaces)	1	32	1		HSA - Sec 6.1 and Sec 5.2.1.3
2102	Women's Restroom (All Surfaces)	2	84	1		HSA - Sec 6.2, Sec 5.2.2.3, and Surveys 2007-1958, and 2007-2307
FNR Third Floor						

Room or Area	Description	Class	Approx Surface Area (m ²)	No. of Survey Units	Comments	Reference
3101	Hallway / Corridor (All Surfaces)	2	210	1		HSA - Sec 6.2, Sec 5.2.2.4, and Surveys 2007-1961 and 2007-2155
3102	Electronics Lab (All Surfaces)	2	170	1		HSA - Sec 6.2, Sec 5.2.2.4, and Survey 2007-1948
3103	Floor & Lower Walls	1	60	1	Former Fume Hood for Handling Rx Irradiation Samples	HSA - Sec 6.1, Sec 5.2.1.4, and Survey 2011-0043
3103	Upper Walls & Ceilings	2	56	1		HSA - Sec 6.1, Sec 5.2.1.4, and Surveys 2007-1946 & 2011-0043
3104	Floor & Lower Walls	1	72	1	Former Lab & RAM Area	HSA - Sec 6.1; Sec 5.2.1.4, Surveys 2007-2016 & 2011-0043
3104	Upper Walls & Ceiling	2	84	1		HSA - Sec 6.2, Sec 5.2.2.4, Surveys 2007-2016, 2010-0113, and 2011-0043
3106J	Floor & Lower Walls	1	15	1	Identified as Room 3166 in HSA. Janitor Closet & New-Fuel Vault	HSA - Sec 6.1, Sec 5.2.1.4, and Survey 2007-2188
3106J	Upper Walls & Ceiling	2	21	1	Identified as Room 3166 in HSA. Janitor Closet & New-Fuel Vault	HSA - Sec 6.2, Sec 5.2.2.4, and Survey 2007-2188
3108 & 3109	Floor & Lower Walls	1	74	1	Control Room & Records Storage	HSA - Sec 6.1 and Sec 5.2.1.4
3108 & 3109	Upper Walls & Ceiling	2	80	1	Control Room & Records Storage	HSA - Sec 6.2 and Sec 5.2.2.4
3101A	Floor	1	70	1	Identified in D Plan as Room 3110 (Hatch Covers Not Included)	HSA - Sec 6.1, Sec 5.2.1.4, and Survey 2011-0043
3101A	Pool Floor South Wall - Floor Up to Crane Beam (5.5 m)	1	98	1		HSA - Sec 6.1, Sec 5.2.1.4, and Survey 2007-2116

Room or Area	Description	Class	Approx Surface Area (m ²)	No. of Survey Units	Comments	Reference
3101A	Lower E, W, and N Walls	1	51	1		HSA - Sec 6.1, Sec 5.2.1.4, and Survey 2007-2058
3101A	Upper E, W, and N Walls, S Wall Above Crane Support, and Ceiling	2	480	1		HSA - Sec 6.2, Sec 5.2.2.4, and Survey 2007-2116
3101A	Pool Floor – East & West Hatch Covers (Tops) & Penetrations	1	32	1	Attachment Points on West Hatch Covers Contaminated	HSA - Sec 6.1, Sec 5.2.1.4, and Survey 2007-2034
3101A	FNR Crane	2	60	1	Class 2 Based on Survey Results	Characterization Pkg SP-014 and Survey 2007-2478
FNR Fourth Floor						
Fourth Floor	Cooling Tower Structure	3	630	1	Includes Splashboard Unit	HSA - Sec 6.2, Sec 5.2.2.5, and Characterization Pkg SP-016
Fourth Floor	FNR Stack Plenum	1	100	1	Remediated	HSA - Sec 6.1 and Sec 5.2.1.4
FNR Stairs				1		
Stair No. 1	South Stairwell	3	292	1		HSA - Sec 6.2 and Survey 2007-2315
Stair No.1	South Stairwell to Basement	2	35	1		HSA - Sec 6.1, Sec 6.2, and Survey 2007-2315
Stair No. 2	North Stairwell	3	232	1		HSA - Sec 5.2.2.1, and Survey 2007-2329
Stair No. 3	Cooling Tower - Stairwell Entrance and Remaining Stairs	1	20	1	Former RAM storage. No Remediation Required.	HSA - Sec 6.1 and Sec 5.2.1.4
Stair No. 3	Cooling Tower - Upper & Lower Walls	2	180	1		HSA - Sec 6.1, Sec 5.2.1.4, and Survey 2007-2245

Room or Area	Description	Class	Approx Surface Area (m ²)	No. of Survey Units	Comments	Reference
FNR Roof & Outside Areas						
FNR Exterior	Walls and Roof	3	454	1	Includes Doors, Vents, and Stacks	HSA - Sec 5.2.2.5 and Characterization Pkg SP-017
Outdoors	Temporary Decommissioning Lay Down Area / West Side (Soil, Concrete, and BP Hatch Covers)	1	150	2	Storage Pad Area – West Side - Temporarily Fenced-off as D&D Shipment Staging Area	
Pipe Chases						
Cooling Tower	Supply & Return Vertical Pipe Chase	3	110	1		HSA – Sec 6.2, Sec 5.2.1.5, and Sec 5.2.2.5
Drains						
Storm Drains	Storm Drains ¹	3	N/A	1		Characterization Pkg SP-012
Sanitary Sewer	Sanitary Sewer ¹	2	N/A	1		HSA - Sec 6.1, Sec 5.3, and Characterization Pkg SP-012
Drain Tile Pipe	Foundation Drain Tile (East Side) ²	1	35	1	Decom Plan Sections 2.1.1 and 2.1.2.4	HSA – Sec 5.3 and Sec 6.1
Miscellaneous						
Room 1101	Storage Ports (Truncated / Internal Surfaces)	1	13	1	Underground / Subsurface Storage Ports Removed from West Side	Characterization Pkg SP-004
Soil						
Subsurface Soil	Below FNR Basement & BP Floor Foundation	1	12 m ³ (~73 m ²)	2	Exposed Soil After Removing Embedded Piping	Characterization Pkg SP-018
Subsurface Soil	Foundation Drain Tile (East Side) ³	1	35 m ³ (~54 m ²)	1	Soil Sampling & Analyses Completed	HSA - Sec 6.1 and Sec 5.3

Room or Area	Description	Class	Approx Surface Area (m ²)	No. of Survey Units	Comments	Reference
Subsurface Soil	Excavated/Removed Storage Ports (West Side) ⁴	1	1.5 m ³	1	Activated Soil Remediated After Removal of Storage Ports (Survey Complete)	HSA - Sec 5.2.2.2

Footnotes:

- (1) Addressed during Site Characterization (Characterization Package SP-012) in December 2007. Results will be provided in final report.
- (2) Final decision on the disposition of the foundation drain tile pipe will be provided in the final report.
- (3) Soil sampling in the vicinity of the foundation drain tile pipe (east side) was conducted in September 2010 & September 2011. Results will be provided in the final report.
- (4) Soil sampling in the vicinity of the FNR storage ports (west side) was completed in December 2008 / January 2009. Results will be provided in the final report.

Note: BP - Beam Port Floor (Room 1101)
HSA - Historical Site Assessment (CH2MHill / January 2003)

4.5.3 Testing to Demonstrate Compliance

The Null Hypothesis for the statistical test to demonstrate compliance with project criteria is "Residual FNR radiological contamination levels exceed project criteria". The objective of the FSS is to reject this Null Hypotheses, by demonstrating at a Type I (α) decision error level of 0.05 (i.e., 95% confidence level) that the contamination does not exceed criteria. The Type II (β) decision error level is also 0.05. Because there are multiple potential contaminants in soil, compliance with soil criteria will be evaluated using the sum-of-ratios (SOR) approach. There are multiple building surface types (concrete, metal, wood, glass, etc.) in most survey units and individual survey unit measurements will be adjusted for appropriate material background contributions, using the paired-data approach. For both the soil and building surface surveys, the sign test is the appropriate statistical test of compliance.

4.5.4 Survey Data Requirements

To establish the number of data points needed to demonstrate that residual contamination criteria have been satisfied, a parameter known as the "relative shift", which effectively describes the distribution of final sample data, is calculated, as follows:

$$(1) \Delta/\sigma = (DCGL-LBGR)/\sigma$$

where:

- Δ/σ = relative shift
- DCGL = cleanup level (Section 4.3).
- LBGR = lower bound of the gray region and is defined in the DQOs as 50 percent of the DCGL. Where final sample data are not yet available, MARSSIM guidance (Section 5.5.2.2) assigns a value of one-half of the DCGL for the LBGR.
- σ = standard deviation of the sample concentrations in the survey unit. Where final sample data are not yet available, MARSSIM guidance (Section 5.5.2.2) is to use a value of 30 percent of the DCGL.

Using the equation for relative shift and MARSSIM guidance for situations where final sample data are not yet available, the relative shift for design purposes is $(1 - 0.5)/0.3$ for a value of 1.67. Based on the relative shift of 1.67 and Type I and Type II decision errors of 0.05, the number of required data points from each survey unit to perform the sign test, as obtained from MARSSIM guidance (Table 5.5) is 17.

Once actual sample data are collected, the MARSSIM DQO process requires a retrospective assessment of the selected LBGR and σ values, to confirm that an adequate number of data points was obtained for final evaluation.

4.5.5 Survey Locations

MARSSIM recommends a random-start systematic triangular measurement or sampling pattern for FSS of Class 1 and Class 2 survey units. This type of triangular pattern will be used for this final status survey, except where dimensions and/or other factors related to a specific survey unit require use of an alternate pattern. The spacing (L) between data points on a triangular pattern is determined by:

$$L = [(Survey\ Unit\ Area)/(0.866 \times number\ of\ data\ points)]^{1/2}$$

To simplify the designation of data points while assuring a sufficient number of data points are obtained for statistical purposes, the value of L is rounded to the nearest whole meter. If the systematic pattern does not provide sufficient data points to satisfy the number determined in Section 4.5.4, additional data points will be identified, using a random-number technique.

For FSS of Class 3 survey units, measurement or sampling data points will be judgmental, based on professional opinion. These data points will be biased to locations considered to have the highest probability of residual contamination, with additional locations chosen to provide distributed survey unit coverage.

4.5.6 Survey Design Packages

FSS designs will be prepared and documented in a survey design package. Multiple survey units, having similar history, classification, and conditions, may be covered by one design package. These design packages will include survey unit maps and drawings, classification, scan frequency, data point locations, a description of unusual/unique conditions that may require deviation from standard survey techniques, and alternative techniques to be used in such cases.

4.5.7 Survey Instrumentation

The radiological survey instrumentation listed in Table 4-3 or similar instrumentation capable of meeting the Data Quality Objectives will be used to implement the FNR FSS.

These instruments will be maintained and calibrated in accordance with UM procedures HP-211 and HP-402 or equivalent procedures that meet the established Data Quality Objectives. For simplicity in application to FSS, instrument response (efficiency) is based on NIST-traceable sources of Tc-99 (beta $E_{MAX} = 292$ keV) and Th-230 (alpha $E = 4.68$ MeV). The energies of these radionuclides are representative of the dominant potential contaminants and thus will provide conservative overestimates of the contaminant mixture. For field measurement applications, calibration represents 2 π response. Effects of surface conditions on measurements are integrated into the overall instrument response through use of a "source efficiency" factor, in accordance with the guidance in ISO-7503-1, *Evaluation of Surface Contamination – Part 1: Beta Emitters and Alpha Emitters* (First Edition) and NUREG/CR-1507, *Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Fields Conditions*. Default source efficiency factors, of 0.5 for beta-emitters > 0.4 MeV E_{max} and 0.25 for beta-emitters between 0.150 MeV and 0.400 MeV E_{max} (per ISO-7503-1) are generally applicable to anticipated FNR contaminants and surface conditions. For the predominant maximum beta energy of approximately 0.300 MeV from Co-60, a source efficiency value of 0.37 will be used. If contaminants or conditions in specific survey units are not consistent with use of these default values, specific instrument response and source efficiency factors will be determined and documented in the final status survey packages for those survey units.

Detection sensitivities are estimated using the guidance in MARSSIM and NUREG-1507, *Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Fields Conditions* (NRC, 1997b). Instrumentation and survey techniques are chosen with the objective of achieving detection sensitivities of $\leq 50\%$ of the criteria for structure surfaces, for both scanning and direct measurement. This assures identification of areas potentially exceeding the established project criteria.

TABLE 4-3. INSTRUMENTATION FOR FNR FINAL STATUS SURVEY

Detector	Type	Make	Meter	Application	Sensitivity (dpm/100 cm ² , except as noted)	
					Scanning	Static Count (1 minute)
44-142	Beta Scintillation	Ludlum	2221	Beta scan and measurement	1770 DCGL = 5125	560 DCGL = 5125
43-37	Gas Proportional Floor/Wall Monitor	Ludlum	2221	Beta scan	460 DCGL = 5125	N/A
44-10	Nal	Ludlum	2221	Gamma scan	1.85 pCi/g Co-60 ¹ ; DCGL = 3.8 pCi/g 1.39 pCi/g Ag-108m; DCGL = 8.2 pCi/g 5.08 pCi/g Cs-137; DCGL = 11.0 pCi/g 1.49 pCi/g Ag-110m; DCGL = 4.92 pCi/g (surface soil)	N/A
Tennelec LB5100	Gas proportional	Tennelec	N/A	Alpha smear measurement	N/A	38 DCGL N/A (no α contaminants)
Tennelec LB5100	Gas proportional	Tennelec	N/A	Beta smear measurement	N/A	38 DCGL = 512

cm² – square centimeter, dpm – disintegrations per minute, g – gram., pCi – picocuries.

- (1) 1.85 pCi/g Co-60 assumes a scan speed of 0.25 m/sec instead of the typical 0.5 m/sec speed for larger outside open areas

Measuring instruments are calibrated at prescribed time periods or usage and whenever the accuracy of the equipment is suspect. Calibration is performed using standards traceable to NIST or an equivalent standard organization. Instruments are suitably marked or otherwise identified to indicate calibration status. Instruments found to be out of calibration, require a documented evaluation, commensurate with the significance of the condition, of the validity of data obtained with that instrument since its previous acceptable performance.

Instruments are properly handled and stored to maintain accuracy and shall follow ANSI N323B-2003.

Operational and background checks will be performed at the beginning and end of each day of final status survey activity and whenever there is reason to question instrument performance. These checks should follow procedure HP-401.

4.5.8 Background and Reference Area Measurements

In addition to the instrumentation background response, many construction materials and environmental media (e.g., soil, sediment) contain naturally occurring levels of radioactive materials, which contribute to a survey measurement. Background contributions must therefore be determined, if 1) the residual contamination includes a radionuclide that occurs in background, or 2) measurements are not radionuclide-specific. Multiple background determinations will be required for the final status survey. A set of reference measurements must be obtained for each instrument being used for survey unit evaluation. For applications involving the Sign test, sufficient background determinations will be made for each media or surface material and with each instrument to provide an average background level that is accurate to within +/- 20 percent; this usually requires 8 to 10 measurements, which are then evaluated using the procedure described in draft NUREG/CR-5849, *Manual for Conducting Radiological Surveys in Support of License Termination* (NRC, 1992a), and additional data points obtained, as necessary. Reference area and background requirements will be identified at the time of individual survey unit final status survey design. With several exceptions, structural material backgrounds will be obtained from surfaces in the Cooley Building Tunnel, which is of similar construction and age as the FNR Building, but without a history of radioactive materials use. Because there are no other known sources of high-density concrete in University facilities, background measurements for this material will be obtained at ceiling and upper wall locations in areas of the FNR, where use history indicates a negligible potential for impact by facility operations. Another structural material for which a source outside the FNR has not been identified is the glazed tile in janitor closets, restrooms, and change rooms. It is proposed to obtain background measurements for this material at ceiling and upper wall locations in the 2nd floor women's restroom, where the potential for impact by facility operations is considered negligible. Bulk samples of high-density and glazed tile material from these locations will be analyzed to confirm the absence of other than naturally occurring radioactive material.

4.5.9 Survey Reference Systems

A grid system will be established on surfaces to provide a means for referencing measurement and sampling locations. On Class 1 and 2 structure surfaces, a 1-m interval grid will be established; a 5-m interval grid will be established on Class 3 structure surfaces; and a 10-m interval grid will be established for land area surfaces. Grid systems typically originate at the southwest corner of the

survey unit, but specific survey unit characteristics may necessitate alternate grid origins. Grids are assigned alphanumeric indicators to enable survey location identification. Structure grids are referenced to building features; open land grids are referenced to the state or federal planar grid system. Maps and plot plans of survey areas will include the grid system identifications. Systems and surfaces of less than 20 m² will not be gridded, but survey locations will be referenced to prominent facility features. Procedure FSS-02 describes mapping and gridding for FSS purposes.

4.5.10 Survey Techniques

Data collected for final status survey of structure surfaces will consist of scans to identify locations of residual contamination, direct measurements of beta surface activity, and measurements of removable beta surface activity. Final status survey of open land (soil) areas will consist of scans to identify locations of residual contamination and samples of soil, analyzed for potential contaminants. Additional measurements and samples will be obtained, as necessary, to supplement the information from these typical survey activities. Survey techniques are described in more detail in this section.

4.5.10.1 Beta Surface Scans

Beta scanning of structure surfaces will be performed to identify locations of residual surface activity. Gas-flow proportional detectors and scintillation detectors will be used for beta scans. Floor monitors with 580 cm² gas proportional detectors will be used for floor and other larger accessible horizontal surfaces; hand-held 100 cm² scintillation detectors will be used for surfaces not accessible by the floor monitor. Scanning will be performed with the detector within 0.5 cm of the surface (if surface conditions prevent this distance, the detection sensitivity for an alternate distance will be determined and the scanning technique adjusted accordingly). Scanning speed will be no greater than 1 detector width per second. Audible signals will be monitored and locations of elevated direct levels identified for further investigation.

Minimum scan coverage will be 100 percent for Class 1 surfaces, 25 percent for Class 2 surfaces, and 10 percent for Class 3 surfaces. Coverage for Class 2 and Class 3 surfaces will be biased towards areas considered by professional judgment to have highest potential for contamination.

4.5.10.2 Gamma Surface Scans

Gamma scanning surfaces will be performed on structure and soil surfaces to identify locations of residual surface activity. NaI gamma scintillation detectors (2 inch x 2 inch) will be used for these scans. Scanning will be performed by moving the detector in a serpentine pattern, while advancing at a rate of approximately 0.5 m per second. The distance between the detector and the

surface will be maintained within 5 cm of the surface. Audible signals will be monitored and locations of elevated direct levels identified for further investigation.

Minimum scan coverage will be 100 percent for Class 1 surfaces, 25 percent for Class 2 surfaces, and 10 percent for Class 3 surfaces. Coverage for Class 2 and Class 3 surfaces will be biased towards areas considered by professional judgment to have highest potential for contamination.

4.5.10.3 Surface Activity Measurements

Direct measurement of beta surface activity will be performed at designated locations using a 100-cm² plastic scintillation detector. Measurements will be conducted by integrating the count over a 1-minute period. Where adverse surface conditions may result in underestimating activity by direct measurements, surface samples will be obtained for laboratory analyses. Need for such sampling will be identified in final status survey design for specific survey units.

4.5.10.4 Removable Activity Measurements

A smear for removable activity will be performed at each direct surface activity measurement location. A 100 cm² surface area will be wiped with a 2 inch diameter paper filter or cloth, using moderate pressure. Smears will be analyzed onsite for gross alpha and gross beta activity using a Tennelec gas proportional automatic sample counter.

4.5.10.5 Soil Sampling

Samples of surface (upper 15 cm) soil will be obtained from selected locations using a hand trowel or bucket auger. Approximately 500 to 1000 g of soil will be collected at each sampling location.

4.5.10.6 Special Situations

There will likely be several areas that do not meet the definition of exposed soil or structure surfaces. Examples include the foundation drain around the exterior foundation and the soils in the immediate vicinity of the removed source storage tubes. Where such special situations are encountered, survey approaches and evaluation methods will be developed on a case by case basis and described in the survey design package.

4.6 Data Evaluation and Interpretation

4.6.1 Sample Analysis

Smears for removable activity will be analyzed by the onsite laboratory for gross alpha and gross beta activity. Soil will be screened onsite for gamma emitters

and, if screening indicates the sum-of-ratios for the four contaminants of concern (see Section 4.3) is less than unity, samples will be analyzed at the commercial offsite laboratory by gamma spectrometry for final evaluation that decommissioning criteria have been satisfied.

4.6.2 Data Conversion

Measurement data will be converted to units of dpm/100 cm² or pCi/g for comparison with guidelines and/or for statistical testing. Where appropriate for Sign tests, data will be adjusted for material and instrument background contributions.

4.6.3 Data Assessment

Data will be reviewed to assure that the type, quantity, and quality are consistent with the survey plan and design assumptions. Data standard deviations will be compared with the assumptions made in establishing the number of data points. Individual and average data values will be compared with guideline values and proper survey area classifications will be confirmed. Individual measurement data in excess of the guideline level for Class 2 areas and in excess of 25 percent of the guideline for Class 3 areas will prompt investigation. Patterns, anomalies, and deviations from design assumption and plan requirements will be identified. Need for investigation, reclassification, remediation, and/or resurvey will be determined; a resolution will be initiated and the data conversion and assessment process repeated for new data sets.

4.6.4 Determining Compliance with Guidelines

4.6.4.1 Sign Test

For a structure surface survey unit to be evaluated using the Sign test, individual activity values and the average and standard deviation activity values will be calculated.

If all individual values for a survey unit are less than the guideline level, that survey unit satisfies the criterion and no further evaluation is necessary; the null hypothesis is rejected, and the survey unit meets the established criteria.

If any individual value is greater than the guideline value, the null hypothesis is accepted, and the survey unit does not meet the established criteria; investigation, remediation, reclassification, and/or resurvey will be performed, as appropriate.

4.6.4.2 Unity Rule Sign Test

For an open land or structure surface survey unit to be evaluated using the Unity Rule Sign test, individual activity values and the ratios of the activity values to

their respective guideline values will be calculated. For each data location add the ratios together to determine the Sum of Ratios.

If all Sum of Ratios values for the survey unit are less than 1, that survey unit satisfies the criterion and no further evaluation is necessary; the null hypothesis is rejected, and the survey unit meets the established criteria.

If the Sum of Ratios value for any sample is greater than 1, the survey unit does not satisfy the criterion. The null hypothesis is accepted, and investigation, remediation, reclassification, and/or resurvey will be performed, as appropriate.

4.7 Isolation and Control Measures

Following completion of FSS, the survey unit will be isolated and access controlled. Routine access, equipment removal, material storage, and worker and material transit through the area without proper controls are no longer allowed. One or more of the following administrative and physical controls will be established to minimize the possibility of introducing radioactive material from ongoing decommissioning activities in adjacent or nearby areas:

- Personnel training,
- Installation of barriers to control access to the area(s),
- Installation of postings with access and egress requirements, and/or
- Locking or otherwise securing.

Isolation and control will be discontinued following NRC acceptance that the project decommissioning criteria have been satisfied.

4.8 Final Status Survey Report

A report describing the survey procedures and findings will be prepared for submission to the NRC in support of license termination. The survey report will provide a complete record of the facility's radiological status and a comparison to the site release criteria. The survey report will include survey data and overall conclusions, which demonstrate that the FNR Facility meets the radiological criteria for unrestricted use. Information such as the number and type of measurements, basic statistical quantities, and statistical test results will be included in the report. The survey report will contain additional detail to enable an independent or third party re-creation and evaluation of the survey results and a determination as to whether the site release criteria have been met.

The following outline illustrates a general format that may be used for the final status survey report and may be adjusted to provide a clearer presentation of the information. The level of detail will be sufficient to clearly describe the final status survey program and certify the results.

Information to be submitted:

- A summary of the results of the final status survey,
- A discussion of any changes that were made in the final status survey from what was proposed in the LTP or other prior submittals,
- A description of the method by which the number of samples were determined for each survey unit,
- A summary of the values used to determine the numbers of samples and a justification for these values (refer to Section 4.5.4),
- The results for each survey unit including:
 1. Number of samples taken for the survey unit.
 2. A map or drawing of the survey unit showing the reference system and random start systematic sample locations for Class 1 and 2 survey units, and random locations shown for Class 3 survey units and reference areas.
 3. Measured sample concentrations.
 4. Statistical evaluation of the measured concentrations.
 5. Judgmental and miscellaneous sample data sets reported separately from those samples collected for performing the statistical evaluation.
 6. Discussion of anomalous data including any areas of elevated direct radiation detected during scanning that exceeded the investigation level or measurement locations in excess of the DCGLw.
 7. A description of follow-up actions and results.
 8. A statement that a given survey unit satisfied the DCGLw.
- A description of any deviations from initial survey design and survey techniques, and
- A description of the investigation and follow-up actions when the FSS fails to demonstrate that the criteria have been satisfied.

4.9 References

Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM), NUREG-1575 (Rev. 1), US Nuclear Regulatory Commission, 2000.

University of Michigan Decommissioning Plan for the Ford Nuclear Reactor (Rev 1.), University of Michigan, January 2006.

Consolidated NMSS Decommissioning Guidance. NUREG-1757, US Nuclear Regulatory Commission, 2000.

Residual Radioactive Contamination from Decommissioning, NUREG/CR-5512 Vol. 3, US Nuclear Regulatory Commission, 2000.

Manual for Conducting Radiological Surveys in Support of License Termination, NUREG/CR-5849 (draft), US Nuclear Regulatory Commission, 1992.

Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions, NUREG/CR-1507, US Nuclear Regulatory Commission, 1997.

Evaluation of Surface Contamination – Part 1: Beta Emitters and Alpha Emitters, ISO-7503-1, International Organization for Standardization, 1988.

Installed Radiation Protection Instrumentation Test and Calibration – Portable survey Instruments for Near Background Operation, ANSI-N323B-2003, American national Standards Institute, 2003.

Limiting Values of Radionuclide Intake and Air Concentration and Dose Conversion Factors for Inhalation, Submersion, and Ingestion, Federal Guidance Report No. 11, EPA-520/1-88-1988, Environmental Protection Agency, 1988.

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

Appendix A

Identification of Residual Radiological Contaminants at the Remediated Ford Nuclear Reactor Facility

Numerous radionuclides were potential contaminants at the FNR as a direct result of reactor operations (i.e., fission and activation products) as well as experiments performed in the facility. Research of historical documents, interviews, and preliminary characterization of the facility identified the radionuclides potentially present at the time decommissioning was initiated as Sb-125, C-14, Cs-137, Co-60, Eu-152, Eu-154, Fe-55, H-3, Mn-54, Ni-63, Ag-108m, Ag-110m, and Zn-65. Monitoring of waste and the remaining structure during the remedial activities identified Ba-133 (from activation of high-density barytes concrete) as an additional potential contaminant.

As part of the decontamination and dismantlement efforts, items and structural components in close proximity to the reactor core, including most of the high-density barytes concrete bioshield, were removed. Direct monitoring and sampling of surfaces after remediation was complete, indicated little, if any, residual surface contamination. Table A-1 presents a summary of analyses of samples, representative of as-left surface conditions.

Table A-1 Analyses of Post-Remediation Samples

Radionuclide	Samp 1 (pCi/g)	Samp 2 (pCi/g)	Samp 3 (pCi/g)	Samp 4 (pCi/g)	Samp 5 (pCi/g)	Samp 6 (pCi/g)	Samp 7 (pCi/g)
H-3	<2.04	<2.17	<2.17	<2.21	<2.11	0.62	1.49
C-14	<1.09	<1.14	<1.08	<1.12	<1.07	<0.47	1.26
Fe-55	<7.72	<8.17	<11.7	<10.4	<9.03	<20.1	<17.4
Co-60	<0.05	0.55	0.43	4.21	<0.08	<0.03	<0.03
Ag-108m	<0.05	0.30	0.14	0.36	<0.08	<0.03	<0.03
Ag-110m	<0.07	<0.12	<0.19	<0.27	<0.06	<0.07	<0.05
Cs-137	<0.04	<0.07	0.24	1.77	<0.07	0.02	<0.03
Ba-133	<0.06	0.11	<0.13	<0.14	<0.09	<0.10	<0.24
Mn-54	<0.07	<0.12	<0.19	<0.24	<0.08	<0.07	<0.16
Eu-152	<0.32	<0.55	<0.91	<0.72	<0.54	<0.59	<1.03

Sample 1: UM-2009-06-08-01; Concrete grindings from foundation under North side of former reactor pool

Sample 2: UM-2009-06-10-01; Concrete grindings from foundation under West side of former reactor pool

Sample 3: UM-2009-06-12-01; Concrete grindings from foundation under former reactor thermal column

Sample 4: UM-2009-06-19-01; Concrete grindings from foundation directly beneath former reactor core

Sample 5: UM-2010-01-29-01; Concrete grindings from foundation under West side of former reactor pool

Sample 6: UM-2010-05-18-01; Concrete grindings from foundation under West side of former reactor pool; after additional remediation of area identified by gamma scan

Sample 7: UM-2010-05-27-01; Concrete grindings from foundation under West side of former reactor pool; after additional remediation of area identified by gamma scan

It is evident from these analyses of post-remediation samples that only a few samples contained positive concentrations of radionuclides, attributable to FNR operations. Most concentrations were either less than laboratory detection limits or very low, relative to typical DCGL levels. Co-60, Ag-108m, and Cs-137 are the only radionuclides identified in more than 2 of the 7 samples and/or at concentrations that could be considered positive indication of their presence. Because of the high fraction of non-detectable levels, these data cannot be used to develop meaningful radionuclide ratios for the remediated facility.

Several samples were obtained during remediation from locations contaminated by leakage of reactor pool water and thus believed representative of potential surface contamination throughout the FNR facility. Table A-2 presents a summary of analytical results for these samples. It should be noted that, based on the absence of non-gamma-emitting radionuclides in the post-remediation samples, these analyses included only gamma spectrometry.

Table A-2 Analyses of Residue Samples

Radionuclide*	Sample 8 (pCi/g)	Sample 9 (pCi/g)	Sample 10 (pCi/g)	Sample 11 (pCi/g)	Average Fraction
Co-60	37.7	12.1	0.35	4.6	0.312
Ag-108m	71.5	29.3	2.3	<0.03	0.588
Ag-110m	5.87	2.09	<0.06	<0.46	0.048
Cs-137	1.89	1.50	0.20	<0.03	0.021
Mn-54	0.28	<0.14	<0.02	<0.02	0.003
Zn-65	1.56	0.48	0.05	<0.05	0.012
Ba-133	1.07	0.92	<0.04	<0.04	0.012
Eu-152	<0.29	<0.30	<0.06	<0.06	0.004

* Analyses were by gamma spectrometry and did not include hard-to-detect radionuclides. No other gamma-emitting contaminants were detected.

Sample 8: UM-2009-08-10-01; Concrete grindings from core A in floor slab crack.

Sample 9: UM-2009-10-01-01; Concrete grindings from core L in floor slab crack.

Sample 10: UM-2010-09-16-D823-821; Material from Drain Tile.

Sample 11: UM-2010-08-27-02; Soil beneath MMPP/FNR freight door.

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The fractional contributions of the radionuclides in samples 8-11 were calculated and the average contribution for these four samples were determined. Results are presented in Table A-2. To maximize potential contributions to future occupant dose for surrogate

determination, where the activity was reported as less than the minimum detectable activity (MDA), the MDA value was used in calculating the activity ratios. Appendix D describes application of these ratios in establishing a gross beta DCGL for surface contamination at FNR.

Appendix B

Justification for Use of Default Screening Values for FNR Soils and Surfaces

In accordance with Section 6.6.6 of NUREG-1757, the following conditions must be satisfied to justify use of the Default Screening Values:

- Building Surface Contamination

1. The contamination on building surfaces should be surficial and non-volumetric (e.g., <10 mm (0.4 in)).

Justification: Paint and tile have been removed to expose potentially contaminated structure surfaces. Fixtures and portions of the structural concrete in proximity to the reactor core, where activation may have resulted in volumetric contamination, have been removed. Samples of remaining concrete, representing material at 0.5 to 2.0 and 2.0 to 4.0 inches below the surface, were obtained at two locations, which are closest to the former position of the reactor core. Analyses of these samples did not identify any detectable radionuclides of reactor origin (see Table B-1), indicating absence of volumetric contamination.

2. Contamination on surfaces is mostly fixed (not loose), with the fraction of loose contamination not to exceed 10 percent of the total surface activity.

Justification: Routine surveys, during and following remediation, did not identify the presence of removable contamination. Smears for removable contamination will be obtained at direct measurement locations during the FSS. Removable contamination must be less than 10% of the gross beta DCGL.

3. The screening criteria may not be applied to surfaces as buried structures (e.g., drainage or sewer pipes) or mobile equipment within the building; such surfaces and buried surfaces will be treated on a case-by-case basis.

Justification: Potentially impacted piping, including imbedded piping and adjacent concrete, has been removed, with exception of the short section of piping to the French Drain on the Basement level. Survey and evaluation of the drain system will be performed separately.

- Surface Soil Contamination

1. The initial residual radioactivity (after decommissioning) is contained in the top layer of the surface soil (e.g., approximately 15 cm (6 in)).

Justification: A small volume of soil around a storage tube in the west wall of the first floor level, used to store several PuBe neutron sources, was removed and scans and sampling of the remaining soil surfaces was performed. That evaluation has been completed and results will be provided separate from the remaining facility FSS.

The foundation drain around the foundation of the FNR received a short-term release of low-level contaminated water. Sampling of soil from that system has been performed and results will be provided separate from the remaining facility FSS. Otherwise, potential contamination of soil is limited to soil surfaces on the basement level, exposed during removal of impacted imbedded piping, and soil beneath the first floor at the doorway (South West Freight) between the FNR and MMPP Buildings, resulting from seepage of pool water through a small crack in the bioshield and a possible liquid spill on the floor above the gap between the FNR/MMPP buildings. Consequently, the source of any contamination of soil, other than that in the vicinity of the storage tubes, foundation drain system, and gap between the FNR and MMPP will be due to dispersal of contamination from structure surfaces and will be limited to the exposed soil surfaces.

2. The unsaturated zone and the ground water are initially free of contamination.

Justification: As part of the initial facility characterization in 2007, a ground water monitoring well, installed near the entrance to the MMPP, which is downstream from the FNR facility, was sampled. Sampling of that well (Table B-2) did not identify evidence that the ground water has been impacted as a result of FNR operations.

3. The vertical saturated hydraulic conductivity at the specific site is greater than the infiltration rate.

Justification: No residual radiological contamination of subsurface soil, due to past FNR operations, has been identified. The elevations of the soil in the vicinity of the source storage tubes, cavity beneath the MMPP/FNR SW freight door, and French drain are approximately 839, 829, and 823 ft., respectively. Elevation of the upper bound of the saturated zone is 809 ft. The vertical distance from contaminated soil to the water table is therefore at least 14 ft. There are currently no liquid discharges from the FNR to the ground water in the vicinity of this facility.

Based on results of monitoring in support of remedial actions and ongoing radiological surveys during and following remediation, the above criteria are satisfied. Therefore, the conservative Default Screening Values (NUREG/CR-5512, Vol 3) for the potential radionuclide contaminants have been selected as acceptable final status criteria (i.e., DCGLs).

Table B-1 Analyses of Concrete Cores

Radionuclide	Concentration (pCi/g)		
	2010-06-17-02	2010-06-17-03	2010-06-17-04
	0.5 – 2.0 inches	0.5 – 2.0 inches	0.5– 2.0 inches
Co-60	<0.01	<0.03	<0.03
Ag-108m	<0.01	<0.03	<0.03
Ag-110m	<0.01	<0.03	<0.03
Cs-137	<0.01	<0.04	<0.03
Mn-54	<0.08	<0.04	<0.03
Zn-65	<0.04	<0.11	<0.10
Ba-133	<0.03	<0.07	<0.07
Eu-152	0.03	<0.08	0.11

Table B-2 Analyses of Ground Water Samples from Well Near PML Entrance

Radionuclide	Concentration (pCi/l)	
	7/2/2007	8/8/2007
Gross alpha	58.2 \pm 9.7	20.1 \pm 6.5
Gross beta	67.2 \pm 8.4	31.3 \pm 7.1
H-3	<706	<648
Co-60	<6.68	<9.88
Cs-137	<5.69	<8.07
Ag-108m	<6.03	<7.31
Ag-110m	<5.28	<8.53
Mn-54	<7.03	<8.85
Zn-65	<14.1	<20.6
Eu-152	<42.0	<53.4

Appendix C

Development of Default Screening Values for Ag-108m

Default Screening Values, listed in NUREG/CR-5512, Volume 3, do not include the radionuclide Ag-108m. Also, the DandD code, used to develop those Default Screening Values, does not include the dose values for that radionuclide. Therefore the following approach was used to develop Default Screening Values for Ag-108m:

1. DandD Version 2.2.0 was used to calculate contributions of individual pathways (i.e., by excluding all other pathways) to the dose (mrem/y) from 1000 dpm/100 cm² Ag-110m for the Building Occupancy scenario and from 1.0 pCi/g for the Residential scenario. The surface activity and soil concentrations of Ag-110m, consistent with a 25 mrem/y dose, were then calculated to confirm that the calculation was performed correctly. The resulting calculations yielded 10205 dpm/100 cm² and 4.87 pCi/g, as compared with the values of 1.02E+4 dpm/100 cm² and 4.92 pCi/g, respectively, in NUREG/CR-5512, Volume 3. (Refer to attached table)
2. These individual pathway doses for Ag-110m were adjusted by multiplying the Ag-110m contributions by the Ag-108m to Ag-110m ratios of the following dose values for external and internal exposure, as presented in FRG #12 and FRG #11, respectively.

Pathway	Ag-110m Dose	Ag-108m Dose
External – surface	2.65E-15 Sv/Bq s m ⁻²	1.60E-15 Sv/Bq s m ⁻²
External – 15 cm thick	7.93E-17 Sv/Bq s m ⁻³	4.61E-17 Sv/Bq s m ⁻³
Inhalation	2.17E-08 Sv/Bq	1.07E-08 Sv/Bq
Ingestion	2.92E-09 Sv/Bq	2.06E-09 Sv/Bq

3. The resulting individual Ag-108m doses for all pathways were then calculated and the surface activity and soil concentration values consistent with a 25 mrem/y dose were calculated, yielding Default Screening Values of 1.70E+04 dpm/100 cm² and 8.20 pCi/g for building surface and surface soil contamination, respectively.

Scenario	Pathway	Ag-110m Dose (mrem/1000 dpm/100 cm ²)	Dose factors (Ag-108m/ Ag-110m)	Ag-108m Dose (mrem/1000 dpm/100 cm ²)
Building Occupancy				
	External Exposure	2.34E+00	0.604	1.41E+00
	Inhalation	1.05E-01	0.493	5.18E-02
	Ingestion	7.88E-03	0.705	5.56E-03
	Total	2.45E+00	N/A	1.47E+00
	Default Screening Value for 25mrem/y	1.02E+04 (dpm/100 cm ²)	N/A	1.70E+04 (dpm/100 cm ²)
		Ag-110m Dose (mrem/1.0 pCi/g)	Dose factors (Ag-108m/ Ag-110m)	Ag-108m Dose (mrem/1.0 pCi/g)
Residential				
	External Exposure	4.58E+00	0.581	2.66E+00
	Inhalation	1.22E-05	0.493	6.01E-06
	Sec. Ingestion	9.62E-05	0.705	6.78E-05
	Agricultural	5.59E-01	0.705	3.94E-01
	Drinking Water	1.36E-20	0.705	9.59E-21
	Irrigation	1.34E-19	0.705	9.45E-20
	Surface Water	7.26E-22	0.705	5.12E-22
	Total	5.14E+00	N/A	3.05E+00
	Default Screening Value for 25mrem/y	4.87 pCi/g	N/A	8.20 pCi/g

Appendix D

Gross Beta DCGL for Radionuclide Mixture at FNR

Appendix A described the mixture of radionuclides, determined for samples from the FNR, during and following completion of remediation. Because of the general absence of contamination in the post-remediation samples, it was decided that the samples, obtained before remediation was completed, would be used to develop a radionuclide mixture for purposes of demonstrating final radiological conditions satisfy the NRC requirements for decommissioning. Table A-2 from Appendix A lists the following contributors to the radionuclide mix:

Concentrations of Mn-54, Zn-65, Ba-133, and Eu-152 were very low in the samples during remediation and were not present in post remediation samples; these radionuclides were therefore deleted from the list of residual radionuclides, leaving only Co-60, Ag-108m, Ag-110m, and Cs-137 as potential contaminants in the remediated facility. The fractional contributions of radionuclides to the pre-remediation and post-remediation mixture, are presented in the following table.

Radionuclide	Average Fraction	
	Pre Remediation	Post Remediation
Co-60	0.312	0.322
Ag-108m	0.588	0.607
Ag-110m	0.048	0.050
Cs-137	0.021	0.021
Mn-54	0.003	Negligible
Zn-65	0.012	Negligible
Ba-133	0.012	Negligible
Eu-152	0.004	Negligible

Each of the radionuclides in the post-remediation mixture decays to some extent by emitting beta particles. The abundance (A) of beta emissions per decay is 1.0 for Co-60, Ag-110m, and Cs-137 and 0.087 for Ag-108m.

To develop a gross-beta DCGL for the structural surfaces, the fractional contribution (f) of each of the radionuclide contaminants to the total mix was divided by the Default Screening DCGL for that radionuclide. The gross DCGL was then calculated by:

$$\text{Gross Beta DCGL} = \frac{\text{fraction of beta emitters (i.e., } f \times A)}{\Sigma (f/\text{DCGL})}$$

$$\text{Gross Beta DCGL} = \frac{0.446}{(0.322/7050) + (0.607/17000) + (0.050/10200) + (0.021/28000)}$$

The resulting gross beta DCGL value is 5125 dpm/100 cm².

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Appendix E

**Derived Concentration Guideline Level for C-14 in
Subsurface Soil at the Former Ford Nuclear Reactor
Site**

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May 7, 2012

Derived Concentration Guideline Levels for Subsurface Soil at the Former Ford Nuclear Reactor Site

1.0 INTRODUCTION

The Ford Nuclear Reactor (FNR) at the University of Michigan, in Ann Arbor, MI, is being decommissioned. The decommissioning activities are described in *University of Michigan Decommissioning Plan for the Ford Nuclear Reactor*; Chapter 4 of that Decommissioning Plan describes the Final Status Survey Plan for demonstrating that the decommissioning has been effective in satisfying Nuclear Regulatory Commission (NRC) criteria for termination of the license and to permit unrestricted future use of the facility. NRC Default Screening Values have been selected as radiological criteria for the building surfaces and surface soil. Sampling to date has indicated residual concentrations of radionuclides are typically within their respective Default Screening Values. However, there is one small region of subsurface soil, containing concentrations of C-14, potentially slightly greater than the Default Screening Value for C-14 of 11.6 pCi/g. This location is in the vicinity of the foundation drain around the perimeter of the FNR building. C-14 has not been identified at other locations in the FNR, and the source of this contaminant is not known. The volume of potentially contaminated subsurface soil at this location is estimated to be less than 50 m³; for calculation purposes, 50 m³ was the assumed volume. This document describes the development of a Derived Concentration Guideline Limit (DCGL) for C-14 in subsurface soil associated with the FNR foundation drain.

DCGL calculations were based on a dose limit of 25 mrem/y for likely future land use scenarios. Calculations were performed, based on deterministic analysis, for a time period out to 1000 years, using RESRAD, Version 6.5. The most restrictive DCGL for the various scenarios and time periods was selected for C-14 in the subsurface soil.

2.0 SCENARIO DESCRIPTION

It is assumed that the University will have institutional control of this site for a period of 100 years, and in the immediate future, after decommissioning is completed, that the former FNR facility will be used by the University primarily as offices, classrooms, and laboratories. After the institutional control period ends, the land could be rezoned for industrial, recreational, or residential use. Three scenarios (A-industrial worker on site, B-building occupancy for educational purposes, and C-off-site resident) were considered for current use conditions. The contamination is limited to a small volume (<50 m³) of subsurface soil, located beneath approximately 5 m of clean cover and about 4 m above the saturated zone; contaminated soil is at least 500 m from the nearest off-site residential area; and surrounding off-site areas are urban and subsistence farming is not currently a potential land use. The off-site resident scenario was therefore not considered of potential significance and was not evaluated further. Another two scenarios (D- subsistence farming and E- recreational use) were evaluated for the period following institutional control.

Scenario A (current on-site industrial worker) assumes that certain outdoor work activities will result in removing clean overburden, exposing the contaminated soil. Workers would perform maintenance and construction operations on the surface of the exposed contaminated soil for a period of 3 months (500 hr/yr or 0.0571 yr), after which the clean overburden would be replaced. The worker would also be exposed annually for 3 months (0.0571 yr) during renovation activities inside the building. The worker will not ingest contaminated water, plant, fish, meat, or milk obtained from the site. Direct exposure is to an individual, immediately on the other side of the building wall/floor from the contaminated soil, and the calculation assumed uncovered soil. Because radiological decay would result in slightly lower doses for the industrial use scenario after 100 years of institutional control than for the same scenario during the first 100 years, that scenario was not evaluated beyond the 100 year time period.

Scenario B (building occupant) assumes presence in the building 2000 hr/yr (0.2283 yr). The occupant would be potentially exposed to external radiation from covered contaminated soil. Exposure to airborne contamination and internal radiation from ingestion of water, plants, meat, milk, and fish, impacted by the contaminated soil are not considered potential exposure pathways.

Scenario D (future subsistence farmer) assumes residential use of the site after the institutional control period. The resident farmer would be exposed to direct radiation and to internal radiation from inhalation of contaminated dust, and ingestion of water, plants, meat, milk, and fish and incidental ingestion of soil. All water used by the resident farmer for drinking, irrigation, and household use would be drawn from a deep well, adjacent to the former FNR facility. Nearby surface water sources and shallow wells are not considered adequate to sustain a subsistence farmer. Two versions of this scenario were considered- one with the clean soil cover in place and one with the clean soil cover removed (intrusion) thus exposing the contaminated soil. Because the intrusion scenario would not occur until after the 100 year institutional control period, intrusion was assumed to occur at the 100 year point and the 1, 3, 10 and 30 year times were considered starting at that point in time. Because of the relatively long half life of C-14 no radiological decay was considered to have occurred prior to discontinuation of institutional control.

Scenario E (future recreational use) assumes that an individual camps on the site two weeks per year and engages in recreational activities, such as biking and hiking. During that time drinking water would be drawn from a surface water pond that captures runoff from the site and fish would be obtained from that pond. The recreationist does not ingest plants, meat, or milk obtained from the site.

3.0 PATHWAYS AND KEY PARAMETERS

Potential radiation doses resulting from multiple exposure pathways are considered in this analysis for all exposure scenarios. These pathways include:

- (1) direct exposure to external radiation from contaminated soil material,

- (2) internal radiation from inhalation of contaminated dust,
- (3) internal radiation from incidental ingestion of on-site soil,
- (4) internal radiation from ingestion of plant foods grown in the contaminated area and irrigated with an on-site water source,
- (5) internal radiation from ingestion of meat from livestock raised on site and fed with fodder grown in the contaminated area and irrigated with water drawn from an on-site well or pond (the water ingested by livestock is also drawn from an on-site water source),
- (6) internal radiation from ingestion of milk from livestock raised onsite and fed with fodder grown in the contaminated area and irrigated with on-site well water or pond water (the water ingested by milk cows is also drawn from on-site water source),
- (7) internal radiation from ingestion of fish from a pond located down nearby the contaminated area,
- (8) internal radiation from drinking water from a deep well,
- (9) internal radiation from drinking water from an on-site water source (pond water)
- (10) internal radiation from ingestion of plant foods grown off-site and irrigated with contaminated well water,
- (11) internal radiation from ingestion of meat from livestock raised off-site and fed with fodder grown off-site but irrigated with contaminated well water (the water ingested by livestock is also drawn from a deep well,
- (12) internal radiation from ingestion of milk from livestock raised off-site and fed with fodder grown off-site but irrigated with contaminated well water (the water ingested by milk cow is also drawn from the well), and
- (13) ingestion of fish from an off-site surface water source.

Table 1 summarizes the applicable exposure pathways for all scenarios and Table 2 lists the key parameters for the applicable exposure pathways. With exception of dimensions, cover depth, exposure time, and a few scenario-specific parameters, RESRAD Default values have been used for these calculations. Table 3 contains a list of parameters. Although they may be listed in Table 3, some parameters are not used in the calculations because the applicable pathway has been suppressed.

Table 1 Summary of Applicable Exposure Pathways for Different Scenarios Considered for Former Ford Nuclear Reactor Facility

Exposure Pathway	Applicable Pathways			
	Current Use		Future Use	
	Scenario A ^a	Scenario B ^b	Scenario D ^c	Scenario E ^d
Direct external gamma exposure	Yes	Yes	Yes	Yes
Inhalation of dust	Yes*	No	Yes	Yes
Ingestion of soil	Yes*	No	Yes	Yes
Ingestion of plant foods grown onsite	No	No	Yes	No
Ingestion of meat from livestock raised onsite	No	No	Yes	No
Ingestion of milk from livestock raised onsite	No	No	Yes	No
Ingestion of fish from an on-site pond	No	No	Yes	Yes
Ingestion of water from a down gradient deep well	No	No	Yes	No
Ingestion of water from a nearby surface water source	No	No	Yes	Yes
Ingestion of plant foods grown offsite	No	No	No	No
Ingestion of meat from livestock raised offsite	No	No	No	No
Ingestion of milk from livestock raised offsite	No	No	No	No
Ingestion of fish from surface water source offsite	No	No	No	No
^a Industrial Worker ^b Building Occupant ^c Subsistence Farmer ^d Recreationist * Phase A1 (cover removed) only.				

Table 2 List of Key Parameters for Applicable Exposure Pathways

Exposure Pathway	Key Parameters
Direct external gamma exposure	Time fraction spent on-site and external gamma shielding factor
Inhalation of dust	Inhalation rate, time fraction spent on-site, mass loading for inhalation, and indoor dust filtration factor
Ingestion of soil	Soil ingestion rate and time spent on-site
Ingestion of plant foods grown on-site	Plant transfer factor, plant ingestion rate, surface water dilution factor, and release rate from the source
Ingestion of meat from livestock raised on-site	Plant transfer factor, meat transfer factor, meat ingestion rate, water dilution factor, and release rate from the source
Ingestion of milk from livestock raised on-site	Plant transfer factor, milk transfer factor, milk ingestion rate, surface water dilution factor, and release rate from the source
Ingestion of fish from a nearby pond	Fish bioaccumulation factor, aquatic food contaminated fraction, surface water dilution factor, and release rate from the source

Ingestion of water from a downgradient well	Water ingestion rate, infiltration rate, Kd values (or leach rate) for contaminants, and hydrogeological parameters for the site
Ingestion of water from a nearby surface water source	Water ingestion rate, surface water dilution factor, and release rate from the source
Ingestion of plant foods grown off-site	Plant transfer factor, plant ingestion rate, surface water dilution factor, and release rate from the source
Ingestion of meat from livestock raised off-site	Plant transfer factor, meat transfer factor, meat ingestion rate, surface water dilution factor, and release rate from the source
Ingestion of milk from livestock raised off-site	Plant transfer factor, milk transfer factor, milk ingestion rate, surface water dilution factor, and release rate from the source
Ingestion of fish from surface water source off-site	Fish bioaccumulation factor, aquatic food contaminated fraction, surface water dilution factor, and release rate from the source

Table 3. Parameter Values Used for Deterministic Analysis of Different Scenarios

	Current Use Scenarios		Future Use Scenarios		
Input Parameters	A: Industrial worker	B: Building Occupant	D: Subsistence farmer	E: Recreationist	Comments
Title					
Title	Scenario dependent	Scenario dependent	Scenario dependent	Scenario dependent	Scenario Definition
Dose factor library	ICRP-60	ICRP-60	ICRP-60	ICRP-60	ICRP-60 methodology based DCFs (external from FGR-12 and internal from ICRP-72 and FRG-11 (C-14))
Cut-off Half Life (180 d or 30 d)	30 d	30 d	30 d	30 d	RESRAD default
Number of Points (32, 64, 128, 256, 512, 1024)	32	32	32	32	RESRAD default
Linear Spacing/Log Spacing	Log Spacing	Log Spacing	Log Spacing	Log Spacing	RESRAD default
Maximum No of Points for Dose	17	17	17	17	RESRAD default
Maximum No of Points for Risk	1	1	1	1	
Use line draw character (yes/no)	Yes	yes	yes	yes	RESRAD default
Find peak pathway dose (yes/no)	Yes	yes	yes	yes	
Save all files after each run (yes/no)	Yes	yes	yes	yes	
Time integrated probabilistic risk (yes/no)	No	no	no	no	Dose-to-source ratio (DSR) is calculated
Calculation Parameters					
Basic radiation dose limit (mrem/year)	25	25	25	25	Not used in DSR calculation
Times for calculation (years)	0, 1, 3, 10, 30, 100, 300, 1000	0, 1, 3, 10, 30, 100, 300, 1000	0, 3, 10, 30, 100, 300, 1000	0, 100, 300, 1000	
Source					
Nuclide concentration (pCi/g)	1	1	1	1	Dose-source ratios calculated
Transport Factors					
Distribution coefficient for zones (cm ³ /g)	Cont.; 1 Unsat.; NA	Cont.; 1 Unsat.; NA	Cont.; 1 Unsat.; 1	Cont.; 1 Unsat.; 1	
Number of unsaturated zones	NA	NA	1	1	RESRAD default
Time since placement of material (y)	0	0	0	0	RESRAD default

	Current Use Scenarios		Future Use Scenarios		
Input Parameters	A: Industrial worker	B: Building Occupant	D: Subsistence farmer	E: Recreationist	Comments
Groundwater concentration (pCi/L)	0	0	0	0	RESRAD default
Leach rate (1/y)	0	0	0	0	RESRAD default
Solubility limit (mol/L)	0	0	0	0	RESRAD default
Use plant/soil ration (check box)	No	No	No	No	RESRAD default
Transfer Factors					
Plant transfer factor (wet-plant weight concentration pCi/g / dry soil weight concentration pCi/g)	5.5	5.5	5.5	5.5	RESRAD Default
Meat transfer factor (concentration in meat pCi/g / rate of intake pCi/d)	0.031	0.031	0.031	0.031	RESRAD Default
Milk transfer factor (concentration in milk pCi/L / rate of intake pCi/d)	0.012	0.012	0.012	0.012	RESRAD Default
Fish transfer factor (concentration in fish pCi/Kg / concentration in water pCi/L)	50,000	50,000	50,000	50,000	RESRAD Default
Crustacea transfer factor (concentration in Crustacea pCi/Kg / concentration in water pCi/L)	9100	9100	9100	9100	RESRAD Default
Contaminated Zone Parameters					
Area of Contaminated Zone (m ²)	50	50	50	50	Characterization survey results
Thickness of Contaminated Zone (m)	1	1	1	1	Characterization survey results
Length Parallel to Aquifer Flow (m)	100	100	100	100	RESRAD default
Does the initial contamination penetrate the water table?	No	No	No	No	RESRAD default
Cover and Contaminated Zone Hydrological Data					
Cover Depth (m)	A1; 0 A2; 5	5	A1; 0 A2; 5	5	Characterization survey results
Density of Cover Material (g/cm ³)	A1; NA A2; 1.5	1.5	A1; NA A2; 1.5	1.5	RESRAD Default
Cover Erosion Rate (m/y)	NA	0.001	NA	0	RESRAD Default

	Current Use Scenarios		Future Use Scenarios		
Input Parameters	A: Industrial worker	B: Building Occupant	D: Subsistence farmer	E: Recreationist	Comments
Density of Primary Contaminated Zone (g/cm ³)	1.5	1.5	1.5	1.5	RESRAD Default
Contaminated Zone Erosion Rate (m/y)	0.001	0.001	0.001	0.001	RESRAD Default
Contaminated Zone Total Porosity	0.4	0.4	0.4	0.4	RESRAD Default
Contaminated Zone Field Capacity	0.2	0.2	0.2	0.2	RESRAD default
Contaminated Zone Hydraulic cond. (m/y)	10	10	10	10	RESRAD Default
Contaminated Zone b Parameter	5.3	5.3	5.3	5.3	RESRAD Default
Humidity in Air (g/m ³)	NA	NA	NA	NA	Used only for H-3
Evapotranspiration Coefficient	0.5	0.5	0.5	0.5	RESRAD Default
Wind Speed (m/s)	2.0	2.0	2.0	2.0	RESRAD Default
Precipitation rate (m/y)	1.0	1.0	1.0	1.0	RESRAD Default
Irrigation rate (m/y)	0.2	0.2	0.2	0.2	RESRAD Default
Irrigation mode (Overhead/Ditch)	Overhead	Overhead	Overhead	Overhead	RESRAD default
Runoff coefficient	0.2	0.2	0.2	0.2	RESRAD Default
Watershed area for nearby stream or pond (m ²)	NA	NA	1000000	1000000	RESRAD default
Accuracy for water/soil computation	NA	NA	0.001	0.001	RESRAD default
Saturated Zone Hydrological Data					
Density of saturated zone (g/cm ³)	NA	NA	1.5	1.5	RESRAD Default
Saturated zone effective porosity	NA	NA	0.2	0.2	RESRAD Default
Saturated zone total porosity	NA	NA	0.4	0.4	RESRAD Default
Saturated zone field capacity	NA	NA	0.2	0.2	RESRAD Default
Saturated zone hydraulic conductivity (m/y)	NA	NA	100	100	RESRAD Default
Saturated zone b parameter	NA	NA	5.3	5.3	RESRAD Default
Saturated zone hydraulic Gradient	NA	NA	0.02	0.02	RESRAD Default
Water table drop rate (m/y)	NA	NA	0.001	0.001	RESRAD default

	Current Use Scenarios		Future Use Scenarios		
Input Parameters	A: Industrial worker	B: Building Occupant	D: Subsistence farmer	E: Recreationist	Comments
Well pump intake depth (m below water table)	NA	NA	10	10	RESRAD Default
Model for water transportation (nondispersion / mass-balance)	NA	NA	Non-dispersion	Non-dispersion	RESRAD default
Well pumping rate (m ³ /y)	NA	NA	250	250	RESRAD default
Unsaturated zone parameters					
Thickness of unsaturated zone (m)	NA	NA	4	4	RESRAD Default
Density of unsaturated zone (g/cm ³)	NA	NA	1.5	1.5	RESRAD Default
Unsaturated zone effective porosity	NA	NA	0.2	0.2	RESRAD Default
Unsaturated zone total porosity	NA	NA	0.4	0.4	RESRAD Default
Unsaturated zone field capacity	NA	NA	0.2	0.2	RESRAD default
Unsaturated zone hydraulic conductivity (m/y)	NA	NA	10	10	RESRAD Default
Unsaturated zone b parameter	NA	NA	5.3	5.3	RESRAD Default
Occupancy, Inhalation, and External Gamma Parameters					
Inhalation rate (m ³ /y)	11,400	NA	8400	14,000	Scenario-specific
Mass loading for inhalation (g/m ³)	1E-4	NA	1E-4	1E-4	RESRAD default
Exposure duration (y)	25	30	30	30	Not used in DSR calculations
Indoor dust filtration factor	NA	NA	0.4	0.4	RESRAD default
External gamma shielding factor	A1; 0 A2; 0.7	0.7	A1; 0 A2; 0.7	NA	RESRAD default
Indoor time fraction	A1; 0.0571 A2; 0.0571	0.2285	0.6833	0	Scenario-specific
Outdoor time fraction	A1; 0.0571 A2; 0.0571	0	0.0833	0.0384	Scenario-specific
Shape of contaminated zone (circular/noncircular)	Circular	circular	circular	circular	Characterization survey results
Ingestion Pathway Dietary Data					
Fruit, vegetable and grain consumption	NA	NA	160	NA	RESRAD default

	Current Use Scenarios		Future Use Scenarios		
Input Parameters	A: Industrial worker	B: Building Occupant	D: Subsistence farmer	E: Recreationist	Comments
(kg/y)					
Leafy vegetable consumption (kg/y)	NA	NA	14	NA	RESRAD default
Milk consumption (L/y)	NA	NA	92	NA	RESRAD default
Meat and poultry consumption (kg/y)	NA	NA	63	NA	RESRAD default and scenario-specific for recreational use
Fish consumption (kg/y)	NA	NA	5.4	NA	RESRAD default and scenario-specific for recreational use
Other sea food consumption (kg/y)	NA	NA	0.9	0	RESRAD default; Rec. scenario specific.
Soil ingestion (g/y)	A1; 36.5 A2; 0	NA	36.5	36.5	RESRAD default
Drinking water intake (L/y)	NA	NA	510	19.6	RESRAD default and scenario specific for Recreation use
Drinking water contaminated fraction	NA	NA	1	1	RESRAD default and for offsite receptor scenario water is not contaminated
Household water contaminated fraction	NA	NA	NA	NA	RESRAD default
Livestock water contaminated fraction	NA	NA	1	NA	RESRAD default
Irrigation water contaminated fraction	NA	NA	1	NA	RESRAD default
Aquatic food contaminated fraction	NA	NA	0.5	0.5	Distribution from NUREG/CR-6697
Plant food contaminated fraction	NA	NA	-1	NA	Calculated by RESRAD from area factor
Meat contaminated fraction	NA	NA	-1	NA	Scenario specific
Milk contaminated fraction	NA	NA	-1	NA	Calculated by RESRAD from area factor
Ingestion Pathway, Nondietary Data					
Livestock fodder intake for meat (kg/d)	NA	NA	68	NA	RESRAD default or scenario specific
Livestock fodder intake for milk (kg/d)	NA	NA	55	NA	RESRAD default
Livestock water intake for meat (L/d)	NA	NA	50	NA	Or scenario specific
Livestock water intake for milk (L/d)	NA	NA	160	NA	RESRAD default
Livestock intake of soil for meat (kg/d)	NA	NA	0.5	NA	RESRAD default
Livestock intake of soil for milk (kg/d)	NA	NA	0.5	NA	RESRAD default
Mass loading for foliar deposition (g/m ³)	NA	NA	0.0001	NA	RESRAD default

	Current Use Scenarios		Future Use Scenarios		
Input Parameters	A: Industrial worker	B: Building Occupant	D: Subsistence farmer	E: Recreationist	Comments
Depth of soil mixing layer (m)	0.15	NA	0.15	NA	RESRAD default
Depth of roots (m)	NA	NA	0.9	NA	RESRAD default
Drinking water fraction from groundwater Source	NA	NA	1	NA	Scenario specific
Household water fraction from groundwater Source	NA	NA	NA	NA	Scenario specific
Livestock water fraction from groundwater Source	NA	NA	1	NA	RESRAD default for Resident Farmer and 0 for Recreational Use Scenario because surface water is used by livestock
Irrigation water fraction from groundwater Source	NA	NA	1	NA	RESRAD default
Plant Factors					
Wet weight crop yield for non-leafy vegetables (kg/m ²)	NA	NA	0.7	NA	RESRAD default
Length of growing season for non-leafy vegetables (y)	NA	NA	0.17	NA	RESRAD default
Translocation factor for non-leafy vegetables	NA	NA	0.1	NA	RESRAD default
Weathering removal constant (1/y)	NA	NA	20	NA	Distribution from NUREG/CR-6697
Wet foliar interception fraction for non-leafy vegetables	NA	NA	0.25	NA	RESRAD default
Dry foliar interception fraction for non-leafy vegetables	NA	NA	0.25	NA	RESRAD default
Wet weight crop yield for leafy vegetables (kg/m ²)	NA	NA	1.5	NA	RESRAD default
Length of growing season for leafy vegetables (y)	NA	NA	0.25	NA	RESRAD default
Translocation factor for leafy vegetables	NA	NA	1	NA	RESRAD default
Wet foliar interception fraction for leafy	NA	NA	0.25	NA	RESRAD default

	Current Use Scenarios		Future Use Scenarios		
Input Parameters	A: Industrial worker	B: Building Occupant	D: Subsistence farmer	E: Recreationist	Comments
vegetables					
Dry foliar interception fraction for leafy vegetables	NA	NA	0.25	NA	RESRAD default
Wet weight crop yield for fodder (kg/m ²)	NA	NA	1.1	NA	RESRAD default
Length of growing season for fodder (y)	NA	NA	0.08	NA	RESRAD default
Translocation factor for fodder	NA	NA	1	NA	RESRAD default
Wet foliar interception fraction for fodder	NA	NA	0.25	NA	RESRAD default
Dry foliar interception fraction for fodder	NA	NA	0.25	NA	RESRAD default
Storage-Times-Before-Use Data					
Storage time for fruits, non-leafy vegetables and grain (d)	14	NA	14	NA	RESRAD default
Storage time for leafy vegetables (d)	1	NA	1	NA	RESRAD default
Storage time for milk (d)	1	NA	1	NA	RESRAD default
Storage time for meat (d)	20	NA	20	NA	RESRAD default for Resident Farmer and scenario specific for Recreational Use
Storage time for fish (d)	7	NA	7	0	RESRAD default and scenario specific for Recreational use
Storage time for crustacea and mollusks (d)	7	NA	7	0	RESRAD default and scenario specific for Recreational use
Storage time for well water (d)	3	NA	1	NA	RESRAD default for Resident Farmer and not required for Recreational Use
Storage time for surface water (d)	1	NA	1	NA	RESRAD default for Resident Farmer and 0 for Recreational Use
Storage time for livestock fodder (d)	45	NA	45	NA	RESRAD default for Resident Farmer and scenario specific for Recreational Use

	Current Use Scenarios		Future Use Scenarios		
Input Parameters	A: Industrial worker	B: Building Occupant	D: Subsistence farmer	E: Recreationist	Comments
Radon Data	NA	NA	NA	NA	Radon not a potential contaminant
Carbon-14 Data					
C-12 concentration in local water, g/cm ³	2E-5	2E-5	2E-5	2E-5	RESRAD default
C-12 concentration in contaminated soil, g/g	0.03	0.03	0.03	0.03	RESRAD default
Fraction of vegetation carbon absorbed from soil	0.02	0.02	0.02	0.02	RESRAD default
Fraction of vegetation carbon absorbed from air	0.98	0.98	0.98	0.98	RESRAD default
Thickness of evasion layer of C-14 in soil, m	0.3	0.3	0.3	0.3	RESRAD default
C-14 evasion flux rate from soil, sec ⁻¹	7E-7	7E-7	7E-7	7E-7	RESRAD default
C-12 evasion flux rate from soil, sec ⁻¹	1E-10	1E-10	1E-10	1E-10	RESRAD default
Grain fraction in beef cattle feed	0.8	0.8	0.8	0.8	RESRAD default
Grain fraction in milk cow feed	0.2	0.2	0.2	0.2	RESRAD default

NA indicates not applicable to scenario.

3.0 RESULTS OF CALCULATIONS

Printouts of computer runs for the exposure scenarios are attached as an appendix to this report. Dose estimates for 1 pCi/g (at $t = 0$) of C-14 soil contamination are summarized in Table 5. Values less than $1\text{E-}02$ mrem/pCi/g would result in DCGL values greater than 2500 pCi/g; that value is therefore used as a lower dose bound.

Table 4 Annual Dose from 1 pCi/g of C-14 for Evaluated Scenarios

Time (yr)	Dose (mrem)				Recreationist
	Industrial Worker*	Building Occupant	Subsistence Farmer		
			5 m Cover	0 m Cover	
0	<1E-02	<1E-02	NA	NA	NA
1	<1E-02	<1E-02	NA	NA	NA
3	<1E-02	<1E-02	NA	NA	NA
10	<1E-02	<1E-02	NA	NA	NA
30	<1E-02	<1E-02	NA	NA	NA
100	NA	NA	<1E-02	<1E-02	<1E-02
300	NA	NA	<1E-02	<1E-02	<1E-02
1000	NA	NA	<1E-02	<1E-02	<1E-02

* Sum of dose from indoor and outdoor activities

Estimated annual doses from all of the scenarios evaluated were less than $1\text{E-}02$ mrem/y for a 1 pCi/g concentration of C-14. The concentration of C-14 in subsurface soil would therefore have to exceed 2500 pCi/g to deliver an annual dose of 25 mrem, based on any of these four scenarios. That concentration is therefore selected as the subsurface soil DCGL for residual C-14 at the FNR site. Criteria for other subsurface soil concentrations of other radionuclides, associated with the former FNR operations, will be the conservative Default Screening Values for surface soil.

Appendix F

DETECTION SENSITIVITIES FOR FNR SURVEY

F-1.0 Introduction

The final status of the former Ford Nuclear Reactor facility includes surface scans and contamination measurements of structure surfaces and gamma scans of exposed soil surfaces for residual radiological contaminants. Table F-1 is a listing of the radionuclides that have been identified as potential contaminants at the site. In order to assure that residual radioactivity satisfies established decommissioning criteria, instrumentation and survey methods must be capable of detecting residual radioactivity at levels below those criteria. This Appendix describes the determination of radiation detection sensitivities, following the methodology described in NUREG-1507, "Minimum Detectable concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions."

Table F-1 FNR Radiological Contaminants and Decommissioning Criteria (DCGL)

Radionuclide	Surface Soil DCGL (pCi/g)	Subsurface Soil DCGL (pCi/g)	Structure Surface DCGL (dpm/100 cm ²)	
			Total	Removable
Co-60	3.8	46	7050	705
Cs-137	11.0	211	28000	2800
Ag-108m	8.2	130	17000	1700
Ag-110m	4.92	N/A	10200	1020
C-14	N/A	2500	N/A	N/A
Eu-152	N/A	103	N/A	N/A
Gross beta	N/A	N/A	5125	512
a. N/A = not applicable or not present as a contaminant. b. Includes short-lived daughter products present due to assumed ingrowth period of 20 years.				

F-2.0 Gamma Scans

Gamma scan surveys are conducted using a Ludlum Model 44-10, 2-in.-diameter × 2-in.-thick detector, coupled with a Ludlum Model 2221 scaler/ratemeter, with an open energy window for all photon energies above the input threshold setting of 10 mV. The detector is passed over the ground surface in a serpentine pattern. The nominal distance from the detector to the surface is estimated at 5 cm. The serpentine path of the detector is approximately 0.75 to 1 m in width, and the rate of advancement is approximately 0.5 m/second. The audible signal from the instrument is monitored by the surveyor. Detectable changes in the count rate are noted, and the immediate area resurveyed at a reduced speed to confirm the change in audible signal and, if applicable, to identify the boundary of the impacted area. The minimum detectable count rate (MDCR) is a function of the background count rate (BKGD) in counts per minute (cpm) and the time (i) in seconds that the detector is within close proximity to the source of radiation. Equation 6-6 of NUREG-1507 provides the following relationship:

$$\text{MDCR} = d' [\text{BKGD} \cdot i / 60]^{1/2} \cdot 60 / i \quad (\text{B1})$$

For the purposes of application to FNR Final Status Surveys, the area of contaminated soil of concern is assumed to be 0.5 m². At a speed of 0.5 m/second, the time (i) in close proximity to the source is, therefore, estimated to be approximately 1 second. A high probability (95%) of true detection is the objective, and the survey is willing to accept a high probability of false-positive detections (60%) with resulting investigations. The value of d' is selected from Table 6.1 in NUREG-1507 to be 1.38. The nominal site background count rates for the 2 × 2 detectors is 8,000 cpm. Based on these parameters, the MDCR is calculated to be 956 cpm.

The minimum detectable count rate is converted to a radionuclide concentration, using factors representing the detector response in cpm/μR/h and the exposure rate per unit activity concentration in μR/h/pCi/g. Values for the detector response for various photon energies are available in tables obtained from NUREG-1507, Table 6.3, and the *Multi-Agency Radiation Survey and Assessment of Materials and Equipment Manual* (MARSAME), Appendix F (EPA et al. 2009). A summary of these values is provided in Table F-2. Values for the exposure rate per unit activity were calculated using Version 6.02 of the Microshield computer code. Secular equilibrium of short half-life daughter products with parent was assumed for an ingrowth period of 30 years. The design parameters were uniform concentration in a 50-cm diameter, × 15-cm-thick slab of soil (density 1.5 g/cm³). The exposure rate, was determined at 5 cm above the surface for various photon energies. The products of these two factors for all applicable energy regions was calculated and summed for an overall response factor of cpm/pCi/g associated with a particular radionuclide. These values are summarized in Table F-3.

To account for less than ideal survey performance, a surveyor efficiency factor (p) of (0.5)^{1/2} was also incorporated into the final calculation as follows:

$$\text{Scan Sensitivity (pCi/g)} = \frac{\text{MDCR}}{(0.5)^{1/2} \cdot (\text{cpm/pCi/g})} \quad (\text{B2})$$

The resulting scan sensitivity for the potential soil contaminants is also presented in Table F-3, along with the soil DCGL's for comparison.

Table F-2 Detector count rate versus exposure rate (cpm/ μ R/h)

Energy (keV)	2-in. \times 2-in. detector
15	---
20	2200
30	5160
40	8880
50	11800
60	13000
80	12000
100	9840
150	6040
200	4230
300	2520
400	1700
500	1270
600	1010
800	710
1000	540
1500	350
2000	260
3000	180

Table F-3 Values of cpm/pCi/g and MDC for potential soil contaminants

Radionuclide	cpm/pCi/g	MDC (pCi/g)	Surface Soil DCGL (pCi/g)	Subsurface Soil DCGL (pCi/g)
Co-60	515	2.62	3.8	46
Cs-137	266	5.08	11.0	211
Ag-108m	976	1.39	8.2	130
Ag-110m	910	1.49	4.92	N/A
C-14	N/A ^a	N/A	N/A	2500
Eu-152	433	3.12	N/A	103

^a beta emitter only, not detectable by gamma scans

F-3.0 Structure Beta Scans

Beta scan surveys are conducted using a Ludlum Model 44-142, 100 cm² scintillation detector or a Ludlum Model 43-37, 572 cm² gas proportional detector, coupled with a Ludlum Model 2221 scaler/ratemeters. The detector is passed over the surface at a rate of 1 detector width/sec (i=1) for the Model 44-142 detector and ½ detector width /sec (i = 2) for the Model 43-37 detector, while maintaining the distance from the detector to the surface at approximately 0.5 cm. The audible signal from the instrument is monitored by the surveyor. Detectable changes in the count rate are noted, and the immediate area resurveyed at a reduced speed to confirm the change in audible signal and, if applicable, to identify the boundary of the impacted area. The minimum detectable count rate (MDCR) is a function of the background count rate (BKGD) in counts per minute (cpm) and the time (i) in seconds that the detector is within close proximity to the source of radiation. Equation 6-6 of NUREG-1507 provides the following relationship:

$$MDCR = d' [BKGD \cdot i / 60]^{1/2} \cdot 60 / i \quad (B1)$$

A high probability (95%) of true detection is the objective, and the survey is willing to accept a high probability of false-positive detections (60%) with resulting investigations. The value of d' is selected from Table 6.1 in NUREG-1507 to be 1.38. The nominal site background count rates for the 100 cm² and 572 cm² detectors are 300 cpm and 990 cpm, respectively. Based on these parameters, the MDCR is calculated to be 185 cpm for the 100 cm² detector and 238 cpm for the 572 cm² detector .

Applying detector efficiency values of 0.40 (Model 44-142) and 0.33 (Model 43-37), surface correction of 0.37, surveyor efficiency of (0.5)^{1/2}, and detector area factors results in an estimated scan detection sensitivity of 1770 dpm/100 cm² for the Model 44-142 detector and 480 dpm/100 cm² (2760 dpm/total probe area) for the 43-37 detector.

F-4.0 Structure Beta Activity Measurements

Direct measurements of beta surface activity are performed using a Ludlum Model 44-142, 100 cm² scintillation detector, coupled with a Ludlum Model 2221 scaler/ratemeter. The detector is placed on the surface and allowed to integrate the count for a period of 1 minute. The MDC is calculated by proximity to the source of radiation. NUREG-1507 provides the following relationship:

$$MDC = [3 + 4.65 (BKGD)^{1/2}] / \text{efficiency factors}$$

The resulting value is 560 dpm/100 cm².

Smears for removable activity are counted for 1 minute in a Tennelec low-background alpha/beta counter. The backgrounds are 0.00 alpha cpm and 1.67 beta cpm; 4π detection efficiencies are 0.079 alpha and 0.24 beta. Using the same equation as above

for direct measurements yields removable activity MDCs of 38 alpha dpm/100 cm² and 38 beta dpm/100 cm².

F-5.0. References

EPA et al., 2009, *Multi-Agency Radiation Survey and Assessment of Materials and Equipment Manual (MARSAME)*, EPA 420-R-09-001, U.S. Environmental Protection Agency, U.S. Nuclear Regulatory Commission, U.S. Department of Defense, and U.S. Department of Energy,

NUREG-1507, 1997, *Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions*, U.S. Nuclear Regulatory Commission, December 1997. January 2001.

APPENDIX A

Printouts of RESRAD Computer Runs

Summary : UM_C14_r0a_5m

File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\UM\C14\IWC14_R0A_5M.RAD

(FR)

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Industrial Worker

C14

5m

IDF = 0.0571

ODF = 0.0571

Summary : UM_C14_r0a_5m

File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\UM\C14\IWC14_R0A_5M.RAD

Dose Conversion Factor (and Related) Parameter Summary

Dose Library: FGR 12 & FGR 11

Menu	Parameter	Current Value#	Base Case*	Parameter Name
A-1	DCF's for external ground radiation, (mrem/yr)/(pCi/g)			
A-1	C-14 (Source: FGR 12)	1.345E-05	1.345E-05	DCF1(1)
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	C-14(p) (Class: ORGANIC)	2.090E-06	2.090E-06	DCF2(1)
B-1	C-14(g) (Class: CO2)	2.350E-08	2.350E-08	C14GInhDCF
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	C-14	2.090E-06	2.090E-06	DCF3(1)
D-34	Food transfer factors:			
D-34	C-14 , plant/soil concentration ratio, dimensionless	5.500E+00	5.500E+00	RTF(1,1)
D-34	C-14 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.100E-02	3.100E-02	RTF(1,2)
D-34	C-14 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.200E-02	1.200E-02	RTF(1,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	C-14 , fish	5.000E+04	5.000E+04	BIOFAC(1,1)
D-5	C-14 , crustacea and mollusks	9.100E+03	9.100E+03	BIOFAC(1,2)

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

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

Summary : UM_C14_r0a_5m

File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\UM\C14\IWC14_R0A_5M.RAD

Site-Specific Parameter Summary

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R011	Area of contaminated zone (m**2)	5.000E+01	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	1.000E+00	2.000E+00	---	THICKO
R011	Fraction of contamination that is submerged	0.000E+00	0.000E+00	---	SUBMFRACT
R011	Length parallel to aquifer flow (m)	not used	1.000E+02	---	LCZPAQ
R011	Basic radiation dose limit (mrem/yr)	2.500E+01	3.000E+01	---	BRDL
R011	Time since placement of material (yr)	0.000E+00	0.000E+00	---	TI
R011	Times for calculations (yr)	1.000E+00	1.000E+00	---	T (2)
R011	Times for calculations (yr)	3.000E+00	3.000E+00	---	T (3)
R011	Times for calculations (yr)	1.000E+01	1.000E+01	---	T (4)
R011	Times for calculations (yr)	3.000E+01	3.000E+01	---	T (5)
R011	Times for calculations (yr)	1.000E+02	1.000E+02	---	T (6)
R011	Times for calculations (yr)	3.000E+02	3.000E+02	---	T (7)
R011	Times for calculations (yr)	1.000E+03	1.000E+03	---	T (8)
R011	Times for calculations (yr)	not used	0.000E+00	---	T (9)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(10)
R012	Initial principal radionuclide (pCi/g): C-14	1.000E+00	0.000E+00	---	S1(1)
R012	Concentration in groundwater (pCi/L): C-14	not used	0.000E+00	---	W1(1)
R013	Cover depth (m)	5.000E+00	0.000E+00	---	COVERO
R013	Density of cover material (g/cm**3)	1.500E+00	1.500E+00	---	DENSCV
R013	Cover depth erosion rate (m/yr)	1.000E-03	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)	1.000E-03	1.000E-03	---	VCZ
R013	Contaminated zone total porosity	4.000E-01	4.000E-01	---	TPCZ
R013	Contaminated zone field capacity	2.000E-01	2.000E-01	---	FCCZ
R013	Contaminated zone hydraulic conductivity (m/yr)	1.000E+01	1.000E+01	---	HCCZ
R013	Contaminated zone b parameter	5.300E+00	5.300E+00	---	BCZ
R013	Average annual wind speed (m/sec)	2.000E+00	2.000E+00	---	WIND
R013	Humidity in air (g/m**3)	not used	8.000E+00	---	HUMID
R013	Evapotranspiration coefficient	5.000E-01	5.000E-01	---	EVAPTR
R013	Precipitation (m/yr)	1.000E+00	1.000E+00	---	PRECIP
R013	Irrigation (m/yr)	2.000E-01	2.000E-01	---	RI
R013	Irrigation mode	overhead	overhead	---	IDITCH
R013	Runoff coefficient	2.000E-01	2.000E-01	---	RUNOFF
R013	Watershed area for nearby stream or pond (m**2)	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

Summary : UM_C14_r0a_5m

File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\UM\C14\IWC14_R0A_5M.RAD

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R015	Number of unsaturated zone strata	not used	1	---	NS
R015	Unsat. zone 1, thickness (m)	not used	4.000E+00	---	H(1)
R015	Unsat. zone 1, soil density (g/cm**3)	not used	1.500E+00	---	DENSUZ(1)
R015	Unsat. zone 1, total porosity	not used	4.000E-01	---	TPUZ(1)
R015	Unsat. zone 1, effective porosity	not used	2.000E-01	---	EPUZ(1)
R015	Unsat. zone 1, field capacity	not used	2.000E-01	---	FCUZ(1)
R015	Unsat. zone 1, soil-specific b parameter	not used	5.300E+00	---	BUZ(1)
R015	Unsat. zone 1, hydraulic conductivity (m/yr)	not used	1.000E+01	---	HCUZ(1)
R016	Distribution coefficients for C-14				
R016	Contaminated zone (cm**3/g)	1.000E+00	0.000E+00	---	DCNUCC(1)
R016	Unsat. zone 1 (cm**3/g)	not used	0.000E+00	---	DCNUCU(1,1)
R016	Saturated zone (cm**3/g)	not used	0.000E+00	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.746E-01	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
R017	Inhalation rate (m**3/yr)	1.140E+04	8.400E+03	---	INHALR
R017	Mass loading for inhalation (g/m**3)	1.000E-04	1.000E-04	---	MLINH
R017	Exposure duration	2.500E+01	3.000E+01	---	ED
R017	Shielding factor, inhalation	4.000E-01	4.000E-01	---	SHF3
R017	Shielding factor, external gamma	7.000E-01	7.000E-01	---	SHF1
R017	Fraction of time spent indoors	5.710E-02	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	5.710E-02	2.500E-01	---	FOTD
R017	Shape factor flag, external gamma	1.000E+00	1.000E+00	>0 shows circular AREA.	FS
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)

Summary : UM_C14_r0a_5m

File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\UM\C14\IWC14_R0A_5M.RAD

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R017	Fractions of annular areas within AREA:				
R017	Ring 1	not used	1.000E+00	---	FRACA(1)
R017	Ring 2	not used	2.732E-01	---	FRACA(2)
R017	Ring 3	not used	0.000E+00	---	FRACA(3)
R017	Ring 4	not used	0.000E+00	---	FRACA(4)
R017	Ring 5	not used	0.000E+00	---	FRACA(5)
R017	Ring 6	not used	0.000E+00	---	FRACA(6)
R017	Ring 7	not used	0.000E+00	---	FRACA(7)
R017	Ring 8	not used	0.000E+00	---	FRACA(8)
R017	Ring 9	not used	0.000E+00	---	FRACA(9)
R017	Ring 10	not used	0.000E+00	---	FRACA(10)
R017	Ring 11	not used	0.000E+00	---	FRACA(11)
R017	Ring 12	not used	0.000E+00	---	FRACA(12)
R018	Fruits, vegetables and grain consumption (kg/yr)	not used	1.600E+02	---	DIET(1)
R018	Leafy vegetable consumption (kg/yr)	not used	1.400E+01	---	DIET(2)
R018	Milk consumption (L/yr)	not used	9.200E+01	---	DIET(3)
R018	Meat and poultry consumption (kg/yr)	not used	6.300E+01	---	DIET(4)
R018	Fish consumption (kg/yr)	not used	5.400E+00	---	DIET(5)
R018	Other seafood consumption (kg/yr)	not used	9.000E-01	---	DIET(6)
R018	Soil ingestion rate (g/yr)	0.000E+00	3.650E+01	---	SOIL
R018	Drinking water intake (L/yr)	not used	5.100E+02	---	DWI
R018	Contamination fraction of drinking water	not used	1.000E+00	---	FDW
R018	Contamination fraction of household water	not used	1.000E+00	---	FHHW
R018	Contamination fraction of livestock water	not used	1.000E+00	---	FLW
R018	Contamination fraction of irrigation water	not used	1.000E+00	---	FIRW
R018	Contamination fraction of aquatic food	not used	5.000E-01	---	FR9
R018	Contamination fraction of plant food	not used	-1	---	FPLANT
R018	Contamination fraction of meat	not used	-1	---	FMEAT
R018	Contamination fraction of milk	not used	-1	---	FMILK
R019	Livestock fodder intake for meat (kg/day)	not used	6.800E+01	---	LFI5
R019	Livestock fodder intake for milk (kg/day)	not used	5.500E+01	---	LF16
R019	Livestock water intake for meat (L/day)	not used	5.000E+01	---	LWI5
R019	Livestock water intake for milk (L/day)	not used	1.600E+02	---	LWI6
R019	Livestock soil intake (kg/day)	not used	5.000E-01	---	LSI
R019	Mass loading for foliar deposition (g/m**3)	not used	1.000E-04	---	MLFD
R019	Depth of soil mixing layer (m)	1.500E-01	1.500E-01	---	DM
R019	Depth of roots (m)	not used	9.000E-01	---	DROOT
R019	Drinking water fraction from ground water	not used	1.000E+00	---	FGWDW
R019	Household water fraction from ground water	not used	1.000E+00	---	FGWHH
R019	Livestock water fraction from ground water	not used	1.000E+00	---	FGWLW
R019	Irrigation fraction from ground water	not used	1.000E+00	---	FGWIR
R19B	Wet weight crop yield for Non-Leafy (kg/m**2)	not used	7.000E-01	---	YV(1)
R19B	Wet weight crop yield for Leafy (kg/m**2)	not used	1.500E+00	---	YV(2)
R19B	Wet weight crop yield for Fodder (kg/m**2)	not used	1.100E+00	---	YV(3)
R19B	Growing Season for Non-Leafy (years)	not used	1.700E-01	---	TE(1)
R19B	Growing Season for Leafy (years)	not used	2.500E-01	---	TE(2)
R19B	Growing Season for Fodder (years)	not used	8.000E-02	---	TE(3)

Summary : UM_C14_r0a_5m

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Site-Specific Parameter Summary (continued)

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

Summary : UM_C14_r0a_5m

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Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
TITL	Maximum number of integration points for dose	17	---	---	LYMAX
TITL	Maximum number of integration points for risk	257	---	---	KYMAX

Summary of Pathway Selections

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

Summary : UM_C14_r0a_5m

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Contaminated Zone Dimensions		Initial Soil Concentrations, pCi/g	
Area:	50.00 square meters	C-14	1.000E+00
Thickness:	1.00 meters		
Cover Depth:	5.00 meters		

Total Dose TDOSE(t), mrem/yr

Basic Radiation Dose Limit = 2.500E+01 mrem/yr

Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

t (years):	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
TDOSE(t):	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
M(t):	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

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

Summary : UM_C14_r0a_5m

File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\UM\C14\IWC14_R0A_5M.RAD

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

Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	frac
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.00
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	0.000E+00	0.00

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

Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	frac
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.00
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	0.000E+00	0.00

*Sum of all water independent and dependent pathways.

Summary : UM_C14_r0a_5m

File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\UM\C14\IWC14_R0A_5M.RAD

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

Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	frac
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.00
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	0.000E+00	0.00

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

Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	frac
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.00
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	0.000E+00	0.00

*Sum of all water independent and dependent pathways.

Summary : UM_C14_r0a_5m

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

Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	frac
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.00
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	0.000E+00	0.00

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

Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	frac
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.00
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	0.000E+00	0.00

*Sum of all water independent and dependent pathways.

Summary : UM_C14_r0a_5m

File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\UM\C14\IWC14_R0A_5M.RAD

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

Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	frac
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.00
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	0.000E+00	0.00

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

Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	frac
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.00
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	0.000E+00	0.00

*Sum of all water independent and dependent pathways.

Summary : UM_C14_r0a_5m

File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\UM\C14\IWC14_R0A_5M.RAD

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

Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	frac
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.00
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	0.000E+00	0.00

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

Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	frac
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.00
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	0.000E+00	0.00

*Sum of all water independent and dependent pathways.

Summary : UM_C14_r0a_5m

File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\UM\C14\IWC14_R0A_5M.RAD

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

Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	frac
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.00
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	0.000E+00	0.00

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

Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	frac
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.00
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	0.000E+00	0.00

*Sum of all water independent and dependent pathways.

Summary : UM_C14_r0a_5m

File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\UM\C14\IWC14_ROA_5M.RAD

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

Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	frac
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.00
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	0.000E+00	0.00

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

Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	frac
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.00
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	0.000E+00	0.00

*Sum of all water independent and dependent pathways.

Summary : UM_C14_r0a_5m

File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\UM\C14\IWC14_R0A_5M.RAD

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

Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	frac
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.00
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	0.000E+00	0.00

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

Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	frac
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.00
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	0.000E+00	0.00

*Sum of all water independent and dependent pathways.

Summary : UM_C14_r0a_5m

File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\UM\C14\IWC14_ROA_5M.RAD

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

Parent (i)	Product (j)	Thread Fraction	DSR(j,t) At Time in Years (mrem/yr)/(pCi/g)							
			0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
C-14	C-14	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

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

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

Nuclide									
(i)	t=	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
C-14	*4.455E+12	*4.455E+12	*4.455E+12	*4.455E+12	*4.455E+12	*4.455E+12	*4.455E+12	*4.455E+12	*4.455E+12

*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 t_{min} = time of minimum single radionuclide soil guideline
and at t_{max} = time of maximum total dose = 0.000E+00 years

Nuclide (i)	Initial (pCi/g)	t _{min} (years)	DSR(i,t _{min}) (pCi/g)	G(i,t _{min}) (pCi/g)	DSR(i,t _{max}) (pCi/g)	G(i,t _{max}) (pCi/g)
C-14	1.000E+00	0.000E+00	0.000E+00	*4.455E+12	0.000E+00	*4.455E+12

*At specific activity limit

Summary : UM_C14_r0a_5m

File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\UM\C14\IWC14_ROA_5M.RAD

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	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
C-14	C-14	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

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

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	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
C-14	C-14	1.000E+00	1.000E+00	7.598E-01	4.386E-01	6.412E-02	2.636E-04	1.174E-12	1.617E-36	0.000E+00	0.000E+00

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

RESCALC.EXE execution time = 8.72 seconds

Summary : Building Occupant_C14_r0a_5m

File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\UM\C14\BOC14_R0A_5M.RAD

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Total Dose Components	
Time = 0.000E+00	9
Time = 1.000E+00	10
Time = 3.000E+00	11
Time = 1.000E+01	12
Time = 3.000E+01	13
Time = 1.000E+02	14
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Building Occupant.

C14

IDF = 0.2285

ODF = 0.0

Summary : Building Occupant_C14_r0a_5m

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Dose Conversion Factor (and Related) Parameter Summary

Dose Library: FGR 12 & FGR 11

Menu	Parameter	Current Value#	Base Case*	Parameter Name
A-1	DCF's for external ground radiation, (mrem/yr)/(pCi/g)			
A-1	C-14 (Source: FGR 12)	1.345E-05	1.345E-05	DCF1(1)
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	C-14(p) (Class: ORGANIC)	2.090E-06	2.090E-06	DCF2(1)
B-1	C-14(g) (Class: CO2)	2.350E-08	2.350E-08	C14GIInhDCF
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	C-14	2.090E-06	2.090E-06	DCF3(1)
D-34	Food transfer factors:			
D-34	C-14 , plant/soil concentration ratio, dimensionless	5.500E+00	5.500E+00	RTF(1,1)
D-34	C-14 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.100E-02	3.100E-02	RTF(1,2)
D-34	C-14 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.200E-02	1.200E-02	RTF(1,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	C-14 , fish	5.000E+04	5.000E+04	BIOFAC(1,1)
D-5	C-14 , crustacea and mollusks	9.100E+03	9.100E+03	BIOFAC(1,2)

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

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

Summary : Building Occupant_C14_r0a_5m

File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\UM\C14\BOC14_R0A_5M.RAD

Site-Specific Parameter Summary

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R011	Area of contaminated zone (m**2)	5.000E+01	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	1.000E+00	2.000E+00	---	THICKO
R011	Fraction of contamination that is submerged	0.000E+00	0.000E+00	---	SUBMFRACT
R011	Length parallel to aquifer flow (m)	not used	1.000E+02	---	LCZPAQ
R011	Basic radiation dose limit (mrem/yr)	2.500E+01	3.000E+01	---	BRDL
R011	Time since placement of material (yr)	0.000E+00	0.000E+00	---	TI
R011	Times for calculations (yr)	1.000E+00	1.000E+00	---	T(2)
R011	Times for calculations (yr)	3.000E+00	3.000E+00	---	T(3)
R011	Times for calculations (yr)	1.000E+01	1.000E+01	---	T(4)
R011	Times for calculations (yr)	3.000E+01	3.000E+01	---	T(5)
R011	Times for calculations (yr)	1.000E+02	1.000E+02	---	T(6)
R011	Times for calculations (yr)	3.000E+02	3.000E+02	---	T(7)
R011	Times for calculations (yr)	1.000E+03	1.000E+03	---	T(8)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(9)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(10)
R012	Initial principal radionuclide (pCi/g): C-14	1.000E+00	0.000E+00	---	S1(1)
R012	Concentration in groundwater (pCi/L): C-14	not used	0.000E+00	---	W1(1)
R013	Cover depth (m)	5.000E+00	0.000E+00	---	COVERO
R013	Density of cover material (g/cm**3)	1.500E+00	1.500E+00	---	DENSCV
R013	Cover depth erosion rate (m/yr)	1.000E-03	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)	1.000E-03	1.000E-03	---	VCZ
R013	Contaminated zone total porosity	4.000E-01	4.000E-01	---	TPCZ
R013	Contaminated zone field capacity	2.000E-01	2.000E-01	---	FCCZ
R013	Contaminated zone hydraulic conductivity (m/yr)	1.000E+01	1.000E+01	---	HCCZ
R013	Contaminated zone b parameter	5.300E+00	5.300E+00	---	BCZ
R013	Average annual wind speed (m/sec)	2.000E+00	2.000E+00	---	WIND
R013	Humidity in air (g/m**3)	not used	8.000E+00	---	HUMID
R013	Evapotranspiration coefficient	5.000E-01	5.000E-01	---	EVAPTR
R013	Precipitation (m/yr)	1.000E+00	1.000E+00	---	PRECIP
R013	Irrigation (m/yr)	2.000E-01	2.000E-01	---	RI
R013	Irrigation mode	overhead	overhead	---	IDITCH
R013	Runoff coefficient	2.000E-01	2.000E-01	---	RUNOFF
R013	Watershed area for nearby stream or pond (m**2)	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

Summary : Building Occupant_C14_r0a_5m

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Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R015	Number of unsaturated zone strata	not used	1	---	NS
R015	Unsat. zone 1, thickness (m)	not used	4.000E+00	---	H(1)
R015	Unsat. zone 1, soil density (g/cm**3)	not used	1.500E+00	---	DENSUZ(1)
R015	Unsat. zone 1, total porosity	not used	4.000E-01	---	TPUZ(1)
R015	Unsat. zone 1, effective porosity	not used	2.000E-01	---	EPUZ(1)
R015	Unsat. zone 1, field capacity	not used	2.000E-01	---	FCUZ(1)
R015	Unsat. zone 1, soil-specific b parameter	not used	5.300E+00	---	BUZ(1)
R015	Unsat. zone 1, hydraulic conductivity (m/yr)	not used	1.000E+01	---	HCUZ(1)
R016	Distribution coefficients for C-14				
R016	Contaminated zone (cm**3/g)	1.000E+00	0.000E+00	---	DCNUCC(1)
R016	Unsaturated zone 1 (cm**3/g)	not used	0.000E+00	---	DCNUCU(1,1)
R016	Saturated zone (cm**3/g)	not used	0.000E+00	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.746E-01	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
R017	Inhalation rate (m**3/yr)	not used	8.400E+03	---	INHALR
R017	Mass loading for inhalation (g/m**3)	not used	1.000E-04	---	MLINH
R017	Exposure duration	3.000E+01	3.000E+01	---	ED
R017	Shielding factor, inhalation	not used	4.000E-01	---	SHF3
R017	Shielding factor, external gamma	7.000E-01	7.000E-01	---	SHF1
R017	Fraction of time spent indoors	2.285E-01	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	0.000E+00	2.500E-01	---	FOTD
R017	Shape factor flag, external gamma	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)

Summary : Building Occupant_C14_r0a_5m

File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\UM\C14\BOC14_R0A_5M.RAD

Site-Specific Parameter Summary (continued)

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

Summary : Building Occupant_C14_r0a_5m

File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\UM\C14\BOC14_R0A_5M.RAD

Site-Specific Parameter Summary (continued)

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

Summary : Building Occupant_C14_r0a_5m

File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\UM\C14\BOC14_R0A_5M.RAD

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
TITL	Maximum number of integration points for dose	17	---	---	LYMAX
TITL	Maximum number of integration points for risk	257	---	---	KYMAX

Summary of Pathway Selections

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

Summary : Building Occupant C14_r0a_5m

File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\UM\C14\BOC14_R0A_5M.RAD

Contaminated Zone Dimensions

Initial Soil Concentrations, pCi/g

Area: 50.00 square meters
 Thickness: 1.00 meters
 Cover Depth: 5.00 meters

C-14 1.000E+00

Total Dose TDOSE(t), mrem/yr

Basic Radiation Dose Limit = 2.500E+01 mrem/yr

Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

t (years):	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
TDOSE(t):	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
M(t):	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

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

Summary : Building Occupant_C14_r0a_5m

File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\UM\C14\BOC14_R0A_5M.RAD

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

Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	frac
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.00
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	0.000E+00	0.00

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

Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	frac
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.00
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	0.000E+00	0.00

*Sum of all water independent and dependent pathways.

Summary : Building Occupant_C14_r0a_5m

File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\UM\C14\BOC14_ROA_5M.RAD

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

Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	frac
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.00
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	0.000E+00	0.00

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

Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	frac
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.00
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	0.000E+00	0.00

*Sum of all water independent and dependent pathways.

Summary : Building Occupant_C14_r0a_5m

File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\UM\C14\BOC14_R0A_5M.RAD

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

Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	frac
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.00
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	0.000E+00	0.00

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

Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	frac
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.00
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	0.000E+00	0.00

*Sum of all water independent and dependent pathways.

Summary : Building Occupant_C14_r0a_5m

File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\UM\C14\BOC14_R0A_5M.RAD

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

Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	frac
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.00
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	0.000E+00	0.00

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

Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	frac
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.00
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	0.000E+00	0.00

*Sum of all water independent and dependent pathways.

Summary : Building Occupant_C14_r0a_5m

File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\UM\C14\BOC14_R0A_5M.RAD

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

Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	frac
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.00
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	0.000E+00	0.00

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

Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	frac
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.00
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	0.000E+00	0.00

*Sum of all water independent and dependent pathways.

Summary : Building Occupant_C14_r0a_5m

File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\UM\C14\BOC14_R0A_5M.RAD

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

Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	frac
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.00
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	0.000E+00	0.00

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

Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	frac
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.00
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	0.000E+00	0.00

*Sum of all water independent and dependent pathways.

Summary : Building Occupant_C14_r0a_5m

File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\UM\C14\BOC14_R0A_5M.RAD

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

Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	frac
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.00
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	0.000E+00	0.00

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

Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	frac
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.00
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	0.000E+00	0.00

*Sum of all water independent and dependent pathways.

Summary : Building Occupant_C14_r0a_5m

File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\UM\C14\BOC14_R0A_5M.RAD

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

Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	frac
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.00
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	0.000E+00	0.00

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

Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	frac
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.00
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	0.000E+00	0.00

*Sum of all water independent and dependent pathways.

Summary : Building Occupant_C14_r0a_5m

File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\UM\C14\BOC14_R0A_5M.RAD

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

Parent (i)	Product (j)	Thread Fraction	DSR(j,t) At Time in Years (mrem/yr)/(pCi/g)							
			0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
C-14	C-14	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

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

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

Nuclide (i)	t=	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
C-14	*4.455E+12	*4.455E+12	*4.455E+12	*4.455E+12	*4.455E+12	*4.455E+12	*4.455E+12	*4.455E+12	*4.455E+12

*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)
C-14	1.000E+00	0.000E+00	0.000E+00	*4.455E+12	0.000E+00	*4.455E+12

*At specific activity limit

Summary : Building Occupant_C14_r0a_5m

File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\UM\C14\BOC14_R0A_5M.RAD

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	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
C-14	C-14	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

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

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	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
C-14	C-14	1.000E+00	1.000E+00	7.598E-01	4.386E-01	6.412E-02	2.636E-04	1.174E-12	1.617E-36	0.000E+00	0.000E+00

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

RESCALC.EXE execution time = 8.58 seconds

Summary : Subsistence Farmer_C14_r0b_5m

File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\UM\C14\SFC14_ROC_5M.RAD

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Total Dose Components	
Time = 0.000E+00	9
Time = 1.000E+00	10
Time = 3.000E+00	11
Time = 1.000E+01	12
Time = 3.000E+01	13
Time = 1.000E+02	14
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Farmer

C14

5 m

$IDS = 0.6833$

$ODS = 0.0887$

Summary : Subsistence Farmer_C14_r0b_5m

File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\UM\C14\SFC14_R0C_5M.RAD

Dose Conversion Factor (and Related) Parameter Summary

Dose Library: FGR 12 & FGR 11

Menu	Parameter	Current Value#	Base Case*	Parameter Name
A-1	DCF's for external ground radiation, (mrem/yr)/(pCi/g)			
A-1	C-14 (Source: FGR 12)	1.345E-05	1.345E-05	DCF1(1)
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	C-14(p) (Class: ORGANIC)	2.090E-06	2.090E-06	DCF2(1)
B-1	C-14(g) (Class: CO2)	2.350E-08	2.350E-08	C14GInhDCF
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	C-14	2.090E-06	2.090E-06	DCF3(1)
D-34	Food transfer factors:			
D-34	C-14 , plant/soil concentration ratio, dimensionless	5.500E+00	5.500E+00	RTF(1,1)
D-34	C-14 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.100E-02	3.100E-02	RTF(1,2)
D-34	C-14 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.200E-02	1.200E-02	RTF(1,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	C-14 , fish	5.000E+04	5.000E+04	BIOFAC(1,1)
D-5	C-14 , crustacea and mollusks	9.100E+03	9.100E+03	BIOFAC(1,2)

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

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

Summary : Subsistence Farmer_C14_r0b_5m

File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\UM\C14\SFC14_ROC_5M.RAD

Site-Specific Parameter Summary

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R011	Area of contaminated zone (m**2)	5.000E+01	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	1.000E+00	2.000E+00	---	THICK0
R011	Fraction of contamination that is submerged	0.000E+00	0.000E+00	---	SUBMFRACT
R011	Length parallel to aquifer flow (m)	1.000E+02	1.000E+02	---	LCZPAQ
R011	Basic radiation dose limit (mrem/yr)	2.500E+01	3.000E+01	---	BRDL
R011	Time since placement of material (yr)	0.000E+00	0.000E+00	---	TI
R011	Times for calculations (yr)	1.000E+00	1.000E+00	---	T(2)
R011	Times for calculations (yr)	3.000E+00	3.000E+00	---	T(3)
R011	Times for calculations (yr)	1.000E+01	1.000E+01	---	T(4)
R011	Times for calculations (yr)	3.000E+01	3.000E+01	---	T(5)
R011	Times for calculations (yr)	1.000E+02	1.000E+02	---	T(6)
R011	Times for calculations (yr)	3.000E+02	3.000E+02	---	T(7)
R011	Times for calculations (yr)	1.000E+03	1.000E+03	---	T(8)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(9)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(10)
R012	Initial principal radionuclide (pCi/g): C-14	1.000E+00	0.000E+00	---	S1(1)
R012	Concentration in groundwater (pCi/L): C-14	not used	0.000E+00	---	W1(1)
R013	Cover depth (m)	5.000E+00	0.000E+00	---	COVER0
R013	Density of cover material (g/cm**3)	1.500E+00	1.500E+00	---	DENSCV
R013	Cover depth erosion rate (m/yr)	1.000E-03	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)	1.000E-03	1.000E-03	---	VCZ
R013	Contaminated zone total porosity	4.000E-01	4.000E-01	---	TPCZ
R013	Contaminated zone field capacity	2.000E-01	2.000E-01	---	FCCZ
R013	Contaminated zone hydraulic conductivity (m/yr)	1.000E+01	1.000E+01	---	HCCZ
R013	Contaminated zone b parameter	5.300E+00	5.300E+00	---	BCZ
R013	Average annual wind speed (m/sec)	2.000E+00	2.000E+00	---	WIND
R013	Humidity in air (g/m**3)	not used	8.000E+00	---	HUMID
R013	Evapotranspiration coefficient	5.000E-01	5.000E-01	---	EVAPTR
R013	Precipitation (m/yr)	1.000E+00	1.000E+00	---	PRECIP
R013	Irrigation (m/yr)	2.000E-01	2.000E-01	---	RI
R013	Irrigation mode	overhead	overhead	---	IDITCH
R013	Runoff coefficient	2.000E-01	2.000E-01	---	RUNOFF
R013	Watershed area for nearby stream or pond (m**2)	1.000E+06	1.000E+06	---	WAREA
R013	Accuracy for water/soil computations	1.000E-03	1.000E-03	---	EPS
R014	Density of saturated zone (g/cm**3)	1.500E+00	1.500E+00	---	DENSAQ
R014	Saturated zone total porosity	4.000E-01	4.000E-01	---	TPSZ
R014	Saturated zone effective porosity	2.000E-01	2.000E-01	---	EPSZ
R014	Saturated zone field capacity	2.000E-01	2.000E-01	---	FCSZ
R014	Saturated zone hydraulic conductivity (m/yr)	1.000E+02	1.000E+02	---	HCSZ
R014	Saturated zone hydraulic gradient	2.000E-02	2.000E-02	---	HGWT
R014	Saturated zone b parameter	5.300E+00	5.300E+00	---	BSZ
R014	Water table drop rate (m/yr)	1.000E-03	1.000E-03	---	VWT
R014	Well pump intake depth (m below water table)	1.000E+01	1.000E+01	---	DWIBWT
R014	Model: Nondispersion (ND) or Mass-Balance (MB)	ND	ND	---	MODEL
R014	Well pumping rate (m**3/yr)	2.500E+02	2.500E+02	---	UW

Summary : Subsistence Farmer_C14_r0b_5m

File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\UM\C14\SFC14_ROC_5M.RAD

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R015	Number of unsaturated zone strata	1	1	---	NS
R015	Unsat. zone 1, thickness (m)	4.000E+00	4.000E+00	---	H(1)
R015	Unsat. zone 1, soil density (g/cm**3)	1.500E+00	1.500E+00	---	DENSUZ(1)
R015	Unsat. zone 1, total porosity	4.000E-01	4.000E-01	---	TPUZ(1)
R015	Unsat. zone 1, effective porosity	2.000E-01	2.000E-01	---	EPUZ(1)
R015	Unsat. zone 1, field capacity	2.000E-01	2.000E-01	---	FCUZ(1)
R015	Unsat. zone 1, soil-specific b parameter	5.300E+00	5.300E+00	---	BUZ(1)
R015	Unsat. zone 1, hydraulic conductivity (m/yr)	1.000E+01	1.000E+01	---	HCUZ(1)
R016	Distribution coefficients for C-14				
R016	Contaminated zone (cm**3/g)	1.000E+00	0.000E+00	---	DCNUCC(1)
R016	Unsaturated zone 1 (cm**3/g)	1.000E+00	0.000E+00	---	DCNUCU(1,1)
R016	Saturated zone (cm**3/g)	5.000E+00	0.000E+00	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.746E-01	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
R017	Inhalation rate (m**3/yr)	8.400E+03	8.400E+03	---	INHALR
R017	Mass loading for inhalation (g/m**3)	1.000E-04	1.000E-04	---	MLINH
R017	Exposure duration	3.000E+01	3.000E+01	---	ED
R017	Shielding factor, inhalation	4.000E-01	4.000E-01	---	SHF3
R017	Shielding factor, external gamma	7.000E-01	7.000E-01	---	SHF1
R017	Fraction of time spent indoors	6.833E-01	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	8.330E-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)

Summary : Subsistence Farmer_C14_r0b_5m

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Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R017	Fractions of annular areas within AREA:				
R017	Ring 1	not used	1.000E+00	---	FRACA (1)
R017	Ring 2	not used	2.732E-01	---	FRACA (2)
R017	Ring 3	not used	0.000E+00	---	FRACA (3)
R017	Ring 4	not used	0.000E+00	---	FRACA (4)
R017	Ring 5	not used	0.000E+00	---	FRACA (5)
R017	Ring 6	not used	0.000E+00	---	FRACA (6)
R017	Ring 7	not used	0.000E+00	---	FRACA (7)
R017	Ring 8	not used	0.000E+00	---	FRACA (8)
R017	Ring 9	not used	0.000E+00	---	FRACA (9)
R017	Ring 10	not used	0.000E+00	---	FRACA (10)
R017	Ring 11	not used	0.000E+00	---	FRACA (11)
R017	Ring 12	not used	0.000E+00	---	FRACA (12)
R018	Fruits, vegetables and grain consumption (kg/yr)	1.600E+02	1.600E+02	---	DIET (1)
R018	Leafy vegetable consumption (kg/yr)	1.400E+01	1.400E+01	---	DIET (2)
R018	Milk consumption (L/yr)	9.200E+01	9.200E+01	---	DIET (3)
R018	Meat and poultry consumption (kg/yr)	6.300E+01	6.300E+01	---	DIET (4)
R018	Fish consumption (kg/yr)	5.400E+00	5.400E+00	---	DIET (5)
R018	Other seafood consumption (kg/yr)	9.000E-01	9.000E-01	---	DIET (6)
R018	Soil ingestion rate (g/yr)	3.650E+01	3.650E+01	---	SOIL
R018	Drinking water intake (L/yr)	5.100E+02	5.100E+02	---	DWI
R018	Contamination fraction of drinking water	1.000E+00	1.000E+00	---	FDW
R018	Contamination fraction of household water	not used	1.000E+00	---	FHHW
R018	Contamination fraction of livestock water	1.000E+00	1.000E+00	---	FLW
R018	Contamination fraction of irrigation water	1.000E+00	1.000E+00	---	FIRW
R018	Contamination fraction of aquatic food	5.000E-01	5.000E-01	---	FR9
R018	Contamination fraction of plant food	-1	-1	0.250E-01	FPLANT
R018	Contamination fraction of meat	-1	-1	0.250E-02	FMEAT
R018	Contamination fraction of milk	-1	-1	0.250E-02	FMILK
R019	Livestock fodder intake for meat (kg/day)	6.800E+01	6.800E+01	---	LFI5
R019	Livestock fodder intake for milk (kg/day)	5.500E+01	5.500E+01	---	LFI6
R019	Livestock water intake for meat (L/day)	5.000E+01	5.000E+01	---	LWI5
R019	Livestock water intake for milk (L/day)	1.600E+02	1.600E+02	---	LWI6
R019	Livestock soil intake (kg/day)	5.000E-01	5.000E-01	---	LSI
R019	Mass loading for foliar deposition (g/m**3)	1.000E-04	1.000E-04	---	MLFD
R019	Depth of soil mixing layer (m)	1.500E-01	1.500E-01	---	DM
R019	Depth of roots (m)	9.000E-01	9.000E-01	---	DROOT
R019	Drinking water fraction from ground water	1.000E+00	1.000E+00	---	FGWDW
R019	Household water fraction from ground water	not used	1.000E+00	---	FGWHH
R019	Livestock water fraction from ground water	1.000E+00	1.000E+00	---	FGWLW
R019	Irrigation fraction from ground water	1.000E+00	1.000E+00	---	FGWIR
R19B	Wet weight crop yield for Non-Leafy (kg/m**2)	7.000E-01	7.000E-01	---	YV (1)
R19B	Wet weight crop yield for Leafy (kg/m**2)	1.500E+00	1.500E+00	---	YV (2)
R19B	Wet weight crop yield for Fodder (kg/m**2)	1.100E+00	1.100E+00	---	YV (3)
R19B	Growing Season for Non-Leafy (years)	1.700E-01	1.700E-01	---	TE (1)
R19B	Growing Season for Leafy (years)	2.500E-01	2.500E-01	---	TE (2)
R19B	Growing Season for Fodder (years)	8.000E-02	8.000E-02	---	TE (3)

Summary : Subsistence Farmer_C14_r0b_5m

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Site-Specific Parameter Summary (continued)

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

Summary : Subsistence Farmer_C14_r0b_5m

File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\UM\C14\SFC14_R0C_5M.RAD

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
TITL	Maximum number of integration points for dose	17	---	---	LYMAX
TITL	Maximum number of integration points for risk	257	---	---	KYMAX

Summary of Pathway Selections

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

Summary : Subsistence Farmer_C14_r0b_5m

File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\UM\C14\SFC14_ROC_5M.RAD

Contaminated Zone Dimensions		Initial Soil Concentrations, pCi/g	
Area:	50.00 square meters	C-14	1.000E+00
Thickness:	1.00 meters		
Cover Depth:	5.00 meters		

Total Dose TDOSE(t), mrem/yr

Basic Radiation Dose Limit = 2.500E+01 mrem/yr

Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

t (years):	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
TDOSE(t):	0.000E+00	0.000E+00	0.000E+00	1.249E-03	2.163E-03	5.420E-05	1.142E-28	0.000E+00
M(t):	0.000E+00	0.000E+00	0.000E+00	4.997E-05	8.653E-05	2.168E-06	4.569E-30	0.000E+00

Maximum TDOSE(t): 2.165E-03 mrem/yr at t = 35.22 ± 0.07 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 = 3.522E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	frac
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.00
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	0.000E+00	0.00

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 3.522E+01 years

Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	frac
C-14	1.611E-03	0.7443	5.494E-04	0.2538	0.000E+00	0.0000	2.839E-06	0.0013	2.907E-07	0.0001	9.847E-07	0.0005	2.165E-03	1.00
Total	1.611E-03	0.7443	5.494E-04	0.2538	0.000E+00	0.0000	2.839E-06	0.0013	2.907E-07	0.0001	9.847E-07	0.0005	2.165E-03	1.00

*Sum of all water independent and dependent pathways.

Summary : Subsistence Farmer_C14_r0b_5m

File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\UM\C14\SFC14_R0C_5M.RAD

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

Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	frac
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.00
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	0.000E+00	0.00

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

Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	frac
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.00
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	0.000E+00	0.00

*Sum of all water independent and dependent pathways.

Summary : Subsistence Farmer_C14_r0b_5m

File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\UM\C14\SFC14_ROC_5M.RAD

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

Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	frac
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.00
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	0.000E+00	0.00

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

Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	frac
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.00
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	0.000E+00	0.00

*Sum of all water independent and dependent pathways.

Summary : Subsistence Farmer_C14_r0b_5m

File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\UM\C14\SFC14_R0C_5M.RAD

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

Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	frac
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.00
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	0.000E+00	0.00

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

Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	frac
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.00
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	0.000E+00	0.00

*Sum of all water independent and dependent pathways.

Summary : Subsistence Farmer_C14_r0b_5m

File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\UM\C14\SFC14_R0C_5M.RAD

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

Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	frac
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.00
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	0.000E+00	0.00

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

Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	frac
C-14	9.307E-04	0.7450	3.162E-04	0.2531	0.000E+00	0.0000	1.627E-06	0.0013	1.655E-07	0.0001	5.682E-07	0.0005	1.249E-03	1.00
Total	9.307E-04	0.7450	3.162E-04	0.2531	0.000E+00	0.0000	1.627E-06	0.0013	1.655E-07	0.0001	5.682E-07	0.0005	1.249E-03	1.00

*Sum of all water independent and dependent pathways.

Summary : Subsistence Farmer_C14_r0b_5m

File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\UM\C14\SFC14_R0C_5M.RAD

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

Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	frac
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.00
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	0.000E+00	0.00

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

Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	frac
C-14	1.610E-03	0.7443	5.489E-04	0.2538	0.000E+00	0.0000	2.837E-06	0.0013	2.905E-07	0.0001	9.839E-07	0.0005	2.163E-03	1.00
Total	1.610E-03	0.7443	5.489E-04	0.2538	0.000E+00	0.0000	2.837E-06	0.0013	2.905E-07	0.0001	9.839E-07	0.0005	2.163E-03	1.00

*Sum of all water independent and dependent pathways.

Summary : Subsistence Farmer_C14_r0b_5m

File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\UM\C14\SFC14_ROC_5M.RAD

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

Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	frac
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.00
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	0.000E+00	0.00

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

Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	frac
C-14	4.030E-05	0.7435	1.380E-05	0.2546	0.000E+00	0.0000	7.174E-08	0.0013	7.407E-09	0.0001	2.465E-08	0.0005	5.420E-05	1.00
Total	4.030E-05	0.7435	1.380E-05	0.2546	0.000E+00	0.0000	7.174E-08	0.0013	7.407E-09	0.0001	2.465E-08	0.0005	5.420E-05	1.00

*Sum of all water independent and dependent pathways.

Summary : Subsistence Farmer_C14_r0b_5m

File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\UM\C14\SFC14_R0C_5M.RAD

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

Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	frac
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.00
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	0.000E+00	0.00

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

Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	frac
C-14	8.508E-29	0.7449	2.914E-29	0.2551	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.142E-28	1.00
Total	8.508E-29	0.7449	2.914E-29	0.2551	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.142E-28	1.00

*Sum of all water independent and dependent pathways.

Summary : Subsistence Farmer_C14_r0b_5m

File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\UM\C14\SFC14_R0C_5M.RAD

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

Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
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	0.000E+00	0.0000

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

Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
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	0.000E+00	0.0000

*Sum of all water independent and dependent pathways.

Summary : Subsistence Farmer_C14_r0b_5m

File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\UM\C14\SFC14_R0C_5M.RAD

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

Parent (i)	Product (j)	Thread Fraction	DSR(j,t) At Time in Years (mrem/yr)/(pCi/g)							
			0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
C-14	C-14	1.000E+00	0.000E+00	0.000E+00	0.000E+00	1.249E-03	2.163E-03	5.420E-05	1.144E-28	0.000E+00

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

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

Nuclide (i)	t=	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
C-14	*4.455E+12	*4.455E+12	*4.455E+12	2.001E+04	1.156E+04	4.612E+05	*4.455E+12	*4.455E+12	

*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 = 35.22 ± 0.07 years

Nuclide (i)	Initial (pCi/g)	tmin (years)	DSR(i,tmin)	G(i,tmin) (pCi/g)	DSR(i,tmax)	G(i,tmax) (pCi/g)
C-14	1.000E+00	35.22 ± 0.07	2.165E-03	1.155E+04	2.165E-03	1.155E+04

Summary : Subsistence Farmer_C14_r0b_5m

File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\UM\C14\SFC14_R0C_5M.RAD

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	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
C-14	C-14	1.000E+00	0.000E+00	0.000E+00	0.000E+00	1.249E-03	2.163E-03	5.420E-05	1.142E-28	0.000E+00	

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

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	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
C-14	C-14	1.000E+00		1.000E+00	7.598E-01	4.386E-01	6.412E-02	2.636E-04	1.174E-12	1.617E-36	0.000E+00

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

RESRAD.EXE execution time = 218.51 seconds

Summary : Subsistence Farmer_C14_r0a_0m

File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\UM\C14\SFC14_R0A_0M.RAD

(FR)

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Time = 0.000E+00	9
Time = 1.000E+00	10
Time = 3.000E+00	11
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Farmer

C14

0m

IDF = 0.6833

DDF = 0.0833

Summary : Subsistence Farmer_C14_r0a_0m

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Dose Conversion Factor (and Related) Parameter Summary

Dose Library: FGR 12 & FGR 11

Menu	Parameter	Current Value#	Base Case*	Parameter Name
A-1	DCF's for external ground radiation, (mrem/yr)/(pCi/g)			
A-1	C-14 (Source: FGR 12)	1.345E-05	1.345E-05	DCF1(1)
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	C-14(p) (Class: ORGANIC)	2.090E-06	2.090E-06	DCF2(1)
B-1	C-14(g) (Class: CO2)	2.350E-08	2.350E-08	C14GInhDCF
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	C-14	2.090E-06	2.090E-06	DCF3(1)
D-34	Food transfer factors:			
D-34	C-14 , plant/soil concentration ratio, dimensionless	5.500E+00	5.500E+00	RTF(1,1)
D-34	C-14 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.100E-02	3.100E-02	RTF(1,2)
D-34	C-14 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.200E-02	1.200E-02	RTF(1,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	C-14 , fish	5.000E+04	5.000E+04	BIOFAC(1,1)
D-5	C-14 , crustacea and mollusks	9.100E+03	9.100E+03	BIOFAC(1,2)

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

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

Summary : Subsistence Farmer_C14_r0a_0m

File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\UM\C14\SFC14_R0A_0M.RAD

Site-Specific Parameter Summary

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R011	Area of contaminated zone (m**2)	5.000E+01	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	1.000E+00	2.000E+00	---	THICK0
R011	Fraction of contamination that is submerged	0.000E+00	0.000E+00	---	SUBMFRACT
R011	Length parallel to aquifer flow (m)	1.000E+02	1.000E+02	---	LCZPAQ
R011	Basic radiation dose limit (mrem/yr)	2.500E+01	3.000E+01	---	BRDL
R011	Time since placement of material (yr)	0.000E+00	0.000E+00	---	TI
R011	Times for calculations (yr)	1.000E+00	1.000E+00	---	T(2)
R011	Times for calculations (yr)	3.000E+00	3.000E+00	---	T(3)
R011	Times for calculations (yr)	1.000E+01	1.000E+01	---	T(4)
R011	Times for calculations (yr)	3.000E+01	3.000E+01	---	T(5)
R011	Times for calculations (yr)	1.000E+02	1.000E+02	---	T(6)
R011	Times for calculations (yr)	3.000E+02	3.000E+02	---	T(7)
R011	Times for calculations (yr)	1.000E+03	1.000E+03	---	T(8)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(9)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(10)
R012	Initial principal radionuclide (pCi/g): C-14	1.000E+00	0.000E+00	---	SI(1)
R012	Concentration in groundwater (pCi/L): C-14	not used	0.000E+00	---	WI(1)
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)	1.000E-03	1.000E-03	---	VCZ
R013	Contaminated zone total porosity	4.000E-01	4.000E-01	---	TPCZ
R013	Contaminated zone field capacity	2.000E-01	2.000E-01	---	FCCZ
R013	Contaminated zone hydraulic conductivity (m/yr)	1.000E+01	1.000E+01	---	HCCZ
R013	Contaminated zone b parameter	5.300E+00	5.300E+00	---	BCZ
R013	Average annual wind speed (m/sec)	2.000E+00	2.000E+00	---	WIND
R013	Humidity in air (g/m**3)	not used	8.000E+00	---	HUMID
R013	Evapotranspiration coefficient	5.000E-01	5.000E-01	---	EVAPTR
R013	Precipitation (m/yr)	1.000E+00	1.000E+00	---	PRECIP
R013	Irrigation (m/yr)	2.000E-01	2.000E-01	---	RI
R013	Irrigation mode	overhead	overhead	---	IDITCH
R013	Runoff coefficient	2.000E-01	2.000E-01	---	RUNOFF
R013	Watershed area for nearby stream or pond (m**2)	1.000E+06	1.000E+06	---	WAREA
R013	Accuracy for water/soil computations	1.000E-03	1.000E-03	---	EPS
R014	Density of saturated zone (g/cm**3)	1.500E+00	1.500E+00	---	DENSAQ
R014	Saturated zone total porosity	4.000E-01	4.000E-01	---	TPSZ
R014	Saturated zone effective porosity	2.000E-01	2.000E-01	---	EPSZ
R014	Saturated zone field capacity	2.000E-01	2.000E-01	---	FCSZ
R014	Saturated zone hydraulic conductivity (m/yr)	1.000E+02	1.000E+02	---	HCSZ
R014	Saturated zone hydraulic gradient	2.000E-02	2.000E-02	---	HGWT
R014	Saturated zone b parameter	5.300E+00	5.300E+00	---	BSZ
R014	Water table drop rate (m/yr)	1.000E-03	1.000E-03	---	VWT
R014	Well pump intake depth (m below water table)	1.000E+01	1.000E+01	---	DWIBWT
R014	Model: Nondispersion (ND) or Mass-Balance (MB)	ND	ND	---	MODEL
R014	Well pumping rate (m**3/yr)	2.500E+02	2.500E+02	---	UW

Summary : Subsistence Farmer_C14_r0a_0m

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Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R015	Number of unsaturated zone strata	1	1	---	NS
R015	Unsat. zone 1, thickness (m)	4.000E+00	4.000E+00	---	H(1)
R015	Unsat. zone 1, soil density (g/cm**3)	1.500E+00	1.500E+00	---	DENSUZ(1)
R015	Unsat. zone 1, total porosity	4.000E-01	4.000E-01	---	TPUZ(1)
R015	Unsat. zone 1, effective porosity	2.000E-01	2.000E-01	---	EPUZ(1)
R015	Unsat. zone 1, field capacity	2.000E-01	2.000E-01	---	FCUZ(1)
R015	Unsat. zone 1, soil-specific b parameter	5.300E+00	5.300E+00	---	BUZ(1)
R015	Unsat. zone 1, hydraulic conductivity (m/yr)	1.000E+01	1.000E+01	---	HCUZ(1)
R016	Distribution coefficients for C-14				
R016	Contaminated zone (cm**3/g)	1.000E+00	0.000E+00	---	DCNUCC(1)
R016	Unsaturated zone 1 (cm**3/g)	1.000E+00	0.000E+00	---	DCNUCU(1,1)
R016	Saturated zone (cm**3/g)	5.000E+00	0.000E+00	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.746E-01	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
R017	Inhalation rate (m**3/yr)	8.400E+03	8.400E+03	---	INHALR
R017	Mass loading for inhalation (g/m**3)	1.000E-04	1.000E-04	---	MLINH
R017	Exposure duration	3.000E+01	3.000E+01	---	ED
R017	Shielding factor, inhalation	4.000E-01	4.000E-01	---	SHF3
R017	Shielding factor, external gamma	7.000E-01	7.000E-01	---	SHF1
R017	Fraction of time spent indoors	6.833E-01	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	8.330E-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)

Summary : Subsistence Farmer_C14_r0a_0m

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Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R017	Fractions of annular areas within AREA:				
R017	Ring 1	not used	1.000E+00	---	FRACA(1)
R017	Ring 2	not used	2.732E-01	---	FRACA(2)
R017	Ring 3	not used	0.000E+00	---	FRACA(3)
R017	Ring 4	not used	0.000E+00	---	FRACA(4)
R017	Ring 5	not used	0.000E+00	---	FRACA(5)
R017	Ring 6	not used	0.000E+00	---	FRACA(6)
R017	Ring 7	not used	0.000E+00	---	FRACA(7)
R017	Ring 8	not used	0.000E+00	---	FRACA(8)
R017	Ring 9	not used	0.000E+00	---	FRACA(9)
R017	Ring 10	not used	0.000E+00	---	FRACA(10)
R017	Ring 11	not used	0.000E+00	---	FRACA(11)
R017	Ring 12	not used	0.000E+00	---	FRACA(12)
R018	Fruits, vegetables and grain consumption (kg/yr)	1.600E+02	1.600E+02	---	DIET(1)
R018	Leafy vegetable consumption (kg/yr)	1.400E+01	1.400E+01	---	DIET(2)
R018	Milk consumption (L/yr)	9.200E+01	9.200E+01	---	DIET(3)
R018	Meat and poultry consumption (kg/yr)	6.300E+01	6.300E+01	---	DIET(4)
R018	Fish consumption (kg/yr)	5.400E+00	5.400E+00	---	DIET(5)
R018	Other seafood consumption (kg/yr)	9.000E-01	9.000E-01	---	DIET(6)
R018	Soil ingestion rate (g/yr)	3.650E+01	3.650E+01	---	SOIL
R018	Drinking water intake (L/yr)	5.100E+02	5.100E+02	---	DWI
R018	Contamination fraction of drinking water	1.000E+00	1.000E+00	---	FDW
R018	Contamination fraction of household water	not used	1.000E+00	---	FHHW
R018	Contamination fraction of livestock water	1.000E+00	1.000E+00	---	FLW
R018	Contamination fraction of irrigation water	1.000E+00	1.000E+00	---	FIRW
R018	Contamination fraction of aquatic food	5.000E-01	5.000E-01	---	FR9
R018	Contamination fraction of plant food	-1	-1	0.250E-01	FPLANT
R018	Contamination fraction of meat	-1	-1	0.250E-02	FMEAT
R018	Contamination fraction of milk	-1	-1	0.250E-02	FMILK
R019	Livestock fodder intake for meat (kg/day)	6.800E+01	6.800E+01	---	LFI5
R019	Livestock fodder intake for milk (kg/day)	5.500E+01	5.500E+01	---	LFI6
R019	Livestock water intake for meat (L/day)	5.000E+01	5.000E+01	---	LWI5
R019	Livestock water intake for milk (L/day)	1.600E+02	1.600E+02	---	LWI6
R019	Livestock soil intake (kg/day)	5.000E-01	5.000E-01	---	LSI
R019	Mass loading for foliar deposition (g/m**3)	1.000E-04	1.000E-04	---	MLFD
R019	Depth of soil mixing layer (m)	1.500E-01	1.500E-01	---	DM
R019	Depth of roots (m)	9.000E-01	9.000E-01	---	DROOT
R019	Drinking water fraction from ground water	1.000E+00	1.000E+00	---	FGWDW
R019	Household water fraction from ground water	not used	1.000E+00	---	FGWHH
R019	Livestock water fraction from ground water	1.000E+00	1.000E+00	---	FGWLW
R019	Irrigation fraction from ground water	1.000E+00	1.000E+00	---	FGWIR
R19B	Wet weight crop yield for Non-Leafy (kg/m**2)	7.000E-01	7.000E-01	---	YV(1)
R19B	Wet weight crop yield for Leafy (kg/m**2)	1.500E+00	1.500E+00	---	YV(2)
R19B	Wet weight crop yield for Fodder (kg/m**2)	1.100E+00	1.100E+00	---	YV(3)
R19B	Growing Season for Non-Leafy (years)	1.700E-01	1.700E-01	---	TE(1)
R19B	Growing Season for Leafy (years)	2.500E-01	2.500E-01	---	TE(2)
R19B	Growing Season for Fodder (years)	8.000E-02	8.000E-02	---	TE(3)

Summary : Subsistence Farmer_C14_r0a_0m

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Site-Specific Parameter Summary (continued)

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

Summary : Subsistence Farmer_C14_r0a_0m

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Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
TITL	Maximum number of integration points for dose	17	---	---	LYMAX
TITL	Maximum number of integration points for risk	257	---	---	KYMAX

Summary of Pathway Selections

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

Summary : Subsistence Farmer_C14_r0a_0m

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Contaminated Zone Dimensions		Initial Soil Concentrations, pCi/g	
Area:	50.00 square meters	C-14	1.000E+00
Thickness:	1.00 meters		
Cover Depth:	0.00 meters		

Total Dose TDOSE(t), mrem/yr

Basic Radiation Dose Limit = 2.500E+01 mrem/yr

Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

t (years):	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
TDOSE(t):	2.137E-03	2.547E-06	2.395E-12	8.669E-05	8.632E-05	0.000E+00	0.000E+00	0.000E+00
M(t):	8.549E-05	1.019E-07	9.579E-14	3.468E-06	3.453E-06	0.000E+00	0.000E+00	0.000E+00

Maximum TDOSE(t): 2.137E-03 mrem/yr at t = 0.000E+00 years

Summary : Subsistence Farmer_C14_r0a_0m

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

Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	frac
C-14	8.386E-07	0.0004	6.099E-06	0.0029	0.000E+00	0.0000	2.023E-03	0.9467	7.941E-05	0.0372	2.722E-05	0.0127	4.227E-07	0.00
Total	8.386E-07	0.0004	6.099E-06	0.0029	0.000E+00	0.0000	2.023E-03	0.9467	7.941E-05	0.0372	2.722E-05	0.0127	4.227E-07	0.00

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

Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	frac
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.137E-03	1.00
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	2.137E-03	1.00

*Sum of all water independent and dependent pathways.

Summary : Subsistence Farmer_C14_r0a_0m

File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\UM\C14\SFC14_R0A_0M.RAD

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

Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	frac
C-14	8.290E-10	0.0003	6.029E-09	0.0024	0.000E+00	0.0000	2.353E-06	0.9239	1.437E-07	0.0564	4.274E-08	0.0168	4.178E-10	0.00
Total	8.290E-10	0.0003	6.029E-09	0.0024	0.000E+00	0.0000	2.353E-06	0.9239	1.437E-07	0.0564	4.274E-08	0.0168	4.178E-10	0.00

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

Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	frac
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.547E-06	1.00
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	2.547E-06	1.00

*Sum of all water independent and dependent pathways.

Summary : Subsistence Farmer_C14_r0a_0m

File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\UM\C14\SFC14_R0A_0M.RAD

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

Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	frac
C-14	7.784E-16	0.0003	5.661E-15	0.0024	0.000E+00	0.0000	2.212E-12	0.9237	1.356E-13	0.0566	4.026E-14	0.0168	3.923E-16	0.00
Total	7.784E-16	0.0003	5.661E-15	0.0024	0.000E+00	0.0000	2.212E-12	0.9237	1.356E-13	0.0566	4.026E-14	0.0168	3.923E-16	0.00

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

Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	frac
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.395E-12	1.00
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	2.395E-12	1.00

*Sum of all water independent and dependent pathways.

Summary : Subsistence Farmer_C14_r0a_0m

File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\UM\C14\SFC14_R0A_0M.RAD

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

Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	frac
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.00
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	0.000E+00	0.00

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

Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	frac
C-14	6.453E-05	0.7444	2.200E-05	0.2537	0.000E+00	0.0000	1.137E-07	0.0013	1.164E-08	0.0001	3.943E-08	0.0005	8.669E-05	1.00
Total	6.453E-05	0.7444	2.200E-05	0.2537	0.000E+00	0.0000	1.137E-07	0.0013	1.164E-08	0.0001	3.943E-08	0.0005	8.669E-05	1.00

*Sum of all water independent and dependent pathways.

Summary : Subsistence Farmer_C14_r0a_0m

File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\UM\C14\SFC14_R0A_0M.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	frac
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.00
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	0.000E+00	0.00

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years

Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	frac
C-14	6.425E-05	0.7443	2.190E-05	0.2538	0.000E+00	0.0000	1.132E-07	0.0013	1.159E-08	0.0001	3.926E-08	0.0005	8.632E-05	1.00
Total	6.425E-05	0.7443	2.190E-05	0.2538	0.000E+00	0.0000	1.132E-07	0.0013	1.159E-08	0.0001	3.926E-08	0.0005	8.632E-05	1.00

*Sum of all water independent and dependent pathways.

Summary : Subsistence Farmer_C14_r0a_0m

File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\UM\C14\SFC14_R0A_0M.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	frac
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.00
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	0.000E+00	0.00

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	frac
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.00
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	0.000E+00	0.00

*Sum of all water independent and dependent pathways.

Summary : Subsistence Farmer_C14_r0a_0m

File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\UM\C14\SFC14_R0A_0M.RAD

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

Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	frac
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.00
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	0.000E+00	0.00

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

Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	frac
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.00
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	0.000E+00	0.00

*Sum of all water independent and dependent pathways.

Summary : Subsistence Farmer_C14_r0a_0m

File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\UM\C14\SFC14_R0A_0M.RAD

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

Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	frac
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.00
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	0.000E+00	0.00

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

Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	frac
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.00
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	0.000E+00	0.00

*Sum of all water independent and dependent pathways.

Summary : Subsistence Farmer_C14_r0a_0m

File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\UM\C14\SFC14_ROA_0M.RAD

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

Parent (i)	Product (j)	Thread Fraction	DSR(j,t) At Time in Years (mrem/yr)/(pCi/g)							
			0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
C-14	C-14	1.000E+00	2.137E-03	2.547E-06	2.395E-12	8.669E-05	8.632E-05	7.006E-45	0.000E+00	0.000E+00

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

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

Nuclide										
(i)	t=	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03	
C-14		1.170E+04	9.815E+06	*4.455E+12	2.884E+05	2.896E+05	*4.455E+12	*4.455E+12	*4.455E+12	

*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 t_{min} = time of minimum single radionuclide soil guideline
and at t_{max} = time of maximum total dose = 0.000E+00 years

Nuclide (i)	Initial (pCi/g)	t _{min} (years)	DSR(i,t _{min})	G(i,t _{min}) (pCi/g)	DSR(i,t _{max})	G(i,t _{max}) (pCi/g)
C-14	1.000E+00	0.000E+00	2.137E-03	1.170E+04	2.137E-03	1.170E+04

Summary : Subsistence Farmer_C14_r0a_0m

File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\UM\C14\SFC14_R0A_0M.RAD

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	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
C-14	C-14	1.000E+00	2.137E-03	2.547E-06	2.395E-12	8.669E-05	8.632E-05	0.000E+00	0.000E+00	0.000E+00	0.000E+00

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

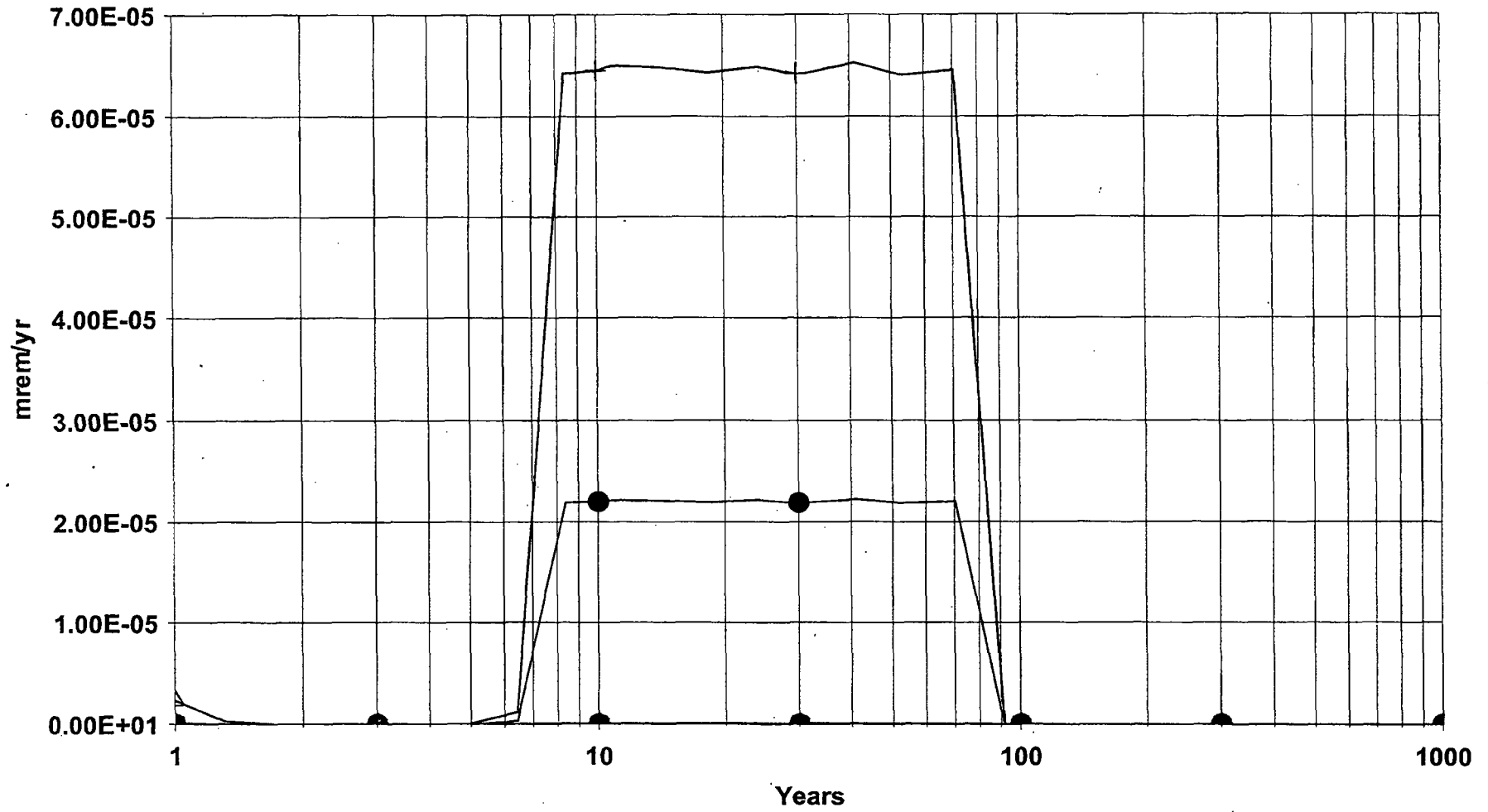
Individual Nuclide Soil Concentration
Parent Nuclide and Branch Fraction Indicated

Nuclide	Parent	THF(i)	S(j,t), pCi/g								
(j)	(i)		t=	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
C-14	C-14	1.000E+00	1.000E+00	9.905E-04	9.335E-10	4.967E-31	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

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

RESCALC.EXE execution time = 1051.29 seconds

DOSE: C-14, Component Pathways



- | | | | | |
|-----------------------------|-----------------------------|------------------|---------------------------|--------------------------|
| ○ External | △ Plant (Water Independent) | × Soil Ingest | ◆ Radon (Water Dependent) | ▼ Milk (Water Dependent) |
| ◇ Inhalation | ▽ Meat (Water Independent) | + Drinking Water | ■ Plant (Water Dependent) | |
| □ Radon (Water Independent) | * Milk (Water Independent) | ● Fish | ▲ Meat (Water Dependent) | |

Summary : Recre_C14_r0a_5m

File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\UM\C14\RE_C14_R0A_5M.RAD

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Rec. U_{sr}

C14

5m

IDF = 0.0

ODf = 0.0384

Summary : Recre_C14_r0a_5m

File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\UM\C14\RE_C14_R0A_5M.RAD

Dose Conversion Factor (and Related) Parameter Summary

Dose Library: FGR 12 & FGR 11

Menu	Parameter	Current Value#	Base Case*	Parameter Name
A-1	DCF's for external ground radiation, (mrem/yr)/(pCi/g)			
A-1	C-14 (Source: FGR 12)	1.345E-05	1.345E-05	DCF1(1)
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	C-14(p) (Class: ORGANIC)	2.090E-06	2.090E-06	DCF2(1)
B-1	C-14(g) (Class: CO2)	2.350E-08	2.350E-08	C14GinhDCF
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	C-14	2.090E-06	2.090E-06	DCF3(1)
D-34	Food transfer factors:			
D-34	C-14 , plant/soil concentration ratio, dimensionless	5.500E+00	5.500E+00	RTF(1,1)
D-34	C-14 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.100E-02	3.100E-02	RTF(1,2)
D-34	C-14 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.200E-02	1.200E-02	RTF(1,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	C-14 , fish	5.000E+04	5.000E+04	BIOFAC(1,1)
D-5	C-14 , crustacea and mollusks	9.100E+03	9.100E+03	BIOFAC(1,2)

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

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

Summary : Recre_C14_r0a_5m

File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\UM\C14\RE_C14_R0A_5M.RAD

Site-Specific Parameter Summary

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R011	Area of contaminated zone (m**2)	5.000E+01	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	1.000E+00	2.000E+00	---	THICK0
R011	Fraction of contamination that is submerged	0.000E+00	0.000E+00	---	SUBMFRACT
R011	Length parallel to aquifer flow (m)	1.000E+02	1.000E+02	---	LCZPAQ
R011	Basic radiation dose limit (mrem/yr)	2.500E+01	3.000E+01	---	BRDL
R011	Time since placement of material (yr)	0.000E+00	0.000E+00	---	TI
R011	Times for calculations (yr)	1.000E+02	1.000E+00	---	T(2)
R011	Times for calculations (yr)	3.000E+02	3.000E+00	---	T(3)
R011	Times for calculations (yr)	1.000E+03	1.000E+01	---	T(4)
R011	Times for calculations (yr)	not used	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): C-14	1.000E+00	0.000E+00	---	S1(1)
R012	Concentration in groundwater (pCi/L): C-14	not used	0.000E+00	---	W1(1)
R013	Cover depth (m)	5.000E+00	0.000E+00	---	COVER0
R013	Density of cover material (g/cm**3)	1.500E+00	1.500E+00	---	DENSCV
R013	Cover depth erosion rate (m/yr)	1.000E-03	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)	1.000E-03	1.000E-03	---	VCZ
R013	Contaminated zone total porosity	4.000E-01	4.000E-01	---	TPCZ
R013	Contaminated zone field capacity	2.000E-01	2.000E-01	---	FCCZ
R013	Contaminated zone hydraulic conductivity (m/yr)	1.000E+01	1.000E+01	---	HCCZ
R013	Contaminated zone b parameter	5.300E+00	5.300E+00	---	BCZ
R013	Average annual wind speed (m/sec)	2.000E+00	2.000E+00	---	WIND
R013	Humidity in air (g/m**3)	not used	8.000E+00	---	HUMID
R013	Evapotranspiration coefficient	5.000E-01	5.000E-01	---	EVAPTR
R013	Precipitation (m/yr)	1.000E+00	1.000E+00	---	PRECIP
R013	Irrigation (m/yr)	2.000E-01	2.000E-01	---	RI
R013	Irrigation mode	overhead	overhead	---	IDITCH
R013	Runoff coefficient	2.000E-01	2.000E-01	---	RUNOFF
R013	Watershed area for nearby stream or pond (m**2)	1.000E+06	1.000E+06	---	WAREA
R013	Accuracy for water/soil computations	1.000E-03	1.000E-03	---	EPS
R014	Density of saturated zone (g/cm**3)	1.500E+00	1.500E+00	---	DENSAQ
R014	Saturated zone total porosity	4.000E-01	4.000E-01	---	TPSZ
R014	Saturated zone effective porosity	2.000E-01	2.000E-01	---	EPSZ
R014	Saturated zone field capacity	2.000E-01	2.000E-01	---	FCSZ
R014	Saturated zone hydraulic conductivity (m/yr)	1.000E+02	1.000E+02	---	HCSZ
R014	Saturated zone hydraulic gradient	2.000E-02	2.000E-02	---	HGWT
R014	Saturated zone b parameter	5.300E+00	5.300E+00	---	BSZ
R014	Water table drop rate (m/yr)	1.000E-03	1.000E-03	---	VWT
R014	Well pump intake depth (m below water table)	1.000E+01	1.000E+01	---	DWIBWT
R014	Model: Nondispersion (ND) or Mass-Balance (MB)	ND	ND	---	MODEL
R014	Well pumping rate (m**3/yr)	2.500E+02	2.500E+02	---	UW

Summary : Recre_C14_r0a_5m

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Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R015	Number of unsaturated zone strata	1	1	---	NS
R015	Unsat. zone 1, thickness (m)	4.000E+00	4.000E+00	---	H(1)
R015	Unsat. zone 1, soil density (g/cm**3)	1.500E+00	1.500E+00	---	DENSUZ(1)
R015	Unsat. zone 1, total porosity	4.000E-01	4.000E-01	---	TPUZ(1)
R015	Unsat. zone 1, effective porosity	2.000E-01	2.000E-01	---	EPUZ(1)
R015	Unsat. zone 1, field capacity	2.000E-01	2.000E-01	---	FCUZ(1)
R015	Unsat. zone 1, soil-specific b parameter	5.300E+00	5.300E+00	---	BUZ(1)
R015	Unsat. zone 1, hydraulic conductivity (m/yr)	1.000E+01	1.000E+01	---	HCUZ(1)
R016	Distribution coefficients for C-14				
R016	Contaminated zone (cm**3/g)	1.000E+00	0.000E+00	---	DCNUCC(1)
R016	Unsat. zone 1 (cm**3/g)	1.000E+00	0.000E+00	---	DCNUCU(1,1)
R016	Saturated zone (cm**3/g)	5.000E+00	0.000E+00	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.746E-01	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
R017	Inhalation rate (m**3/yr)	1.400E+04	8.400E+03	---	INHALR
R017	Mass loading for inhalation (g/m**3)	1.000E-04	1.000E-04	---	MLINH
R017	Exposure duration	3.000E+01	3.000E+01	---	ED
R017	Shielding factor, inhalation	4.000E-01	4.000E-01	---	SHF3
R017	Shielding factor, external gamma	7.000E-01	7.000E-01	---	SHF1
R017	Fraction of time spent indoors	0.000E+00	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	3.840E-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)

Summary : Recre_C14_r0a_5m

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Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R017	Fractions of annular areas within AREA:				
R017	Ring 1	not used	1.000E+00	---	FRACA(1)
R017	Ring 2	not used	2.732E-01	---	FRACA(2)
R017	Ring 3	not used	0.000E+00	---	FRACA(3)
R017	Ring 4	not used	0.000E+00	---	FRACA(4)
R017	Ring 5	not used	0.000E+00	---	FRACA(5)
R017	Ring 6	not used	0.000E+00	---	FRACA(6)
R017	Ring 7	not used	0.000E+00	---	FRACA(7)
R017	Ring 8	not used	0.000E+00	---	FRACA(8)
R017	Ring 9	not used	0.000E+00	---	FRACA(9)
R017	Ring 10	not used	0.000E+00	---	FRACA(10)
R017	Ring 11	not used	0.000E+00	---	FRACA(11)
R017	Ring 12	not used	0.000E+00	---	FRACA(12)
R018	Fruits, vegetables and grain consumption (kg/yr)	not used	1.600E+02	---	DIET(1)
R018	Leafy vegetable consumption (kg/yr)	not used	1.400E+01	---	DIET(2)
R018	Milk consumption (L/yr)	not used	9.200E+01	---	DIET(3)
R018	Meat and poultry consumption (kg/yr)	not used	6.300E+01	---	DIET(4)
R018	Fish consumption (kg/yr)	0.000E+00	5.400E+00	---	DIET(5)
R018	Other seafood consumption (kg/yr)	0.000E+00	9.000E-01	---	DIET(6)
R018	Soil ingestion rate (g/yr)	3.650E+01	3.650E+01	---	SOIL
R018	Drinking water intake (L/yr)	1.960E+01	5.100E+02	---	DWI
R018	Contamination fraction of drinking water	1.000E+00	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	5.000E-01	5.000E-01	---	FR9
R018	Contamination fraction of plant food	not used	-1	---	FPLANT
R018	Contamination fraction of meat	not used	-1	---	FMEAT
R018	Contamination fraction of milk	not used	-1	---	FMILK
R019	Livestock fodder intake for meat (kg/day)	not used	6.800E+01	---	LFI5
R019	Livestock fodder intake for milk (kg/day)	not used	5.500E+01	---	LFI6
R019	Livestock water intake for meat (L/day)	not used	5.000E+01	---	LWI5
R019	Livestock water intake for milk (L/day)	not used	1.600E+02	---	LWI6
R019	Livestock soil intake (kg/day)	not used	5.000E-01	---	LSI
R019	Mass loading for foliar deposition (g/m**3)	not used	1.000E-04	---	MLFD
R019	Depth of soil mixing layer (m)	1.500E-01	1.500E-01	---	DM
R019	Depth of roots (m)	not used	9.000E-01	---	DROOT
R019	Drinking water fraction from ground water	1.000E+00	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)

Summary : Recre_C14_r0a_5m

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Site-Specific Parameter Summary (continued)

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

Summary : Recre_C14_r0a_5m

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Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
TITL	Maximum number of integration points for dose	17	---	---	LYMAX
TITL	Maximum number of integration points for risk	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	active
7 -- drinking water	active
8 -- soil ingestion	active
9 -- radon	suppressed
Find peak pathway doses	active

Summary : Recre_C14_r0a_5m

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Contaminated Zone Dimensions		Initial Soil Concentrations, pCi/g	
Area:	50.00 square meters	C-14	1.000E+00
Thickness:	1.00 meters		
Cover Depth:	5.00 meters		

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+02	3.000E+02	1.000E+03
TDOSE(t):	0.000E+00	1.549E-06	3.270E-30	0.000E+00
M(t):	0.000E+00	6.195E-08	1.308E-31	0.000E+00

Maximum TDOSE(t): 6.193E-05 mrem/yr at t = 35.24 ± 0.07 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 = 3.524E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
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	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.524E+01 years

Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	6.193E-05	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.193E-05	1.0000
Total	6.193E-05	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.193E-05	1.0000

*Sum of all water independent and dependent pathways.

Summary : Recre_C14_r0a_5m

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

Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
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	0.000E+00	0.0000

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

Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
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	0.000E+00	0.0000

*Sum of all water independent and dependent pathways.

Summary : Recre_C14_r0a_5m

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

Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	frac
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.00
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	0.000E+00	0.00

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

Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	frac
C-14	1.549E-06	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.549E-06	1.00
Total	1.549E-06	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.549E-06	1.00

*Sum of all water independent and dependent pathways.

Summary : Recre_C14_r0a_5m

File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\UM\C14\RE_C14_R0A_5M.RAD

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

Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	frac
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.00
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	0.000E+00	0.00

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

Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	frac
C-14	3.270E-30	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.270E-30	1.00
Total	3.270E-30	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.270E-30	1.00

*Sum of all water independent and dependent pathways.

Summary : Recre_C14_r0a_5m

File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\UM\C14\RE_C14_R0A_5M.RAD

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

Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	frac
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.00
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	0.000E+00	0.00

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

Water Dependent Pathways

Radio- Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	frac
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.00
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	0.000E+00	0.00

*Sum of all water independent and dependent pathways.

Summary : Recre_C14_r0a_5m

File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\UM\C14\RE_C14_R0A_5M.RAD

Dose/Source Ratios Summed Over All Pathways

Parent and Progeny Principal Radionuclide Contributions Indicated

Parent (i)	Product (j)	Thread Fraction	DSR(j,t) 0.000E+00	At Time in Years 1.000E+02	(mrem/yr)/(pCi/g) 3.000E+02	1.000E+03
C-14	C-14	1.000E+00	0.000E+00	1.549E-06	3.270E-30	0.000E+00

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

Single Radionuclide Soil Guidelines G(i,t) in pCi/g

Basic Radiation Dose Limit = 2.500E+01 mrem/yr

Nuclide

(i)	t = 0.000E+00	1.000E+02	3.000E+02	1.000E+03
C-14	*4.455E+12	1.614E+07	*4.455E+12	*4.455E+12

*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 t_{min} = time of minimum single radionuclide soil guidelineand at t_{max} = time of maximum total dose = 35.24 ± 0.07 years

Nuclide (i)	Initial (pCi/g)	t _{min} (years)	DSR(i,t _{min})	G(i,t _{min}) (pCi/g)	DSR(i,t _{max})	G(i,t _{max}) (pCi/g)
C-14	1.000E+00	35.24 ± 0.07	6.193E-05	4.037E+05	6.193E-05	4.037E+05

Summary : Recre_C14_r0a_5m

File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\UM\C14\RE_C14_R0A_5M.RAD

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

Nuclide (j)	Parent (i)	THF(i)	DOSE(j,t), mrem/yr			
			t= 0.000E+00	1.000E+02	3.000E+02	1.000E+03
C-14	C-14	1.000E+00	0.000E+00	1.549E-06	3.270E-30	0.000E+00

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+02	3.000E+02	1.000E+03
C-14	C-14	1.000E+00	1.000E+00	1.174E-12	1.617E-36	0.000E+00

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

RESCALC.EXE execution time = 45.47 seconds