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TECHNICAL MEMORANDUM

March 6, 2002

Originator: Harry J. Newman, CHP, Technical Director

Subject: ***Derivation of Indoor Surface DCGLs for KMTC***

Revision: 2

Endorsement: This document contains the results of research and technical analysis which have been reviewed and approved for publication by the Technical Director, NEXTEP Environmental, Inc.

H Newman by W. A. Rogers 3-6-02

Harry J. Newman, CHP, Technical Director Date

Introduction

This Technical Memo provides information regarding the modeling and parameters used in deriving a 25 mrem/y, industrial use, release limit for indoor surfaces and structures. As this modeling supports MARSSIM activities, the release limits will be referred to as Derived Concentration Guideline Levels (DCGL). The characterization data for the Kerr-McGee Technical Center (KMTC) indicates that elevated quantities of uranium and thorium contamination exist at several locations, and that equilibrium with progeny may not exist. DCGLs are therefore derived for:

- Thorium – 232 and progeny
- The uranium series through uranium 234
- Ra-226 and progeny (includes dose contribution from Th-230)

This approach allows flexibility whereby higher or lower than expected concentrations of radium 226 (in comparison to uranium 238) can be accommodated, and allows for comparison of measured values with the calculated DCGLs.

$DCGL_{EMC}$ calculations for these scenarios are shown to be impractical due to the high residual contamination levels that would be allowable. KMTC has chosen to utilize a more conservative ALARA based approach as described herein.

General Method for Calculating DCGL

The software code RESRAD-BUILD[1] is used to provide pathway modeling and contains default values for model parameters. The following bullets describe key parameters and criteria that differ from the default parameters used in RESRAD-BUILD.

- **Building Air Exchange Rate** – An air turnover rate of 1.52 exchanges per hour is used based on mean air exchange rates for commercial buildings as presented in Appendix C to NUREG-6697. This turnover rate conservatively under-represents the actual design ventilation air turnover rate of 10 per hour found in laboratories at KMTC.

- **Room Height** – The height of the false ceiling for most rooms at KMTC is 10.8 feet[3]. A ceiling height of 3 m, or 9.8 feet is conservatively applied in the modeling.

- **Removable Fraction** – 0.7 percent removable fraction is used. This value is based upon comparisons of smear measurements and fixed plus removable measurements for beta radioactivity in affected labs.

- **Dose Conversion Factors** – ICRP 72 dose conversion factors for the radionuclides (and progeny) of interest were substituted for the default ICRP 30 parameter for consistency with the other pathway analyses and DCGLs derived sitewide.

Derived DCGLs

The RESRAD-BUILD default room area of 6m x 6m was used, with a height of 3m. The individual is assumed to be located in the center of the room for the exposure duration with exposure from all 6 surfaces of the room. The input concentration for the RESRAD-BUILD code is in pCi/m² while the output is provided in mrem/y. The input values represent a contamination level of 1dpm/100cm^2 for the initial parent nuclide, with appropriate entries for daughter products. In order to convert the results from RESRAD-BUILD to the $DCGL_w$, the following step is necessary.

$$DCGL_w = \frac{25 mrem \lim it}{RESRADoutput\{mrem / y(dpm / 100cm^2)\}} * (beta + ice) / dpm$$

Where the betas plus internal conversion electron (i.c.e.) per /dpm is radionuclide series specific[4]. The individual DCGLw are provided in Table 1. The units for the calculated $DCGL_w$ are Beta + i.c.e./100cm^2. Attachments 1-3 provide the results of the RESRAD-BUILD computer calculations for each radionuclide series.

[1] RESRAD-BUILD for Windows, Version 3.0. Argonne National Laboratory for USNRC and USDOE, August 25, 2000.

[3] In other locations such as the Pilot Plant, storage building, and TSSL building, the ceiling height is in excess of 14 feet.

[4] For the natural thorium series 3.61 betas + ice/dpm, for uranium 238 to uranium 234, 2.03 betas + ice/dpm, and 3.31 betas + ice/dpm is used for Ra-226 and progeny (including Th-230).

Table 1
Derived DCGLs

Radionuclide	mrem/y per dpm/100cm^2	DCGLw (dpm/100 cm^2)*
Thorium 232 and progeny	7.13E-03	12,675
Uranium Series through U-234	2.50E-04	203,000
Ra-226 and progeny	1.92E-03	43,000

**The release limit in dpm/100 cm² is based upon the total beta (plus i.c.e.) emissions.*

$DCGL_{EMC}$ and ALARA Considerations

The $DCGL_w$ for the 3 contaminant types is presented in Table 2. The $DCGL_w$ is the residual concentration level at which a dose of 25 mrem/y will be received under the modeled scenario, if all surfaces are uniformly contaminated at that level. Higher levels of residual contamination are allowable when the area of the contamination is less than 144m^2. For example, if only the floor area of 36m^2 was contaminated at the $DCGL_w$, the dose to the hypothetical modeled individual would be reduced by the contributions from the walls and ceiling. Table 2 presents the dose associated with this scenario for the three contaminant types at KMTC.

Table 2
Dose to Individual for Two Scenarios

	Entire Room Contaminated at $DCGL_w$	Floor only Contaminated at $DCGL_w$
Thorium 232 and progeny	25 mrem/y	7.3 mrem/y
Uranium Series through U-234	25 mrem/y	6.8 mrem/y
Ra-226 and progeny	25 mrem/y	8.9 mrem/y

Table 2 shows that if the floor area only was contaminated at a level between 2.8 and 3.7 times the DCGLw, the dose to the modeled individual would still be less than 25 mrem/y. Smaller areas of residual contamination would allow even higher levels to remain. However, in consideration of ALARA principles, KMTC will ensure that all residual indoor contamination exceeding the $DCGL_w$ will be limited to a value which is less than or equal to 2.8 x $DCGL_w$ for all radionuclides. Therefore, the $DCGL_{EMC}$ values to be used at KMTC are as follows:

- Thorium – 232 and progeny : 35,000 dpm/100cm^2
- U-238 through U-234: 568,000 dpm/100cm^2
- Ra-226 and progeny: 120,000 dpm/100cm^2

where the units represent total beta plus i.c.e emissions per 100cm^2

Conclusions/Recommendations

The individual surface $DCGL_w$ for building surfaces are provided in Table 1. It will be possible in numerous locations to perform final status surveys assuming the contaminant is natural thorium only and apply this $DCGL_w$, which is lower than the $DCGL_w$ for the other two series. In instances where contamination greater than the natural thorium $DCGL_w$ is identified, it will be necessary to determine the relative contaminant contributions if the residual contamination will be left in place. Guidance on application and use of the unity rule for three separate DCGLs in this instance is outlined in MARSSIM, appendix I.11.

The use of area factors allows for the evaluation of higher than expected contaminant concentrations in areas significantly smaller than the modeled 6m x 6m x 3m area ($144m^2$). KMTC has established the $DCGL_{EMC}$ at an upper threshold of 2.8 times the $DCGL_w$ for all radionuclides, in consideration of ALARA.

Attachment 1

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** RESRAD-BUILD Program Output, Version 3.1 03/06/02 10:19 Page: 1
**
Title : Natural Th with ICRP72 DCFs Eval Rev. 1
Input File : C:\Winbld\Tc232b.bld

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** RESRAD-BUILD Program Output, Version 3.1 03/06/02 10:19 Page: 2
**
Title : Natural Th with ICRP72 DCFs Eval Rev. 1
Input File : C:\Winbld\Tc232b.bld

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ííí RESRAD-BUILD Input Parameters ííí
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```
Number of Sources  :   6
Number of Receptors:   1
Total Time         :  3.650000E+02 days
Fraction Inside    :  7.000000E-01
```

íííííííííí Receptor Information íííííííííí

Receptor	Room	x [m]	y [m]	z [m]	FracTime	Inhalation [m3/day]	Ingestion [m2/hr]
1	1	3.000	3.000	1.000	0.330	3.36E+01	1.00E-04

ííí Receptor-Source Shielding Relationship ííí

Receptor	Source	Density [g/cm3]	Thickness [cm]	Material
1	1	2.40E+00	0.00E+00	Concrete
1	2	2.40E+00	0.00E+00	Concrete
1	3	2.40E+00	0.00E+00	Concrete
1	4	2.40E+00	0.00E+00	Concrete
1	5	2.40E+00	0.00E+00	Concrete
1	6	2.40E+00	0.00E+00	Concrete

íííííííí Building Information íííííííí

Building Air Exchange Rate: 1.52E+00 1/hr

```
    Height [m]          Air Exchanges [m3/hr]
    Area [m2]
                       ******************************
                       *                            *
                       *                            *
                       *                           <=Q01: 1.64E+02
    H1:    3.000       *           Room  1          *      Q10 :  1.64E
+02
                       *   LAMBDA: 1.52E+00         *
                       *                            *
   Area  36.000        *                            *
                       ******************************
```

Deposition velocity: 1.00E-02 [m/s] Resuspension Rate: 5.00E-0
7 [1/s]
□
** RESRAD-BUILD Program Output, Version 3.1 03/06/02 10:19 Page: 4
**
Title : Natural Th with ICRP72 DCFs Eval Rev. 1
Input File : C:\Winbld\Tc232b.bld

íííííííí Source Information íííííííí

```
 Source:  1
        Location::  Room :  1  x:   3.00 y:   3.00  z:   0.00[m]
        Geometry::  Type: Area        Area:3.60E+01 [m2]  Direction:
 z
        Pathway ::
             Direct Ingestion Rate:     0.000E+00 [1/hr]
             Fraction released to air: 1.000E-01
             Removable fraction:        7.000E-03
             Time to Remove:            3.650E+02 [day]

             Radon Release Fraction:    1.000E-01


    Contamination::
     Nuclide Concentration        Dose Conversion Factors
     ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
                                  Ingestion   Inhalation  Submersion
                 [pCi/m2]         [mrem/pCi]  [mrem/pCi]  [mrem/yr/
```

```
                                                    (pCi/m3)]
     TH-232     4.550E+01   1.000E-03   9.260E-02   1.020E-06
     TH-228     4.550E+01   2.670E-04   1.480E-01   9.410E-03
     RA-228     4.550E+01   2.560E-03   9.630E-03   5.590E-03

 Source:  2
        Location::  Room :  1  x:   3.00 y:   3.00  z:   3.00[m]
        Geometry::  Type: Area        Area:3.60E+01 [m2]  Direction:
z
        Pathway ::
             Direct Ingestion Rate:    0.000E+00 [1/hr]
             Fraction released to air: 1.000E-01
             Removable fraction:       7.000E-03
             Time to Remove:           3.650E+02 [day]

             Radon Release Fraction:   1.000E-01


   Contamination::
    Nuclide Concentration       Dose Conversion Factors
    ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
                            Ingestion   Inhalation  Submersion
                [pCi/m2]    [mrem/pCi]  [mrem/pCi]  [mrem/yr/
                                                    (pCi/m3)]
     TH-232     4.550E+01   1.000E-03   9.260E-02   1.020E-06
     TH-228     4.550E+01   2.670E-04   1.480E-01   9.410E-03
     RA-228     4.550E+01   2.560E-03   9.630E-03   5.590E-03
□
** RESRAD-BUILD Program Output, Version 3.1 03/06/02 10:19  Page:   5
**
Title : Natural Th with ICRP72 DCFs Eval Rev. 1
Input File : C:\Winbld\Tc232b.bld


 Source:  3
        Location::  Room :  1  x:   0.00 y:   3.00  z:   1.50[m]
        Geometry::  Type: Area        Area:1.80E+01 [m2]  Direction:
x
        Pathway ::
             Direct Ingestion Rate:    0.000E+00 [1/hr]
             Fraction released to air: 1.000E-01
             Removable fraction:       7.000E-03
             Time to Remove:           3.650E+02 [day]

             Radon Release Fraction:   1.000E-01
```

```
   Contamination::
    Nuclide Concentration        Dose Conversion Factors
    ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
                                Ingestion   Inhalation  Submersion
                 [pCi/m2]       [mrem/pCi]  [mrem/pCi]  [mrem/yr/
                                                        (pCi/m3)]
     TH-232     4.550E+01   1.000E-03   9.260E-02   1.020E-06
     TH-228     4.550E+01   2.670E-04   1.480E-01   9.410E-03
     RA-228     4.550E+01   2.560E-03   9.630E-03   5.590E-03

 Source:  4
         Location::  Room :  1  x:   3.00 y:   0.00  z:   1.50[m]
         Geometry::  Type: Area        Area:1.80E+01 [m2]  Direction:
y
         Pathway ::
              Direct Ingestion Rate:     0.000E+00 [1/hr]
              Fraction released to air: 1.000E-01
              Removable fraction:        7.000E-03
              Time to Remove:            3.650E+02 [day]

              Radon Release Fraction:    1.000E-01


   Contamination::
    Nuclide Concentration        Dose Conversion Factors
    ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
                                Ingestion   Inhalation  Submersion
                 [pCi/m2]       [mrem/pCi]  [mrem/pCi]  [mrem/yr/
                                                        (pCi/m3)]
     TH-232     4.550E+01   1.000E-03   9.260E-02   1.020E-06
     TH-228     4.550E+01   2.670E-04   1.480E-01   9.410E-03
     RA-228     4.550E+01   2.560E-03   9.630E-03   5.590E-03
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** RESRAD-BUILD Program Output, Version 3.1 03/06/02 10:19  Page:   6
**
Title : Natural Th with ICRP72 DCFs Eval Rev. 1
Input File : C:\Winbld\Tc232b.bld


 Source:  5
         Location::  Room :  1  x:   6.00 y:   3.00  z:   1.50[m]
         Geometry::  Type: Area        Area:1.80E+01 [m2]  Direction:
x
         Pathway ::
```

```
Direct Ingestion Rate:     0.000E+00 [1/hr]
Fraction released to air: 1.000E-01
Removable fraction:        7.000E-03
Time to Remove:            3.650E+02 [day]

Radon Release Fraction:    1.000E-01
```

Contamination::

Nuclide	Concentration [pCi/m2]	Dose Conversion Factors Ingestion [mrem/pCi]	Inhalation [mrem/pCi]	Submersion [mrem/yr/ (pCi/m3)]
TH-232	4.550E+01	1.000E-03	9.260E-02	1.020E-06
TH-228	4.550E+01	2.670E-04	1.480E-01	9.410E-03
RA-228	4.550E+01	2.560E-03	9.630E-03	5.590E-03

Source: 6

```
Location::  Room :  1  x:   3.00 y:   6.00  z:   1.50[m]
Geometry::  Type: Area        Area:1.80E+01 [m2]  Direction:
y
```

Pathway ::

```
Direct Ingestion Rate:     0.000E+00 [1/hr]
Fraction released to air: 1.000E-01
Removable fraction:        7.000E-03
Time to Remove:            3.650E+02 [day]

Radon Release Fraction:    1.000E-01
```

Contamination::

Nuclide	Concentration [pCi/m2]	Dose Conversion Factors Ingestion [mrem/pCi]	Inhalation [mrem/pCi]	Submersion [mrem/yr/ (pCi/m3)]
TH-232	4.550E+01	1.000E-03	9.260E-02	1.020E-06
TH-228	4.550E+01	2.670E-04	1.480E-01	9.410E-03
RA-228	4.550E+01	2.560E-03	9.630E-03	5.590E-03

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** RESRAD-BUILD Program Output, Version 3.1 03/06/02 10:19 Page: 7
**
Title : Natural Th with ICRP72 DCFs Eval Rev. 1
Input File : C:\Winbld\Tc232b.bld
Evaluation Time: 0.000000 years

```
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ííí       Assessment for Time:  1            ííí
ííí             Time =0.00E+00 yr            ííí
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ííííííííí  Source Information  ííííííííí


Source:  1
        Location::  Room :  1  x:   3.00 y:   3.00  z:   0.00 [m]
        Geometry::  Type: Area        Area:3.60E+01 [m2]  Direction:
z
        Pathway ::
             Direct Ingestion Rate:    0.000E+00 [1/hr]
             Fraction released to air: 1.000E-01
             Removable fraction:       7.000E-03
             Time to Remove:           3.650E+02 [day]



        Contamination::      Nuclide    Concentration
                                          [pCi/m2]
                              TH-232      4.550E+01
                              TH-228      4.550E+01
                              RA-228      4.550E+01

Source:  2
        Location::  Room :  1  x:   3.00 y:   3.00  z:   3.00 [m]
        Geometry::  Type: Area        Area:3.60E+01 [m2]  Direction:
z
        Pathway ::
             Direct Ingestion Rate:    0.000E+00 [1/hr]
             Fraction released to air: 1.000E-01
             Removable fraction:       7.000E-03
             Time to Remove:           3.650E+02 [day]



        Contamination::      Nuclide    Concentration
                                          [pCi/m2]
                              TH-232      4.550E+01
```

TH-228	4.550E+01
RA-228	4.550E+01

Title : Natural Th with ICRP72 DCFs Eval Rev. 1
Input File : C:\Winbld\Tc232b.bld
Evaluation Time: 0.000000 years

Source: 3
Location:: Room : 1 x: 0.00 y: 3.00 z: 1.50 [m]
Geometry:: Type: Area Area:1.80E+01 [m2] Direction: x

Pathway ::

Direct Ingestion Rate:	0.000E+00 [1/hr]
Fraction released to air:	1.000E-01
Removable fraction:	7.000E-03
Time to Remove:	3.650E+02 [day]

Contamination::

Nuclide	Concentration [pCi/m2]
TH-232	4.550E+01
TH-228	4.550E+01
RA-228	4.550E+01

Source: 4
Location:: Room : 1 x: 3.00 y: 0.00 z: 1.50 [m]
Geometry:: Type: Area Area:1.80E+01 [m2] Direction: y

Pathway ::

Direct Ingestion Rate:	0.000E+00 [1/hr]
Fraction released to air:	1.000E-01
Removable fraction:	7.000E-03
Time to Remove:	3.650E+02 [day]

Contamination::

Nuclide	Concentration [pCi/m2]
TH-232	4.550E+01
TH-228	4.550E+01
RA-228	4.550E+01

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** RESRAD-BUILD Program Output, Version 3.1 03/06/02 10:19  Page:   9
**
Title : Natural Th with ICRP72 DCFs Eval Rev. 1
Input File : C:\Winbld\Tc232b.bld
Evaluation Time:    0.000000     years


 Source:  5
        Location::  Room :  1  x:   6.00 y:   3.00  z:   1.50 [m]
        Geometry::  Type: Area        Area:1.80E+01 [m2]  Direction:
x
        Pathway ::
             Direct Ingestion Rate:    0.000E+00 [1/hr]
             Fraction released to air: 1.000E-01
             Removable fraction:       7.000E-03
             Time to Remove:           3.650E+02 [day]



        Contamination::     Nuclide    Concentration
                                         [pCi/m2]
                             TH-232      4.550E+01
                             TH-228      4.550E+01
                             RA-228      4.550E+01

 Source:  6
        Location::  Room :  1  x:   3.00 y:   6.00  z:   1.50 [m]
        Geometry::  Type: Area        Area:1.80E+01 [m2]  Direction:
y
        Pathway ::
             Direct Ingestion Rate:    0.000E+00 [1/hr]
             Fraction released to air: 1.000E-01
             Removable fraction:       7.000E-03
             Time to Remove:           3.650E+02 [day]



        Contamination::     Nuclide    Concentration
                                         [pCi/m2]
                             TH-232      4.550E+01
                             TH-228      4.550E+01
                             RA-228      4.550E+01
□
** RESRAD-BUILD Program Output, Version 3.1 03/06/02 10:19  Page:  10
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**
Title : Natural Th with ICRP72 DCFs Eval Rev. 1
Input File : C:\Winbld\Tc232b.bld
Evaluation Time: 0.000000 years

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ííí RESRAD-BUILD Dose Tables ííí
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Source Contributions to Receptor Doses
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[mrem]

	Source 1	Source 2	Source 3	Source 4	Source 5	Source 6	Total
Receptor 1	2.07E-03	1.75E-03	8.25E-04	8.25E-04	8.25E-04	8.25E-04	7.12E-03
Total	2.07E-03	1.75E-03	8.25E-04	8.25E-04	8.25E-04	8.25E-04	7.12E-03

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**
Title : Natural Th with ICRP72 DCFs Eval Rev. 1
Input File : C:\Winbld\Tc232b.bld
Evaluation Time: 0.000000 years

Pathway Detail of Doses
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[mrem]

Source: 1

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	6.78E-04	2.07E-07	2.43E-09	5.11E-04	8.65E-04	1.16E-05
Total	6.78E-04	2.07E-07	2.43E-09	5.11E-04	8.65E-04	1.16E-05

Source: 2

Receptor	External	Deposition	Immersion	Inhalation	Radon	I ngestion
1	3.63E-04	2.07E-07	2.43E-09	5.11E-04	8.65E-04	1.16E-05
Total	3.63E-04	2.07E-07	2.43E-09	5.11E-04	8.65E-04	1.16E-05

Source: 3

Receptor	External	Deposition	Immersion	Inhalation	Radon	I ngestion
1	1.30E-04	1.04E-07	1.22E-09	2.56E-04	4.33E-04	5.81E-06
Total	1.30E-04	1.04E-07	1.22E-09	2.56E-04	4.33E-04	5.81E-06

Source: 4

Receptor	External	Deposition	Immersion	Inhalation	Radon	I ngestion
1	1.30E-04	1.04E-07	1.22E-09	2.56E-04	4.33E-04	5.81E-06
Total	1.30E-04	1.04E-07	1.22E-09	2.56E-04	4.33E-04	5.81E-06

Source: 5

Receptor	External	Deposition	Immersion	Inhalation	Radon	I ngestion
1	1.30E-04	1.04E-07	1.22E-09	2.56E-04	4.33E-04	5.81E-06
Total	1.30E-04	1.04E-07	1.22E-09	2.56E-04	4.33E-04	5.81E-06

Source: 6

Receptor	External	Deposition	Immersion	Inhalation	Radon	I ngestion
1	1.30E-04	1.04E-07	1.22E-09	2.56E-04	4.33E-04	5.81E-06
Total	1.30E-04	1.04E-07	1.22E-09	2.56E-04	4.33E-04	

5.81E-06
□
** RESRAD-BUILD Program Output, Version 3.1 03/06/02 10:19 Page: 12
**
Title : Natural Th with ICRP72 DCFs Eval Rev. 1
Input File : C:\Winbld\Tc232b.bld
Evaluation Time: 0.000000 years

Nuclide Detail of Doses
íííííííííííííííííííííííí
[mrem]

Source: 1

Nuclide	Receptor 1	Total
TH-232		
TH-232	2.12E-04	2.12E-04
TH-228	1.00E-05	1.00E-05
RA-228	1.75E-05	1.75E-05
TH-228		
TH-228	1.30E-03	1.30E-03
RA-228		
TH-228	2.40E-04	2.40E-04
RA-228	2.85E-04	2.85E-04

Source: 2

Nuclide	Receptor 1	Total
TH-232		
TH-232	2.11E-04	2.11E-04
TH-228	8.80E-06	8.80E-06
RA-228	1.01E-05	1.01E-05
TH-228		
TH-228	1.15E-03	1.15E-03
RA-228		
TH-228	2.11E-04	2.11E-04
RA-228	1.65E-04	1.65E-04

Source: 3

Nuclide	Receptor 1	Total
TH-232		
TH-232	1.06E-04	1.06E-04
TH-228	4.20E-06	4.20E-06
RA-228	3.87E-06	3.87E-06
TH-228		
TH-228	5.47E-04	5.47E-04
RA-228		
TH-228	1.01E-04	1.01E-04
RA-228	6.30E-05	6.30E-05

□
** RESRAD-BUILD Program Output, Version 3.1 03/06/02 10:19 Page: 13
**
Title : Natural Th with ICRP72 DCFs Eval Rev. 1
Input File : C:\Winbld\Tc232b.bld
Evaluation Time: 0.000000 years

Source: 4

Nuclide	Receptor 1	Total
TH-232		
TH-232	1.06E-04	1.06E-04
TH-228	4.20E-06	4.20E-06
RA-228	3.87E-06	3.87E-06
TH-228		
TH-228	5.47E-04	5.47E-04
RA-228		
TH-228	1.01E-04	1.01E-04
RA-228	6.30E-05	6.30E-05

Source: 5

Nuclide	Receptor 1	Total
TH-232		
TH-232	1.06E-04	1.06E-04
TH-228	4.20E-06	4.20E-06
RA-228	3.87E-06	3.87E-06
TH-228		
TH-228	5.47E-04	5.47E-04

```
RA-228
 TH-228    1.01E-04  1.01E-04
 RA-228    6.30E-05  6.30E-05


Source:  6

   Nuclide Receptor   Total
              1
TH-232
 TH-232    1.06E-04  1.06E-04
 TH-228    4.20E-06  4.20E-06
 RA-228    3.87E-06  3.87E-06
TH-228
 TH-228    5.47E-04  5.47E-04
RA-228
 TH-228    1.01E-04  1.01E-04
 RA-228    6.30E-05  6.30E-05


□
** RESRAD-BUILD Program Output, Version 3.1 03/06/02 10:19  Page:  14
**
Title : Natural Th with ICRP72 DCFs Eval Rev. 1
Input File : C:\Winbld\Tc232b.bld
Evaluation Time:     1.00000     years


              íííííííííííííííííííííííííííííííííííííííííííííííííí
              íííííííííííííííííííííííííííííííííííííííííííííííííí
              ííí       Assessment for Time:  2            ííí
              ííí             Time =1.00E+00 yr            ííí
              íííííííííííííííííííííííííííííííííííííííííííííííííí
              íííííííííííííííííííííííííííííííííííííííííííííííííí


              íííííííí  Source Information  íííííííí


 Source:  1
        Location::  Room :  1  x:   3.00 y:   3.00  z:   0.00 [m]
        Geometry::  Type: Area        Area:3.60E+01 [m2]  Direction:
 z
        Pathway ::
             Direct Ingestion Rate:    0.000E+00 [1/hr]
             Fraction released to air: 1.000E-01
```

```
Removable fraction:        0.000E+00
Time to Remove:            3.650E+02 [day]


Contamination::     Nuclide     Concentration
                                  [pCi/m2]
                     TH-232       4.518E+01
                     TH-228       4.518E+01
                     RA-228       4.518E+01

Source:  2
        Location::  Room :  1  x:   3.00 y:   3.00  z:   3.00 [m]
        Geometry::  Type: Area        Area:3.60E+01 [m2]  Direction:
z
        Pathway ::
             Direct Ingestion Rate:     0.000E+00 [1/hr]
             Fraction released to air: 1.000E-01
             Removable fraction:        0.000E+00
             Time to Remove:            3.650E+02 [day]


        Contamination::     Nuclide     Concentration
                                          [pCi/m2]
                             TH-232       4.518E+01
                             TH-228       4.518E+01
                             RA-228       4.518E+01
```



```
Title : Natural Th with ICRP72 DCFs Eval Rev. 1
Input File : C:\Winbld\Tc232b.bld
Evaluation Time:     1.00000     years


Source:  3
        Location::  Room :  1  x:   0.00 y:   3.00  z:   1.50 [m]
        Geometry::  Type: Area        Area:1.80E+01 [m2]  Direction:
x
        Pathway ::
             Direct Ingestion Rate:     0.000E+00 [1/hr]
             Fraction released to air: 1.000E-01
             Removable fraction:        0.000E+00
             Time to Remove:            3.650E+02 [day]
```

```
        Contamination::     Nuclide    Concentration
                                         [pCi/m2]
                             TH-232      4.518E+01
                             TH-228      4.518E+01
                             RA-228      4.518E+01

 Source:  4
        Location::  Room :  1  x:   3.00 y:   0.00  z:   1.50 [m]
        Geometry::  Type: Area        Area:1.80E+01 [m2]  Direction:
y
        Pathway ::
             Direct Ingestion Rate:    0.000E+00 [1/hr]
             Fraction released to air: 1.000E-01
             Removable fraction:       0.000E+00
             Time to Remove:           3.650E+02 [day]



        Contamination::     Nuclide    Concentration
                                         [pCi/m2]
                             TH-232      4.518E+01
                             TH-228      4.518E+01
                             RA-228      4.518E+01
□
** RESRAD-BUILD Program Output, Version 3.1 03/06/02 10:19  Page:  16
**
Title : Natural Th with ICRP72 DCFs Eval Rev. 1
Input File : C:\Winbld\Tc232b.bld
Evaluation Time:     1.00000     years


 Source:  5
        Location::  Room :  1  x:   6.00 y:   3.00  z:   1.50 [m]
        Geometry::  Type: Area        Area:1.80E+01 [m2]  Direction:
x
        Pathway ::
             Direct Ingestion Rate:    0.000E+00 [1/hr]
             Fraction released to air: 1.000E-01
             Removable fraction:       0.000E+00
             Time to Remove:           3.650E+02 [day]
```

```
        Contamination::     Nuclide    Concentration
                                         [pCi/m2]
                             TH-232      4.518E+01
                             TH-228      4.518E+01
                             RA-228      4.518E+01

 Source:  6
        Location::  Room :  1  x:   3.00 y:   6.00  z:   1.50 [m]
        Geometry::  Type: Area        Area:1.80E+01 [m2]  Direction:
y
        Pathway ::
             Direct Ingestion Rate:    0.000E+00 [1/hr]
             Fraction released to air: 1.000E-01
             Removable fraction:       0.000E+00
             Time to Remove:           3.650E+02 [day]



        Contamination::     Nuclide    Concentration
                                         [pCi/m2]
                             TH-232      4.518E+01
                             TH-228      4.518E+01
                             RA-228      4.518E+01
□
** RESRAD-BUILD Program Output, Version 3.1 03/06/02 10:19  Page:  17
**
Title : Natural Th with ICRP72 DCFs Eval Rev. 1
Input File : C:\Winbld\Tc232b.bld
Evaluation Time:     1.00000     years


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             íííííííííííííííííííííííííííííííííííííííííííííííí
             ííí                                          ííí
             ííí        RESRAD-BUILD Dose Tables          ííí
             ííí                                          ííí
             íííííííííííííííííííííííííííííííííííííííííííííííí
             íííííííííííííííííííííííííííííííííííííííííííííííí


                   Source Contributions to Receptor Doses
                   íííííííííííííííííííííííííííííííííííííí
                                  [mrem]
```

	Source 1	Source 2	Source 3	Source 4	Source 5	Source 6	Total
Receptor 1	1.54E-03	1.22E-03	5.61E-04	5.61E-04	5.61E-04	5.61E-04	5.01E-03
Total	1.54E-03	1.22E-03	5.61E-04	5.61E-04	5.61E-04	5.61E-04	5.01E-03

□

** RESRAD-BUILD Program Output, Version 3.1 03/06/02 10:19 Page: 18
**

Title : Natural Th with ICRP72 DCFs Eval Rev. 1
Input File : C:\Winbld\Tc232b.bld
Evaluation Time: 1.00000 years

Pathway Detail of Doses
íííííííííííííííííííííííí
[mrem]

Source: 1

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	6.76E-04	0.00E+00	0.00E+00	0.00E+00	8.62E-04	0.00E+00
Total	6.76E-04	0.00E+00	0.00E+00	0.00E+00	8.62E-04	0.00E+00

Source: 2

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	3.62E-04	0.00E+00	0.00E+00	0.00E+00	8.62E-04	0.00E+00
Total	3.62E-04	0.00E+00	0.00E+00	0.00E+00	8.62E-04	0.00E+00

Source: 3

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	1.30E-04	0.00E+00	0.00E+00	0.00E+00	4.31E-04	0.00E+00
Total	1.30E-04	0.00E+00	0.00E+00	0.00E+00	4.31E-04	0.00E+00

```
Source:  4
   Receptor     External  Deposition Immersion  Inhalation   Radon     I
ngestion
       1        1.30E-04   0.00E+00   0.00E+00   0.00E+00   4.31E-04
0.00E+00
   Total        1.30E-04   0.00E+00   0.00E+00   0.00E+00   4.31E-04
0.00E+00


Source:  5
   Receptor     External  Deposition Immersion  Inhalation   Radon     I
ngestion
       1        1.30E-04   0.00E+00   0.00E+00   0.00E+00   4.31E-04
0.00E+00
   Total        1.30E-04   0.00E+00   0.00E+00   0.00E+00   4.31E-04
0.00E+00


Source:  6
   Receptor     External  Deposition Immersion  Inhalation   Radon     I
ngestion
       1        1.30E-04   0.00E+00   0.00E+00   0.00E+00   4.31E-04
0.00E+00
   Total        1.30E-04   0.00E+00   0.00E+00   0.00E+00   4.31E-04
0.00E+00
```


Title : Natural Th with ICRP72 DCFs Eval Rev. 1
Input File : C:\Winbld\Tc232b.bld
Evaluation Time: 1.00000 years

Nuclide Detail of Doses
[mrem]

Source: 1

Nuclide	Receptor 1	Total
TH-232		
TH-232	3.79E-07	3.79E-07

TH-228	5.22E-05	5.22E-05
RA-228	4.48E-05	4.48E-05
TH-228		
TH-228	7.46E-04	7.46E-04
RA-228		
TH-228	4.66E-04	4.66E-04
RA-228	2.28E-04	2.28E-04

Source: 2

Nuclide	Receptor 1	Total
TH-232		
TH-232	1.80E-07	1.80E-07
TH-228	4.45E-05	4.45E-05
RA-228	2.40E-05	2.40E-05
TH-228		
TH-228	6.36E-04	6.36E-04
RA-228		
TH-228	3.97E-04	3.97E-04
RA-228	1.22E-04	1.22E-04

Source: 3

Nuclide	Receptor 1	Total
TH-232		
TH-232	5.95E-08	5.95E-08
TH-228	2.10E-05	2.10E-05
RA-228	8.61E-06	8.61E-06
TH-228		
TH-228	3.00E-04	3.00E-04
RA-228		
TH-228	1.87E-04	1.87E-04
RA-228	4.39E-05	4.39E-05

□
** RESRAD-BUILD Program Output, Version 3.1 03/06/02 10:19 Page: 20
**
Title : Natural Th with ICRP72 DCFs Eval Rev. 1
Input File : C:\Winbld\Tc232b.bld
Evaluation Time: 1.00000 years

Source: 4

Nuclide	Receptor 1	Total
TH-232		
TH-232	5.95E-08	5.95E-08
TH-228	2.10E-05	2.10E-05
RA-228	8.61E-06	8.61E-06
TH-228		
TH-228	3.00E-04	3.00E-04
RA-228		
TH-228	1.87E-04	1.87E-04
RA-228	4.39E-05	4.39E-05

Source: 5

Nuclide	Receptor 1	Total
TH-232		
TH-232	5.95E-08	5.95E-08
TH-228	2.10E-05	2.10E-05
RA-228	8.61E-06	8.61E-06
TH-228		
TH-228	3.00E-04	3.00E-04
RA-228		
TH-228	1.87E-04	1.87E-04
RA-228	4.39E-05	4.39E-05

Source: 6

Nuclide	Receptor 1	Total
TH-232		
TH-232	5.95E-08	5.95E-08
TH-228	2.10E-05	2.10E-05
RA-228	8.61E-06	8.61E-06
TH-228		
TH-228	3.00E-04	3.00E-04
RA-228		
TH-228	1.87E-04	1.87E-04
RA-228	4.39E-05	4.39E-05

```
□
** RESRAD-BUILD Program Output, Version 3.1 03/06/02 10:19  Page:  21
**
Title : Natural Th with ICRP72 DCFs Eval Rev. 1
Input File : C:\Winbld\Tc232b.bld
Full Summary

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              íííííííííííííííííííííííííííííííííííííííííííííííí
              ííí                                          ííí
              ííí     RESRAD-BUILD Dose (Time) Tables      ííí
              ííí                                          ííí
              íííííííííííííííííííííííííííííííííííííííííííííííí
              íííííííííííííííííííííííííííííííííííííííííííííííí



              Receptor Doses Received for the Exposure Duration
              íííííííííííííííííííííííííííííííííííííííííííííííí
                                   (mrem)

                                 Evaluation Time [yr]
      0.00E+00  1.00E+00
      ÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄ
  1   7.12E-03  5.01E-03


              Receptor Dose/Yr Averaged Over Exposure Duration
              íííííííííííííííííííííííííííííííííííííííííííííííí
                                   (mrem/yr)

                                 Evaluation Time [yr]
      0.00E+00  1.00E+00
      ÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄ
  1   7.12E-03  5.01E-03
```

Attachment 2

□

** RESRAD-BUILD Program Output, Version 3.1 03/04/02 18:08 Page: 1
**
Title : KMTC U-238 thru U-234 w/ ICRP72 DCFs Eva
Input File : C:\Winbld\Tc238b.bld

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ííí RESRAD-BUILD Table of Contents ííí
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Time Specific Parameters..... 19
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□

** RESRAD-BUILD Program Output, Version 3.1 03/04/02 18:08 Page: 2
**
Title : KMTC U-238 thru U-234 w/ ICRP72 DCFs Eva
Input File : C:\Winbld\Tc238b.bld

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ííí RESRAD-BUILD Input Parameters ííí
ííí ííí
íí
íí

Number of Sources : 6
Number of Receptors: 1
Total Time : 3.650000E+02 days
Fraction Inside : 7.000000E-01

íííííííííí Receptor Information íííííííííí

Receptor	Room	x	y	z	FracTime	Inhalation	Ingesti
on(Dust)		[m]	[m]	[m]		[m3/day]	[m2
/hr]							
1	1	3.000	3.000	1.000	0.330	3.36E+01	1.00
E-04							

ííí Receptor-Source Shielding Relationship ííí

Receptor	Source	Density [g/cm3]	Thickness [cm]	Material
1	1	2.40E+00	0.00E+00	Concrete
1	2	2.40E+00	0.00E+00	Concrete
1	3	2.40E+00	0.00E+00	Concrete
1	4	2.40E+00	0.00E+00	Concrete
1	5	2.40E+00	0.00E+00	Concrete
1	6	2.40E+00	0.00E+00	Concrete

íííííííí Building Information íííííííí

Building Air Exchange Rate: 1.52E+00 1/hr

```
    Height[m]          Air Exchanges [m3/hr]
    Area [m2]
                      ******************************
                      *                            *
                      *                            *
                      *                           <=Q01: 1.64E+02
    H1:    3.000      *            Room  1         *      Q10 :  1.64E
+02
                      *   LAMBDA: 1.52E+00         *
   Area  36.000       *                            *
                      *                            *
                      ******************************
```

Deposition velocity: 1.00E-02 [m/s] Resuspension Rate: 5.00E-0
7 [1/s]
□
** RESRAD-BUILD Program Output, Version 3.1 03/04/02 18:08 Page: 4
**
Title : KMTC U-238 thru U-234 w/ ICRP72 DCFs Eva
Input File : C:\Winbld\Tc238b.bld

ÍÍÍÍÍÍÍÍ Source Information ÍÍÍÍÍÍÍÍ

Source: 1
Location:: Room : 1 x: 3.00 y: 3.00 z: 0.00[m]
Geometry:: Type: Area Area:3.60E+01 [m2] Direction:
z
Pathway ::
Direct Ingestion Rate: 0.000E+00 [1/hr]
Fraction released to air: 1.000E-01
Removable fraction: 7.000E-03
Time to Remove: 3.650E+02 [day]

Radon Release Fraction: 1.000E-01

Contamination::

Nuclide	Concentration [pCi/m2]	Dose Conversion Factors Ingestion [mrem/pCi]	Inhalation [mrem/pCi]	Submersion [mrem/yr/

				(pCi/m3)]
U-238	4.550E+01	1.670E-04	1.070E-02	1.600E-04
U-235	2.100E+00	1.740E-04	1.150E-02	9.030E-04
U-234	4.550E+01	1.810E-04	1.300E-02	8.930E-07
PA-231	0.000E+00	2.630E-03	5.180E-01	2.010E-04
TH-230	0.000E+00	7.780E-04	5.180E-02	2.040E-06
AC-227	0.000E+00	4.070E-03	2.040E+00	2.160E-03
RA-226	0.000E+00	1.040E-03	1.300E-02	1.040E-02
PB-210	0.000E+00	2.560E-03	4.070E-03	1.430E-05

□

** RESRAD-BUILD Program Output, Version 3.1 03/04/02 18:08 Page: 5
**

Title : KMTC U-238 thru U-234 w/ ICRP72 DCFs Eva
Input File : C:\Winbld\Tc238b.bld

Source: 2
Location:: Room : 1 x: 3.00 y: 3.00 z: 3.00[m]
Geometry:: Type: Area Area:3.60E+01 [m2] Direction:
z

Pathway ::

Direct Ingestion Rate:	0.000E+00	[1/hr]
Fraction released to air:	1.000E-01	
Removable fraction:	7.000E-03	
Time to Remove:	3.650E+02	[day]
Radon Release Fraction:	1.000E-01	

Contamination::

Nuclide	Concentration	Dose Conversion Factors		
	[pCi/m2]	Ingestion [mrem/pCi]	Inhalation [mrem/pCi]	Submersion [mrem/yr/ (pCi/m3)]
U-238	4.550E+01	1.670E-04	1.070E-02	1.600E-04
U-235	2.100E+00	1.740E-04	1.150E-02	9.030E-04
U-234	4.550E+01	1.810E-04	1.300E-02	8.930E-07
PA-231	0.000E+00	2.630E-03	5.180E-01	2.010E-04
TH-230	0.000E+00	7.780E-04	5.180E-02	2.040E-06
AC-227	0.000E+00	4.070E-03	2.040E+00	2.160E-03
RA-226	0.000E+00	1.040E-03	1.300E-02	1.040E-02
PB-210	0.000E+00	2.560E-03	4.070E-03	1.430E-05

□

** RESRAD-BUILD Program Output, Version 3.1 03/04/02 18:08 Page: 6
**

Title : KMTC U-238 thru U-234 w/ ICRP72 DCFs Eva
Input File : C:\Winbld\Tc238b.bld

Source: 3
Location:: Room : 1 x: 0.00 y: 3.00 z: 1.50[m]
Geometry:: Type: Area Area:1.80E+01 [m2] Direction:
x
Pathway ::
Direct Ingestion Rate: 0.000E+00 [1/hr]
Fraction released to air: 1.000E-01
Removable fraction: 7.000E-03
Time to Remove: 3.650E+02 [day]

Radon Release Fraction: 1.000E-01

Contamination::

Nuclide	Concentration [pCi/m2]	Dose Conversion Factors Ingestion [mrem/pCi]	Inhalation [mrem/pCi]	Submersion [mrem/yr/ (pCi/m3)]
U-238	4.550E+01	1.670E-04	1.070E-02	1.600E-04
U-235	2.100E+00	1.740E-04	1.150E-02	9.030E-04
U-234	4.550E+01	1.810E-04	1.300E-02	8.930E-07
PA-231	0.000E+00	2.630E-03	5.180E-01	2.010E-04
TH-230	0.000E+00	7.780E-04	5.180E-02	2.040E-06
AC-227	0.000E+00	4.070E-03	2.040E+00	2.160E-03
RA-226	0.000E+00	1.040E-03	1.300E-02	1.040E-02
PB-210	0.000E+00	2.560E-03	4.070E-03	1.430E-05

Title : KMTC U-238 thru U-234 w/ ICRP72 DCFs Eva
Input File : C:\Winbld\Tc238b.bld

Source: 4
Location:: Room : 1 x: 3.00 y: 0.00 z: 1.50[m]
Geometry:: Type: Area Area:1.80E+01 [m2] Direction:
y
Pathway ::
Direct Ingestion Rate: 0.000E+00 [1/hr]
Fraction released to air: 1.000E-01

Removable fraction: 7.000E-03
Time to Remove: 3.650E+02 [day]

Radon Release Fraction: 1.000E-01

Contamination::

Nuclide	Concentration [pCi/m2]	Dose Conversion Factors Ingestion [mrem/pCi]	Inhalation [mrem/pCi]	Submersion [mrem/yr/ (pCi/m3)]
U-238	4.550E+01	1.670E-04	1.070E-02	1.600E-04
U-235	2.100E+00	1.740E-04	1.150E-02	9.030E-04
U-234	4.550E+01	1.810E-04	1.300E-02	8.930E-07
PA-231	0.000E+00	2.630E-03	5.180E-01	2.010E-04
TH-230	0.000E+00	7.780E-04	5.180E-02	2.040E-06
AC-227	0.000E+00	4.070E-03	2.040E+00	2.160E-03
RA-226	0.000E+00	1.040E-03	1.300E-02	1.040E-02
PB-210	0.000E+00	2.560E-03	4.070E-03	1.430E-05

□
** RESRAD-BUILD Program Output, Version 3.1 03/04/02 18:08 Page: 8
**
Title : KMTC U-238 thru U-234 w/ ICRP72 DCFs Eva
Input File : C:\Winbld\Tc238b.bld

Source: 5
Location:: Room : 1 x: 6.00 y: 3.00 z: 1.50[m]
Geometry:: Type: Area Area:1.80E+01 [m2] Direction:
x
Pathway ::
Direct Ingestion Rate: 0.000E+00 [1/hr]
Fraction released to air: 1.000E-01
Removable fraction: 7.000E-03
Time to Remove: 3.650E+02 [day]

Radon Release Fraction: 1.000E-01

Contamination::

Nuclide	Concentration [pCi/m2]	Dose Conversion Factors Ingestion [mrem/pCi]	Inhalation [mrem/pCi]	Submersion [mrem/yr/

				(pCi/m3)]
U-238	4.550E+01	1.670E-04	1.070E-02	1.600E-04
U-235	2.100E+00	1.740E-04	1.150E-02	9.030E-04
U-234	4.550E+01	1.810E-04	1.300E-02	8.930E-07
PA-231	0.000E+00	2.630E-03	5.180E-01	2.010E-04
TH-230	0.000E+00	7.780E-04	5.180E-02	2.040E-06
AC-227	0.000E+00	4.070E-03	2.040E+00	2.160E-03
RA-226	0.000E+00	1.040E-03	1.300E-02	1.040E-02
PB-210	0.000E+00	2.560E-03	4.070E-03	1.430E-05

□
** RESRAD-BUILD Program Output, Version 3.1 03/04/02 18:08 Page: 9
**
Title : KMTC U-238 thru U-234 w/ ICRP72 DCFs Eva
Input File : C:\Winbld\Tc238b.bld

Source: 6
Location:: Room : 1 x: 3.00 y: 6.00 z: 1.50[m]
Geometry:: Type: Area Area:1.80E+01 [m2] Direction:
y
Pathway ::
Direct Ingestion Rate: 0.000E+00 [1/hr]
Fraction released to air: 1.000E-01
Removable fraction: 7.000E-03
Time to Remove: 3.650E+02 [day]

Radon Release Fraction: 1.000E-01

Contamination::

Nuclide	Concentration	Dose Conversion Factors		
	[pCi/m2]	Ingestion [mrem/pCi]	Inhalation [mrem/pCi]	Submersion [mrem/yr/ (pCi/m3)]
U-238	4.550E+01	1.670E-04	1.070E-02	1.600E-04
U-235	2.100E+00	1.740E-04	1.150E-02	9.030E-04
U-234	4.550E+01	1.810E-04	1.300E-02	8.930E-07
PA-231	0.000E+00	2.630E-03	5.180E-01	2.010E-04
TH-230	0.000E+00	7.780E-04	5.180E-02	2.040E-06
AC-227	0.000E+00	4.070E-03	2.040E+00	2.160E-03
RA-226	0.000E+00	1.040E-03	1.300E-02	1.040E-02
PB-210	0.000E+00	2.560E-03	4.070E-03	1.430E-05

□
** RESRAD-BUILD Program Output, Version 3.1 03/04/02 18:08 Page: 10
**

Title : KMTC U-238 thru U-234 w/ ICRP72 DCFs Eva
Input File : C:\Winbld\Tc238b.bld
Evaluation Time: 0.000000 years

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ííí       Assessment for Time:  1            ííí
ííí             Time =0.00E+00 yr            ííí
íííííííííííííííííííííííííííííííííííííííííííííííí
íííííííííííííííííííííííííííííííííííííííííííííííí
```

íííííííí Source Information íííííííí

Source: 1
Location:: Room : 1 x: 3.00 y: 3.00 z: 0.00 [m]
Geometry:: Type: Area Area:3.60E+01 [m2] Direction:
z
Pathway ::
Direct Ingestion Rate: 0.000E+00 [1/hr]
Fraction released to air: 1.000E-01
Removable fraction: 7.000E-03
Time to Remove: 3.650E+02 [day]

Contamination::

Nuclide	Concentration [pCi/m2]
U-238	4.550E+01
U-235	2.100E+00
U-234	4.550E+01
PA-231	0.000E+00
TH-230	0.000E+00
AC-227	0.000E+00
RA-226	0.000E+00
PB-210	0.000E+00

□
** RESRAD-BUILD Program Output, Version 3.1 03/04/02 18:08 Page: 11
**
Title : KMTC U-238 thru U-234 w/ ICRP72 DCFs Eva
Input File : C:\Winbld\Tc238b.bld
Evaluation Time: 0.000000 years

Source: 2
Location:: Room : 1 x: 3.00 y: 3.00 z: 3.00 [m]
Geometry:: Type: Area Area:3.60E+01 [m2] Direction:
z

Pathway ::
Direct Ingestion Rate: 0.000E+00 [1/hr]
Fraction released to air: 1.000E-01
Removable fraction: 7.000E-03
Time to Remove: 3.650E+02 [day]

Contamination::

Nuclide	Concentration [pCi/m2]
U-238	4.550E+01
U-235	2.100E+00
U-234	4.550E+01
PA-231	0.000E+00
TH-230	0.000E+00
AC-227	0.000E+00
RA-226	0.000E+00
PB-210	0.000E+00

Source: 3
Location:: Room : 1 x: 0.00 y: 3.00 z: 1.50 [m]
Geometry:: Type: Area Area:1.80E+01 [m2] Direction:
x

Pathway ::
Direct Ingestion Rate: 0.000E+00 [1/hr]
Fraction released to air: 1.000E-01
Removable fraction: 7.000E-03
Time to Remove: 3.650E+02 [day]

Contamination::

Nuclide	Concentration [pCi/m2]
U-238	4.550E+01
U-235	2.100E+00
U-234	4.550E+01
PA-231	0.000E+00
TH-230	0.000E+00
AC-227	0.000E+00
RA-226	0.000E+00
PB-210	0.000E+00

Title : KMTC U-238 thru U-234 w/ ICRP72 DCFs Eva
Input File : C:\Winbld\Tc238b.bld
Evaluation Time: 0.000000 years

Source: 4
Location:: Room : 1 x: 3.00 y: 0.00 z: 1.50 [m]
Geometry:: Type: Area Area:1.80E+01 [m2] Direction:
y
Pathway ::
Direct Ingestion Rate: 0.000E+00 [1/hr]
Fraction released to air: 1.000E-01
Removable fraction: 7.000E-03
Time to Remove: 3.650E+02 [day]

Contamination::

Nuclide	Concentration [pCi/m2]
U-238	4.550E+01
U-235	2.100E+00
U-234	4.550E+01
PA-231	0.000E+00
TH-230	0.000E+00
AC-227	0.000E+00
RA-226	0.000E+00
PB-210	0.000E+00

Source: 5
Location:: Room : 1 x: 6.00 y: 3.00 z: 1.50 [m]
Geometry:: Type: Area Area:1.80E+01 [m2] Direction:
x
Pathway ::
Direct Ingestion Rate: 0.000E+00 [1/hr]
Fraction released to air: 1.000E-01
Removable fraction: 7.000E-03
Time to Remove: 3.650E+02 [day]

Contamination::

Nuclide	Concentration [pCi/m2]
U-238	4.550E+01

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U-235	2.100E+00
U-234	4.550E+01
PA-231	0.000E+00
TH-230	0.000E+00
AC-227	0.000E+00
RA-226	0.000E+00
PB-210	0.000E+00

□
** RESRAD-BUILD Program Output, Version 3.1 03/04/02 18:08 Page: 13
**
Title : KMTC U-238 thru U-234 w/ ICRP72 DCFs Eva
Input File : C:\Winbld\Tc238b.bld
Evaluation Time: 0.000000 years

Source: 6
Location:: Room : 1 x: 3.00 y: 6.00 z: 1.50 [m]
Geometry:: Type: Area Area:1.80E+01 [m2] Direction:
y
Pathway ::
Direct Ingestion Rate: 0.000E+00 [1/hr]
Fraction released to air: 1.000E-01
Removable fraction: 7.000E-03
Time to Remove: 3.650E+02 [day]

Contamination::

Nuclide	Concentration [pCi/m2]
U-238	4.550E+01
U-235	2.100E+00
U-234	4.550E+01
PA-231	0.000E+00
TH-230	0.000E+00
AC-227	0.000E+00
RA-226	0.000E+00
PB-210	0.000E+00

□
** RESRAD-BUILD Program Output, Version 3.1 03/04/02 18:08 Page: 14
**
Title : KMTC U-238 thru U-234 w/ ICRP72 DCFs Eva
Input File : C:\Winbld\Tc238b.bld
Evaluation Time: 0.000000 years

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Source Contributions to Receptor Doses
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[mrem]

	Source 1	Source 2	Source 3	Source 4	Source 5	Source 6	Total
Receptor 1	6.75E-05	6.19E-05	3.00E-05	3.00E-05	3.00E-05	3.00E-05	2.50E-04
Total	6.75E-05	6.19E-05	3.00E-05	3.00E-05	3.00E-05	3.00E-05	2.50E-04

□
** RESRAD-BUILD Program Output, Version 3.1 03/04/02 18:08 Page: 15
**
Title : KMTC U-238 thru U-234 w/ ICRP72 DCFs Eva
Input File : C:\Winbld\Tc238b.bld
Evaluation Time: 0.000000 years

Pathway Detail of Doses
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[mrem]

Source: 1

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	1.19E-05	4.16E-09	3.72E-11	5.44E-05	2.03E-14	1.14E-06
Total	1.19E-05	4.16E-09	3.72E-11	5.44E-05	2.03E-14	1.14E-06

Source: 2

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	6.30E-06	4.16E-09	3.72E-11	5.44E-05	2.03E-14	1.14E-06

Total	6.30E-06	4.16E-09	3.72E-11	5.44E-05	2.03E-14	1.14E-06

Source: 3

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	2.25E-06	2.08E-09	1.86E-11	2.72E-05	1.02E-14	5.71E-07
Total	2.25E-06	2.08E-09	1.86E-11	2.72E-05	1.02E-14	5.71E-07

Source: 4

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	2.25E-06	2.08E-09	1.86E-11	2.72E-05	1.02E-14	5.71E-07
Total	2.25E-06	2.08E-09	1.86E-11	2.72E-05	1.02E-14	5.71E-07

Source: 5

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	2.25E-06	2.08E-09	1.86E-11	2.72E-05	1.02E-14	5.71E-07
Total	2.25E-06	2.08E-09	1.86E-11	2.72E-05	1.02E-14	5.71E-07

Source: 6

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	2.25E-06	2.08E-09	1.86E-11	2.72E-05	1.02E-14	5.71E-07
Total	2.25E-06	2.08E-09	1.86E-11	2.72E-05	1.02E-14	5.71E-07

□

** RESRAD-BUILD Program Output, Version 3.1 03/04/02 18:08 Page: 16 **

Title : KMTC U-238 thru U-234 w/ ICRP72 DCFs Eva
Input File : C:\Winbld\Tc238b.bld
Evaluation Time: 0.000000 years

Nuclide Detail of Doses
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[mrem]

Source: 1

Nuclide	Receptor 1	Total
U-238		
U-238	3.35E-05	3.35E-05
U-234	4.30E-11	4.30E-11
TH-230	5.04E-16	5.04E-16
RA-226	2.19E-19	2.19E-19
PB-210	0.00E+00	0.00E+00
U-235		
U-235	3.59E-06	3.59E-06
PA-231	5.76E-10	5.76E-10
AC-227	2.36E-11	2.36E-11
U-234		
U-234	3.04E-05	3.04E-05
TH-230	5.34E-10	5.34E-10
RA-226	3.55E-13	3.55E-13
PB-210	9.36E-17	9.36E-17

Source: 2

Nuclide	Receptor 1	Total
U-238		
U-238	2.93E-05	2.93E-05
U-234	4.25E-11	4.25E-11
TH-230	5.03E-16	5.03E-16
RA-226	1.29E-19	1.29E-19
PB-210	0.00E+00	0.00E+00
U-235		
U-235	2.48E-06	2.48E-06
PA-231	5.73E-10	5.73E-10
AC-227	2.33E-11	2.33E-11
U-234		
U-234	3.01E-05	3.01E-05
TH-230	5.33E-10	5.33E-10
RA-226	2.09E-13	2.09E-13
PB-210	8.89E-17	8.89E-17

□
** RESRAD-BUILD Program Output, Version 3.1 03/04/02 18:08 Page: 17
**
Title : KMTC U-238 thru U-234 w/ ICRP72 DCFs Eva
Input File : C:\Winbld\Tc238b.bld
Evaluation Time: 0.000000 years

Source: 3

Nuclide	Receptor 1	Total
U-238		
U-238	1.40E-05	1.40E-05
U-234	2.12E-11	2.12E-11
TH-230	2.51E-16	2.51E-16
RA-226	4.99E-20	4.99E-20
PB-210	0.00E+00	0.00E+00
U-235		
U-235	1.06E-06	1.06E-06
PA-231	2.86E-10	2.86E-10
AC-227	1.16E-11	1.16E-11
U-234		
U-234	1.50E-05	1.50E-05
TH-230	2.66E-10	2.66E-10
RA-226	8.11E-14	8.11E-14
PB-210	4.37E-17	4.37E-17

Source: 4

Nuclide	Receptor 1	Total
U-238		
U-238	1.40E-05	1.40E-05
U-234	2.12E-11	2.12E-11
TH-230	2.51E-16	2.51E-16
RA-226	4.99E-20	4.99E-20
PB-210	0.00E+00	0.00E+00
U-235		
U-235	1.06E-06	1.06E-06
PA-231	2.86E-10	2.86E-10
AC-227	1.16E-11	1.16E-11
U-234		

U-234	1.50E-05	1.50E-05
TH-230	2.66E-10	2.66E-10
RA-226	8.11E-14	8.11E-14
PB-210	4.37E-17	4.37E-17

□
** RESRAD-BUILD Program Output, Version 3.1 03/04/02 18:08 Page: 18
**
Title : KMTC U-238 thru U-234 w/ ICRP72 DCFs Eva
Input File : C:\Winbld\Tc238b.bld
Evaluation Time: 0.000000 years

Source: 5

Nuclide	Receptor 1	Total
U-238		
U-238	1.40E-05	1.40E-05
U-234	2.12E-11	2.12E-11
TH-230	2.51E-16	2.51E-16
RA-226	4.99E-20	4.99E-20
PB-210	0.00E+00	0.00E+00
U-235		
U-235	1.06E-06	1.06E-06
PA-231	2.86E-10	2.86E-10
AC-227	1.16E-11	1.16E-11
U-234		
U-234	1.50E-05	1.50E-05
TH-230	2.66E-10	2.66E-10
RA-226	8.11E-14	8.11E-14
PB-210	4.37E-17	4.37E-17

Source: 6

Nuclide	Receptor 1	Total
U-238		
U-238	1.40E-05	1.40E-05
U-234	2.12E-11	2.12E-11
TH-230	2.51E-16	2.51E-16
RA-226	4.99E-20	4.99E-20
PB-210	0.00E+00	0.00E+00
U-235		

U-235	1.06E-06	1.06E-06
PA-231	2.86E-10	2.86E-10
AC-227	1.16E-11	1.16E-11
U-234		
U-234	1.50E-05	1.50E-05
TH-230	2.66E-10	2.66E-10
RA-226	8.11E-14	8.11E-14
PB-210	4.37E-17	4.37E-17

□
** RESRAD-BUILD Program Output, Version 3.1 03/04/02 18:08 Page: 19
**
Title : KMTC U-238 thru U-234 w/ ICRP72 DCFs Eva
Input File : C:\Winbld\Tc238b.bld
Evaluation Time: 1.00000 years

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ÍÍÍ       Assessment for Time:  2            ÍÍÍ
ÍÍÍ             Time =1.00E+00 yr            ÍÍÍ
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ÍÍÍÍÍÍÍÍ  Source Information  ÍÍÍÍÍÍÍÍ


 Source:  1
        Location::  Room :  1  x:   3.00 y:   3.00  z:   0.00 [m]
        Geometry::  Type: Area        Area:3.60E+01 [m2]  Direction:
z
        Pathway ::
             Direct Ingestion Rate:    0.000E+00 [1/hr]
             Fraction released to air: 1.000E-01
             Removable fraction:       0.000E+00
             Time to Remove:           3.650E+02 [day]


        Contamination::     Nuclide    Concentration
                                         [pCi/m2]
                             U-238       4.518E+01
                             U-235       2.085E+00
                             U-234       4.518E+01
```

PA-231	4.412E-05
TH-230	4.067E-04
AC-227	6.962E-07
RA-226	8.809E-08
PB-210	9.056E-10

□
** RESRAD-BUILD Program Output, Version 3.1 03/04/02 18:08 Page: 20
**
Title : KMTC U-238 thru U-234 w/ ICRP72 DCFs Eva
Input File : C:\Winbld\Tc238b.bld
Evaluation Time: 1.00000 years

Source: 2
Location:: Room : 1 x: 3.00 y: 3.00 z: 3.00 [m]
Geometry:: Type: Area Area:3.60E+01 [m2] Direction:
z
Pathway ::
Direct Ingestion Rate: 0.000E+00 [1/hr]
Fraction released to air: 1.000E-01
Removable fraction: 0.000E+00
Time to Remove: 3.650E+02 [day]

Contamination::

Nuclide	Concentration [pCi/m2]
U-238	4.518E+01
U-235	2.085E+00
U-234	4.518E+01
PA-231	4.412E-05
TH-230	4.067E-04
AC-227	6.962E-07
RA-226	8.809E-08
PB-210	9.056E-10

Source: 3
Location:: Room : 1 x: 0.00 y: 3.00 z: 1.50 [m]
Geometry:: Type: Area Area:1.80E+01 [m2] Direction:
x
Pathway ::
Direct Ingestion Rate: 0.000E+00 [1/hr]
Fraction released to air: 1.000E-01
Removable fraction: 0.000E+00
Time to Remove: 3.650E+02 [day]

```
        Contamination::      Nuclide     Concentration
                                           [pCi/m2]
                              U-238        4.518E+01
                              U-235        2.085E+00
                              U-234        4.518E+01
                              PA-231       4.412E-05
                              TH-230       4.067E-04
                              AC-227       6.962E-07
                              RA-226       8.809E-08
                              PB-210       9.056E-10
```

□
** RESRAD-BUILD Program Output, Version 3.1 03/04/02 18:08 Page: 21
**
Title : KMTC U-238 thru U-234 w/ ICRP72 DCFs Eva
Input File : C:\Winbld\Tc238b.bld
Evaluation Time: 1.00000 years

```
 Source:  4
        Location::  Room :  1  x:   3.00 y:   0.00  z:   1.50 [m]
        Geometry::  Type: Area        Area:1.80E+01 [m2]  Direction:
y
        Pathway ::
             Direct Ingestion Rate:     0.000E+00 [1/hr]
             Fraction released to air: 1.000E-01
             Removable fraction:        0.000E+00
             Time to Remove:            3.650E+02 [day]


        Contamination::      Nuclide     Concentration
                                           [pCi/m2]
                              U-238        4.518E+01
                              U-235        2.085E+00
                              U-234        4.518E+01
                              PA-231       4.412E-05
                              TH-230       4.067E-04
                              AC-227       6.962E-07
                              RA-226       8.809E-08
                              PB-210       9.056E-10

 Source:  5
        Location::  Room :  1  x:   6.00 y:   3.00  z:   1.50 [m]
```

Geometry:: Type: Area Area:1.80E+01 [m2] Direction:
x

Pathway ::

Direct Ingestion Rate:	0.000E+00	[1/hr]
Fraction released to air:	1.000E-01	
Removable fraction:	0.000E+00	
Time to Remove:	3.650E+02	[day]

Contamination::

Nuclide	Concentration [pCi/m2]
U-238	4.518E+01
U-235	2.085E+00
U-234	4.518E+01
PA-231	4.412E-05
TH-230	4.067E-04
AC-227	6.962E-07
RA-226	8.809E-08
PB-210	9.056E-10

□
** RESRAD-BUILD Program Output, Version 3.1 03/04/02 18:08 Page: 22
**
Title : KMTC U-238 thru U-234 w/ ICRP72 DCFs Eva
Input File : C:\Winbld\Tc238b.bld
Evaluation Time: 1.00000 years

Source: 6
Location:: Room : 1 x: 3.00 y: 6.00 z: 1.50 [m]
Geometry:: Type: Area Area:1.80E+01 [m2] Direction:
y

Pathway ::

Direct Ingestion Rate:	0.000E+00	[1/hr]
Fraction released to air:	1.000E-01	
Removable fraction:	0.000E+00	
Time to Remove:	3.650E+02	[day]

Contamination::

Nuclide	Concentration [pCi/m2]
U-238	4.518E+01
U-235	2.085E+00
U-234	4.518E+01

PA-231	4.412E-05
TH-230	4.067E-04
AC-227	6.962E-07
RA-226	8.809E-08
PB-210	9.056E-10

RESRAD-BUILD Dose Tables

Source Contributions to Receptor Doses

[mrem]

	Source 1	Source 2	Source 3	Source 4	Source 5	Source 6	Total
Receptor 1	1.18E-05	6.27E-06	2.24E-06	2.24E-06	2.24E-06	2.24E-06	2.71E-05
Total	1.18E-05	6.27E-06	2.24E-06	2.24E-06	2.24E-06	2.24E-06	2.71E-05

Pathway Detail of Doses

[mrem]

Source: 1

Receptor	External	Deposition	Immersion	Inhalation	Radon	I ngestion
1	1.18E-05	0.00E+00	0.00E+00	0.00E+00	1.52E-13	0.00E+00
Total	1.18E-05	0.00E+00	0.00E+00	0.00E+00	1.52E-13	0.00E+00

Source: 2

Receptor	External	Deposition	Immersion	Inhalation	Radon	I ngestion
1	6.27E-06	0.00E+00	0.00E+00	0.00E+00	1.52E-13	0.00E+00
Total	6.27E-06	0.00E+00	0.00E+00	0.00E+00	1.52E-13	0.00E+00

Source: 3

Receptor	External	Deposition	Immersion	Inhalation	Radon	I ngestion
1	2.24E-06	0.00E+00	0.00E+00	0.00E+00	7.62E-14	0.00E+00
Total	2.24E-06	0.00E+00	0.00E+00	0.00E+00	7.62E-14	0.00E+00

Source: 4

Receptor	External	Deposition	Immersion	Inhalation	Radon	I ngestion
1	2.24E-06	0.00E+00	0.00E+00	0.00E+00	7.62E-14	0.00E+00
Total	2.24E-06	0.00E+00	0.00E+00	0.00E+00	7.62E-14	0.00E+00

Source: 5

Receptor	External	Deposition	Immersion	Inhalation	Radon	I ngestion
1	2.24E-06	0.00E+00	0.00E+00	0.00E+00	7.62E-14	0.00E+00
Total	2.24E-06	0.00E+00	0.00E+00	0.00E+00	7.62E-14	0.00E+00

```
Source:  6
   Receptor     External  Deposition Immersion  Inhalation   Radon     I
ngestion
       1        2.24E-06   0.00E+00   0.00E+00   0.00E+00   7.62E-14
0.00E+00
   Total        2.24E-06   0.00E+00   0.00E+00   0.00E+00   7.62E-14
0.00E+00
□
** RESRAD-BUILD Program Output, Version 3.1 03/04/02 18:08  Page:  25
**
Title : KMTC U-238 thru U-234 w/ ICRP72 DCFs Eva
Input File : C:\Winbld\Tc238b.bld
Evaluation Time:     1.00000     years


                         Nuclide Detail of Doses
                         ÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍ
                                [mrem]

Source:  1

   Nuclide Receptor   Total
                 1
 U-238
  U-238    8.90E-06  8.90E-06
  U-234    2.43E-12  2.43E-12
  TH-230   1.37E-17  1.37E-17
  RA-226   4.28E-18  4.28E-18
  PB-210   1.06E-22  1.06E-22
 U-235
  U-235    2.36E-06  2.36E-06
  PA-231   2.08E-11  2.08E-11
  AC-227   4.36E-12  4.36E-12
 U-234
  U-234    5.72E-07  5.72E-07
  TH-230   5.81E-12  5.81E-12
  RA-226   2.50E-12  2.50E-12
  PB-210   1.68E-16  1.68E-16


Source:  2

   Nuclide Receptor   Total
                 1
 U-238
```

U-238	4.74E-06	4.74E-06
U-234	1.17E-12	1.17E-12
TH-230	6.66E-18	6.66E-18
RA-226	2.41E-18	2.41E-18
PB-210	5.31E-23	5.31E-23
U-235		
U-235	1.26E-06	1.26E-06
PA-231	1.09E-11	1.09E-11
AC-227	2.34E-12	2.34E-12
U-234		
U-234	2.75E-07	2.75E-07
TH-230	2.82E-12	2.82E-12
RA-226	1.41E-12	1.41E-12
PB-210	8.39E-17	8.39E-17

□
** RESRAD-BUILD Program Output, Version 3.1 03/04/02 18:08 Page: 26
**
Title : KMTC U-238 thru U-234 w/ ICRP72 DCFs Eva
Input File : C:\Winbld\Tc238b.bld
Evaluation Time: 1.00000 years

Source: 3

Nuclide	Receptor 1	Total
U-238		
U-238	1.70E-06	1.70E-06
U-234	3.90E-13	3.90E-13
TH-230	2.24E-18	2.24E-18
RA-226	9.04E-19	9.04E-19
PB-210	1.84E-23	1.84E-23
U-235		
U-235	4.52E-07	4.52E-07
PA-231	3.86E-12	3.86E-12
AC-227	8.43E-13	8.43E-13
U-234		
U-234	9.17E-08	9.17E-08
TH-230	9.48E-13	9.48E-13
RA-226	5.29E-13	5.29E-13
PB-210	2.90E-17	2.90E-17

Source: 4

Nuclide	Receptor 1	Total
U-238		
U-238	1.70E-06	1.70E-06
U-234	3.90E-13	3.90E-13
TH-230	2.24E-18	2.24E-18
RA-226	9.04E-19	9.04E-19
PB-210	1.84E-23	1.84E-23
U-235		
U-235	4.52E-07	4.52E-07
PA-231	3.86E-12	3.86E-12
AC-227	8.43E-13	8.43E-13
U-234		
U-234	9.17E-08	9.17E-08
TH-230	9.48E-13	9.48E-13
RA-226	5.29E-13	5.29E-13
PB-210	2.90E-17	2.90E-17

□
** RESRAD-BUILD Program Output, Version 3.1 03/04/02 18:08 Page: 27
**
Title : KMTC U-238 thru U-234 w/ ICRP72 DCFs Eva
Input File : C:\Winbld\Tc238b.bld
Evaluation Time: 1.00000 years

Source: 5

Nuclide	Receptor 1	Total
U-238		
U-238	1.70E-06	1.70E-06
U-234	3.90E-13	3.90E-13
TH-230	2.24E-18	2.24E-18
RA-226	9.04E-19	9.04E-19
PB-210	1.84E-23	1.84E-23
U-235		
U-235	4.52E-07	4.52E-07
PA-231	3.86E-12	3.86E-12
AC-227	8.43E-13	8.43E-13
U-234		
U-234	9.17E-08	9.17E-08
TH-230	9.48E-13	9.48E-13
RA-226	5.29E-13	5.29E-13
PB-210	2.90E-17	2.90E-17

Source: 6

Nuclide	Receptor 1	Total
U-238		
U-238	1.70E-06	1.70E-06
U-234	3.90E-13	3.90E-13
TH-230	2.24E-18	2.24E-18
RA-226	9.04E-19	9.04E-19
PB-210	1.84E-23	1.84E-23
U-235		
U-235	4.52E-07	4.52E-07
PA-231	3.86E-12	3.86E-12
AC-227	8.43E-13	8.43E-13
U-234		
U-234	9.17E-08	9.17E-08
TH-230	9.48E-13	9.48E-13
RA-226	5.29E-13	5.29E-13
PB-210	2.90E-17	2.90E-17

□
** RESRAD-BUILD Program Output, Version 3.1 03/04/02 18:08 Page: 28
**
Title : KMTC U-238 thru U-234 w/ ICRP72 DCFs Eva
Input File : C:\Winbld\Tc238b.bld
Full Summary

RESRAD-BUILD Dose (Time) Tables

Receptor Doses Received for the Exposure Duration
(mrem)

Evaluation Time [yr]

```
        0.00E+00   1.00E+00
        ÄÄÄÄÄÄÄÄ   ÄÄÄÄÄÄÄÄ
1       2.50E-04   2.71E-05
```

Receptor Dose/Yr Averaged Over Exposure Duration
íí
(mrem/yr)

Evaluation Time [yr]

```
        0.00E+00   1.00E+00
        ÄÄÄÄÄÄÄÄ   ÄÄÄÄÄÄÄÄ
1       2.50E-04   2.71E-05
```

Attachment 3

□

** RESRAD-BUILD Program Output, Version 3.1 03/06/02 10:02 Page: 1
**
Title : Th-230 through end of chain with ICRP72
Input File : C:\Winbld\Tc230b.bld

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ííí RESRAD-BUILD Table of Contents ííí
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RESRAD-BUILD Input Parameters..... 2
Building Information..... 3
Source Information..... 4
For time = 0.00E+00 yr
Time Specific Parameters..... 7
Receptor-Source Dose Summary..... 10
Dose by Pathway Detail..... 11
Dose by Nuclide Detail..... 12
For time = 1.00E+00 yr
Time Specific Parameters..... 14
Receptor-Source Dose Summary..... 17
Dose by Pathway Detail..... 18
Dose by Nuclide Detail..... 19
Full Summary..... 21

□

** RESRAD-BUILD Program Output, Version 3.1 03/06/02 10:02 Page: 2
**
Title : Th-230 through end of chain with ICRP72
Input File : C:\Winbld\Tc230b.bld

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ííí RESRAD-BUILD Input Parameters ííí
ííí ííí
íí
íí

Number of Sources : 6
Number of Receptors: 1
Total Time : 3.650000E+02 days
Fraction Inside : 7.000000E-01

íííííííííí Receptor Information íííííííííí

Receptor	Room	x	y	z	FracTime	Inhalation	Ingesti
on(Dust)		[m]	[m]	[m]		[m3/day]	[m2
/hr]							
1	1	3.000	3.000	1.000	0.330	3.36E+01	1.00
E-04							

ííí Receptor-Source Shielding Relationship ííí

Receptor	Source	Density [g/cm3]	Thickness [cm]	Material
1	1	2.40E+00	0.00E+00	Concrete
1	2	2.40E+00	0.00E+00	Concrete
1	3	2.40E+00	0.00E+00	Concrete
1	4	2.40E+00	0.00E+00	Concrete
1	5	2.40E+00	0.00E+00	Concrete
1	6	2.40E+00	0.00E+00	Concrete

□
** RESRAD-BUILD Program Output, Version 3.1 03/06/02 10:02 Page: 3
**
Title : Th-230 through end of chain with ICRP72
Input File : C:\Winbld\Tc230b.bld

íííííííí Building Information íííííííí

Building Air Exchange Rate: 1.52E+00 1/hr

```
    Height[m]          Air Exchanges [m3/hr]
    Area [m2]
                      ******************************
                      *                            *
                      *                            *
                      *                           <=Q01: 1.64E+02
    H1:    3.000      *           Room  1          *      Q10 :  1.64E
+02
                      *   LAMBDA: 1.52E+00         *
   Area  36.000       *                            *
                      *                            *
                      ******************************
```

```
      Deposition velocity: 1.00E-02 [m/s]   Resuspension Rate: 5.00E-0
7 [1/s]
□
** RESRAD-BUILD Program Output, Version 3.1 03/06/02 10:02  Page:   4
**
Title : Th-230 through end of chain with ICRP72
Input File : C:\Winbld\Tc230b.bld
```

ÍÍÍÍÍÍÍÍ Source Information ÍÍÍÍÍÍÍÍ

```
 Source:  1
        Location::  Room :  1  x:   3.00 y:   3.00  z:   0.00[m]
        Geometry::  Type: Area        Area:3.60E+01 [m2]  Direction:
z
        Pathway ::
             Direct Ingestion Rate:    0.000E+00 [1/hr]
             Fraction released to air: 1.000E-01
             Removable fraction:       7.000E-03
             Time to Remove:           3.650E+02 [day]

             Radon Release Fraction:   1.000E-01


   Contamination::
    Nuclide Concentration        Dose Conversion Factors
    ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
                            Ingestion   Inhalation  Submersion
                 [pCi/m2]   [mrem/pCi]  [mrem/pCi]  [mrem/yr/
```

```
                                                        (pCi/m3)]
    TH-230     4.550E+01   7.780E-04   5.180E-02   2.040E-06
    RA-226     4.550E+01   1.040E-03   1.300E-02   1.040E-02
    PB-210     4.550E+01   2.560E-03   4.070E-03   1.430E-05

 Source:  2
        Location::  Room :  1  x:   3.00 y:   3.00  z:   3.00[m]
        Geometry::  Type: Area        Area:3.60E+01 [m2]  Direction:
z
        Pathway ::
             Direct Ingestion Rate:    0.000E+00 [1/hr]
             Fraction released to air: 1.000E-01
             Removable fraction:       7.000E-03
             Time to Remove:           3.650E+02 [day]

             Radon Release Fraction:   1.000E-01


   Contamination::
    Nuclide Concentration       Dose Conversion Factors
    ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
                            Ingestion   Inhalation  Submersion
                [pCi/m2]    [mrem/pCi]  [mrem/pCi]  [mrem/yr/
                                                    (pCi/m3)]
    TH-230     4.550E+01   7.780E-04   5.180E-02   2.040E-06
    RA-226     4.550E+01   1.040E-03   1.300E-02   1.040E-02
    PB-210     4.550E+01   2.560E-03   4.070E-03   1.430E-05
□
** RESRAD-BUILD Program Output, Version 3.1 03/06/02 10:02  Page:   5
**
Title : Th-230 through end of chain with ICRP72
Input File : C:\Winbld\Tc230b.bld


 Source:  3
        Location::  Room :  1  x:   0.00 y:   3.00  z:   1.50[m]
        Geometry::  Type: Area        Area:1.80E+01 [m2]  Direction:
x
        Pathway ::
             Direct Ingestion Rate:    0.000E+00 [1/hr]
             Fraction released to air: 1.000E-01
             Removable fraction:       7.000E-03
             Time to Remove:           3.650E+02 [day]

             Radon Release Fraction:   1.000E-01
```

```
   Contamination::
    Nuclide Concentration        Dose Conversion Factors
    ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
                                Ingestion   Inhalation  Submersion
                [pCi/m2]        [mrem/pCi]  [mrem/pCi]  [mrem/yr/
                                                        (pCi/m3)]
     TH-230     4.550E+01       7.780E-04   5.180E-02   2.040E-06
     RA-226     4.550E+01       1.040E-03   1.300E-02   1.040E-02
     PB-210     4.550E+01       2.560E-03   4.070E-03   1.430E-05

 Source:  4
        Location::  Room :  1  x:   3.00 y:   0.00  z:   1.50[m]
        Geometry::  Type: Area        Area:1.80E+01 [m2]  Direction:
y
        Pathway ::
             Direct Ingestion Rate:     0.000E+00 [1/hr]
             Fraction released to air: 1.000E-01
             Removable fraction:        7.000E-03
             Time to Remove:            3.650E+02 [day]

             Radon Release Fraction:    1.000E-01


   Contamination::
    Nuclide Concentration        Dose Conversion Factors
    ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
                                Ingestion   Inhalation  Submersion
                [pCi/m2]        [mrem/pCi]  [mrem/pCi]  [mrem/yr/
                                                        (pCi/m3)]
     TH-230     4.550E+01       7.780E-04   5.180E-02   2.040E-06
     RA-226     4.550E+01       1.040E-03   1.300E-02   1.040E-02
     PB-210     4.550E+01       2.560E-03   4.070E-03   1.430E-05
□
** RESRAD-BUILD Program Output, Version 3.1 03/06/02 10:02  Page:   6
**
Title : Th-230 through end of chain with ICRP72
Input File : C:\Winbld\Tc230b.bld


 Source:  5
        Location::  Room :  1  x:   6.00 y:   3.00  z:   1.50[m]
        Geometry::  Type: Area        Area:1.80E+01 [m2]  Direction:
x
        Pathway ::
```

```
Direct Ingestion Rate:     0.000E+00 [1/hr]
Fraction released to air: 1.000E-01
Removable fraction:        7.000E-03
Time to Remove:            3.650E+02 [day]

Radon Release Fraction:    1.000E-01
```

Contamination::

Nuclide	Concentration [pCi/m2]	Dose Conversion Factors Ingestion [mrem/pCi]	Inhalation [mrem/pCi]	Submersion [mrem/yr/ (pCi/m3)]
TH-230	4.550E+01	7.780E-04	5.180E-02	2.040E-06
RA-226	4.550E+01	1.040E-03	1.300E-02	1.040E-02
PB-210	4.550E+01	2.560E-03	4.070E-03	1.430E-05

Source: 6

```
Location::  Room :  1  x:   3.00 y:   6.00  z:   1.50[m]
Geometry::  Type: Area        Area:1.80E+01 [m2]  Direction:
y
Pathway ::
     Direct Ingestion Rate:     0.000E+00 [1/hr]
     Fraction released to air: 1.000E-01
     Removable fraction:        7.000E-03
     Time to Remove:            3.650E+02 [day]

     Radon Release Fraction:    1.000E-01
```

Contamination::

Nuclide	Concentration [pCi/m2]	Dose Conversion Factors Ingestion [mrem/pCi]	Inhalation [mrem/pCi]	Submersion [mrem/yr/ (pCi/m3)]
TH-230	4.550E+01	7.780E-04	5.180E-02	2.040E-06
RA-226	4.550E+01	1.040E-03	1.300E-02	1.040E-02
PB-210	4.550E+01	2.560E-03	4.070E-03	1.430E-05

□

** RESRAD-BUILD Program Output, Version 3.1 03/06/02 10:02 Page: 7
**
Title : Th-230 through end of chain with ICRP72
Input File : C:\Winbld\Tc230b.bld
Evaluation Time: 0.000000 years

```
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íííííííííííííííííííííííííííííííííííííííííííííííííí
ííí       Assessment for Time:  1              ííí
ííí             Time =0.00E+00 yr              ííí
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ííííííííí  Source Information  ííííííííí


Source:  1
        Location::  Room :  1  x:   3.00 y:   3.00  z:   0.00 [m]
        Geometry::  Type: Area        Area:3.60E+01 [m2]  Direction:
z
        Pathway ::
             Direct Ingestion Rate:    0.000E+00 [1/hr]
             Fraction released to air: 1.000E-01
             Removable fraction:       7.000E-03
             Time to Remove:           3.650E+02 [day]



        Contamination::     Nuclide    Concentration
                                         [pCi/m2]
                             TH-230      4.550E+01
                             RA-226      4.550E+01
                             PB-210      4.550E+01

Source:  2
        Location::  Room :  1  x:   3.00 y:   3.00  z:   3.00 [m]
        Geometry::  Type: Area        Area:3.60E+01 [m2]  Direction:
z
        Pathway ::
             Direct Ingestion Rate:    0.000E+00 [1/hr]
             Fraction released to air: 1.000E-01
             Removable fraction:       7.000E-03
             Time to Remove:           3.650E+02 [day]



        Contamination::     Nuclide    Concentration
                                         [pCi/m2]
                             TH-230      4.550E+01
```

RA-226	4.550E+01
PB-210	4.550E+01

□
** RESRAD-BUILD Program Output, Version 3.1 03/06/02 10:02 Page: 8
**
Title : Th-230 through end of chain with ICRP72
Input File : C:\Winbld\Tc230b.bld
Evaluation Time: 0.000000 years

Source: 3
Location:: Room : 1 x: 0.00 y: 3.00 z: 1.50 [m]
Geometry:: Type: Area Area:1.80E+01 [m2] Direction: x

Pathway ::

Direct Ingestion Rate:	0.000E+00 [1/hr]
Fraction released to air:	1.000E-01
Removable fraction:	7.000E-03
Time to Remove:	3.650E+02 [day]

Contamination::

Nuclide	Concentration [pCi/m2]
TH-230	4.550E+01
RA-226	4.550E+01
PB-210	4.550E+01

Source: 4
Location:: Room : 1 x: 3.00 y: 0.00 z: 1.50 [m]
Geometry:: Type: Area Area:1.80E+01 [m2] Direction: y

Pathway ::

Direct Ingestion Rate:	0.000E+00 [1/hr]
Fraction released to air:	1.000E-01
Removable fraction:	7.000E-03
Time to Remove:	3.650E+02 [day]

Contamination::

Nuclide	Concentration [pCi/m2]
TH-230	4.550E+01
RA-226	4.550E+01
PB-210	4.550E+01

```
□
** RESRAD-BUILD Program Output, Version 3.1 03/06/02 10:02  Page:   9
**
Title : Th-230 through end of chain with ICRP72
Input File : C:\Winbld\Tc230b.bld
Evaluation Time:    0.000000     years


 Source:  5
        Location::  Room :  1  x:   6.00 y:   3.00  z:   1.50 [m]
        Geometry::  Type: Area        Area:1.80E+01 [m2]  Direction:
x
        Pathway ::
             Direct Ingestion Rate:    0.000E+00 [1/hr]
             Fraction released to air: 1.000E-01
             Removable fraction:       7.000E-03
             Time to Remove:           3.650E+02 [day]



        Contamination::     Nuclide    Concentration
                                         [pCi/m2]
                             TH-230      4.550E+01
                             RA-226      4.550E+01
                             PB-210      4.550E+01

 Source:  6
        Location::  Room :  1  x:   3.00 y:   6.00  z:   1.50 [m]
        Geometry::  Type: Area        Area:1.80E+01 [m2]  Direction:
y
        Pathway ::
             Direct Ingestion Rate:    0.000E+00 [1/hr]
             Fraction released to air: 1.000E-01
             Removable fraction:       7.000E-03
             Time to Remove:           3.650E+02 [day]



        Contamination::     Nuclide    Concentration
                                         [pCi/m2]
                             TH-230      4.550E+01
                             RA-226      4.550E+01
                             PB-210      4.550E+01
□
** RESRAD-BUILD Program Output, Version 3.1 03/06/02 10:02  Page:  10
```

**
Title : Th-230 through end of chain with ICRP72
Input File : C:\Winbld\Tc230b.bld
Evaluation Time: 0.000000 years

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Source Contributions to Receptor Doses
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[mrem]

	Source 1	Source 2	Source 3	Source 4	Source 5	Source 6	Total
Receptor 1	6.87E-04	4.61E-04	1.94E-04	1.94E-04	1.94E-04	1.94E-04	1.92E-03
Total	6.87E-04	4.61E-04	1.94E-04	1.94E-04	1.94E-04	1.94E-04	1.92E-03

□
** RESRAD-BUILD Program Output, Version 3.1 03/06/02 10:02 Page: 11
**
Title : Th-230 through end of chain with ICRP72
Input File : C:\Winbld\Tc230b.bld
Evaluation Time: 0.000000 years

Pathway Detail of Doses
íííííííííííííííííííííííí
[mrem]

Source: 1

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	4.87E-04	1.70E-07	1.91E-09	1.55E-04	3.14E-05	1.39E-05
Total	4.87E-04	1.70E-07	1.91E-09	1.55E-04	3.14E-05	1.39E-05

Source: 2

Receptor	External	Deposition	Immersion	Inhalation	Radon	I ngestion
1	2.61E-04	1.70E-07	1.91E-09	1.55E-04	3.14E-05	1.39E-05
Total	2.61E-04	1.70E-07	1.91E-09	1.55E-04	3.14E-05	1.39E-05

Source: 3

Receptor	External	Deposition	Immersion	Inhalation	Radon	I ngestion
1	9.37E-05	8.52E-08	9.55E-10	7.73E-05	1.57E-05	6.96E-06
Total	9.37E-05	8.52E-08	9.55E-10	7.73E-05	1.57E-05	6.96E-06

Source: 4

Receptor	External	Deposition	Immersion	Inhalation	Radon	I ngestion
1	9.37E-05	8.52E-08	9.55E-10	7.73E-05	1.57E-05	6.96E-06
Total	9.37E-05	8.52E-08	9.55E-10	7.73E-05	1.57E-05	6.96E-06

Source: 5

Receptor	External	Deposition	Immersion	Inhalation	Radon	I ngestion
1	9.37E-05	8.52E-08	9.55E-10	7.73E-05	1.57E-05	6.96E-06
Total	9.37E-05	8.52E-08	9.55E-10	7.73E-05	1.57E-05	6.96E-06

Source: 6

Receptor	External	Deposition	Immersion	Inhalation	Radon	I ngestion
1	9.37E-05	8.52E-08	9.55E-10	7.73E-05	1.57E-05	6.96E-06
Total	9.37E-05	8.52E-08	9.55E-10	7.73E-05	1.57E-05	

6.96E-06
□
** RESRAD-BUILD Program Output, Version 3.1 03/06/02 10:02 Page: 12
**
Title : Th-230 through end of chain with ICRP72
Input File : C:\Winbld\Tc230b.bld
Evaluation Time: 0.000000 years

Nuclide Detail of Doses
íííííííííííííííííííííí
[mrem]

Source: 1

Nuclide	Receptor 1	Total
TH-230		
TH-230	1.19E-04	1.19E-04
RA-226	1.19E-07	1.19E-07
PB-210	4.21E-11	4.21E-11
RA-226		
RA-226	5.49E-04	5.49E-04
PB-210	2.91E-07	2.91E-07
PB-210		
PB-210	1.87E-05	1.87E-05

Source: 2

Nuclide	Receptor 1	Total
TH-230		
TH-230	1.19E-04	1.19E-04
RA-226	7.00E-08	7.00E-08
PB-210	4.00E-11	4.00E-11
RA-226		
RA-226	3.24E-04	3.24E-04
PB-210	2.77E-07	2.77E-07
PB-210		
PB-210	1.77E-05	1.77E-05

Source: 3

Nuclide	Receptor 1	Total
TH-230		
TH-230	5.95E-05	5.95E-05
RA-226	2.71E-08	2.71E-08
PB-210	1.97E-11	1.97E-11
RA-226		
RA-226	1.25E-04	1.25E-04
PB-210	1.36E-07	1.36E-07
PB-210		
PB-210	8.73E-06	8.73E-06

□
** RESRAD-BUILD Program Output, Version 3.1 03/06/02 10:02 Page: 13
**
Title : Th-230 through end of chain with ICRP72
Input File : C:\Winbld\Tc230b.bld
Evaluation Time: 0.000000 years

Source: 4

Nuclide	Receptor 1	Total
TH-230		
TH-230	5.95E-05	5.95E-05
RA-226	2.71E-08	2.71E-08
PB-210	1.97E-11	1.97E-11
RA-226		
RA-226	1.25E-04	1.25E-04
PB-210	1.36E-07	1.36E-07
PB-210		
PB-210	8.73E-06	8.73E-06

Source: 5

Nuclide	Receptor 1	Total
TH-230		
TH-230	5.95E-05	5.95E-05
RA-226	2.71E-08	2.71E-08
PB-210	1.97E-11	1.97E-11
RA-226		
RA-226	1.25E-04	1.25E-04

```
  PB-210    1.36E-07  1.36E-07
 PB-210
  PB-210    8.73E-06  8.73E-06


Source:  6

   Nuclide Receptor   Total
              1
 TH-230
  TH-230    5.95E-05  5.95E-05
  RA-226    2.71E-08  2.71E-08
  PB-210    1.97E-11  1.97E-11
 RA-226
  RA-226    1.25E-04  1.25E-04
  PB-210    1.36E-07  1.36E-07
 PB-210
  PB-210    8.73E-06  8.73E-06


□
** RESRAD-BUILD Program Output, Version 3.1 03/06/02 10:02  Page:  14
**
Title : Th-230 through end of chain with ICRP72
Input File : C:\Winbld\Tc230b.bld
Evaluation Time:     1.00000     years


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              ÍÍÍ       Assessment for Time:  2            ÍÍÍ
              ÍÍÍ             Time =1.00E+00 yr            ÍÍÍ
              ÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍ
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              ÍÍÍÍÍÍÍÍ  Source Information  ÍÍÍÍÍÍÍÍ


 Source:  1
        Location::  Room :  1  x:   3.00 y:   3.00  z:   0.00 [m]
        Geometry::  Type: Area        Area:3.60E+01 [m2]  Direction:
z
        Pathway ::
             Direct Ingestion Rate:    0.000E+00 [1/hr]
             Fraction released to air: 1.000E-01
```

```
                Removable fraction:        0.000E+00
                Time to Remove:            3.650E+02 [day]



        Contamination::     Nuclide    Concentration
                                         [pCi/m2]
                             TH-230      4.518E+01
                             RA-226      4.518E+01
                             PB-210      4.518E+01

 Source:  2
        Location::  Room :  1  x:   3.00 y:   3.00  z:   3.00 [m]
        Geometry::  Type: Area        Area:3.60E+01 [m2]  Direction:
z
        Pathway ::
                Direct Ingestion Rate:     0.000E+00 [1/hr]
                Fraction released to air: 1.000E-01
                Removable fraction:        0.000E+00
                Time to Remove:            3.650E+02 [day]



        Contamination::     Nuclide    Concentration
                                         [pCi/m2]
                             TH-230      4.518E+01
                             RA-226      4.518E+01
                             PB-210      4.518E+01
□
** RESRAD-BUILD Program Output, Version 3.1 03/06/02 10:02  Page:  15
**
Title : Th-230 through end of chain with ICRP72
Input File : C:\Winbld\Tc230b.bld
Evaluation Time:     1.00000     years


 Source:  3
        Location::  Room :  1  x:   0.00 y:   3.00  z:   1.50 [m]
        Geometry::  Type: Area        Area:1.80E+01 [m2]  Direction:
x
        Pathway ::
                Direct Ingestion Rate:     0.000E+00 [1/hr]
                Fraction released to air: 1.000E-01
                Removable fraction:        0.000E+00
                Time to Remove:            3.650E+02 [day]
```

```
        Contamination::     Nuclide    Concentration
                                         [pCi/m2]
                             TH-230      4.518E+01
                             RA-226      4.518E+01
                             PB-210      4.518E+01

 Source:  4
        Location::  Room :  1  x:   3.00 y:   0.00  z:   1.50 [m]
        Geometry::  Type: Area        Area:1.80E+01 [m2]  Direction:
y
        Pathway ::
             Direct Ingestion Rate:    0.000E+00 [1/hr]
             Fraction released to air: 1.000E-01
             Removable fraction:       0.000E+00
             Time to Remove:           3.650E+02 [day]


        Contamination::     Nuclide    Concentration
                                         [pCi/m2]
                             TH-230      4.518E+01
                             RA-226      4.518E+01
                             PB-210      4.518E+01
□
** RESRAD-BUILD Program Output, Version 3.1 03/06/02 10:02  Page:  16
**
Title : Th-230 through end of chain with ICRP72
Input File : C:\Winbld\Tc230b.bld
Evaluation Time:     1.00000     years


 Source:  5
        Location::  Room :  1  x:   6.00 y:   3.00  z:   1.50 [m]
        Geometry::  Type: Area        Area:1.80E+01 [m2]  Direction:
x
        Pathway ::
             Direct Ingestion Rate:    0.000E+00 [1/hr]
             Fraction released to air: 1.000E-01
             Removable fraction:       0.000E+00
             Time to Remove:           3.650E+02 [day]
```

```
        Contamination::     Nuclide    Concentration
                                         [pCi/m2]
                             TH-230      4.518E+01
                             RA-226      4.518E+01
                             PB-210      4.518E+01

 Source:  6
        Location::  Room :  1  x:   3.00 y:   6.00  z:   1.50 [m]
        Geometry::  Type: Area        Area:1.80E+01 [m2]  Direction:
y
        Pathway ::
             Direct Ingestion Rate:    0.000E+00 [1/hr]
             Fraction released to air: 1.000E-01
             Removable fraction:       0.000E+00
             Time to Remove:           3.650E+02 [day]



        Contamination::     Nuclide    Concentration
                                         [pCi/m2]
                             TH-230      4.518E+01
                             RA-226      4.518E+01
                             PB-210      4.518E+01
```


Title : Th-230 through end of chain with ICRP72
Input File : C:\Winbld\Tc230b.bld
Evaluation Time: 1.00000 years

```
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ÍÍÍ                                                    ÍÍÍ
ÍÍÍ        RESRAD-BUILD Dose Tables                    ÍÍÍ
ÍÍÍ                                                    ÍÍÍ
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```

Source Contributions to Receptor Doses
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[mrem]

	Source 1	Source 2	Source 3	Source 4	Source 5	Source 6	Total
Receptor 1	5.17E-04	2.91E-04	1.09E-04	1.09E-04	1.09E-04	1.09E-04	1.24E-03
Total	5.17E-04	2.91E-04	1.09E-04	1.09E-04	1.09E-04	1.09E-04	1.24E-03

□

** RESRAD-BUILD Program Output, Version 3.1 03/06/02 10:02 Page: 18
**
Title : Th-230 through end of chain with ICRP72
Input File : C:\Winbld\Tc230b.bld
Evaluation Time: 1.00000 years

Pathway Detail of Doses
ÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍ
[mrem]

Source: 1

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	4.85E-04	0.00E+00	0.00E+00	0.00E+00	3.13E-05	0.00E+00
Total	4.85E-04	0.00E+00	0.00E+00	0.00E+00	3.13E-05	0.00E+00

Source: 2

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	2.60E-04	0.00E+00	0.00E+00	0.00E+00	3.13E-05	0.00E+00
Total	2.60E-04	0.00E+00	0.00E+00	0.00E+00	3.13E-05	0.00E+00

Source: 3

Receptor	External	Deposition	Immersion	Inhalation	Radon	Ingestion
1	9.34E-05	0.00E+00	0.00E+00	0.00E+00	1.56E-05	0.00E+00
Total	9.34E-05	0.00E+00	0.00E+00	0.00E+00	1.56E-05	0.00E+00

```
Source:  4
   Receptor     External  Deposition Immersion  Inhalation   Radon     I
ngestion
        1       9.34E-05   0.00E+00   0.00E+00   0.00E+00   1.56E-05
0.00E+00
   Total        9.34E-05   0.00E+00   0.00E+00   0.00E+00   1.56E-05
0.00E+00


Source:  5
   Receptor     External  Deposition Immersion  Inhalation   Radon     I
ngestion
        1       9.34E-05   0.00E+00   0.00E+00   0.00E+00   1.56E-05
0.00E+00
   Total        9.34E-05   0.00E+00   0.00E+00   0.00E+00   1.56E-05
0.00E+00


Source:  6
   Receptor     External  Deposition Immersion  Inhalation   Radon     I
ngestion
        1       9.34E-05   0.00E+00   0.00E+00   0.00E+00   1.56E-05
0.00E+00
   Total        9.34E-05   0.00E+00   0.00E+00   0.00E+00   1.56E-05
0.00E+00
□
** RESRAD-BUILD Program Output, Version 3.1 03/06/02 10:02  Page:  19
**
Title : Th-230 through end of chain with ICRP72
Input File : C:\Winbld\Tc230b.bld
Evaluation Time:     1.00000     years


                    Nuclide Detail of Doses
                    ÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍ
                            [mrem]

Source:  1

   Nuclide Receptor   Total
                 1
 TH-230
  TH-230   4.31E-07  4.31E-07
```

```
  RA-226    3.34E-07  3.34E-07
  PB-210    3.09E-11  3.09E-11
 RA-226
  RA-226    5.14E-04  5.14E-04
  PB-210    8.50E-08  8.50E-08
 PB-210
  PB-210    1.79E-06  1.79E-06


Source:  2

   Nuclide Receptor   Total
                1
 TH-230
  TH-230    2.09E-07  2.09E-07
  RA-226    1.88E-07  1.88E-07
  PB-210    1.55E-11  1.55E-11
 RA-226
  RA-226    2.90E-04  2.90E-04
  PB-210    4.25E-08  4.25E-08
 PB-210
  PB-210    8.94E-07  8.94E-07


Source:  3

   Nuclide Receptor   Total
                1
 TH-230
  TH-230    7.02E-08  7.02E-08
  RA-226    7.06E-08  7.06E-08
  PB-210    5.35E-12  5.35E-12
 RA-226
  RA-226    1.09E-04  1.09E-04
  PB-210    1.47E-08  1.47E-08
 PB-210
  PB-210    3.10E-07  3.10E-07


□
** RESRAD-BUILD Program Output, Version 3.1 03/06/02 10:02  Page:  20
**
Title : Th-230 through end of chain with ICRP72
Input File : C:\Winbld\Tc230b.bld
Evaluation Time:     1.00000     years
```

Source: 4

Nuclide	Receptor 1	Total
TH-230		
TH-230	7.02E-08	7.02E-08
RA-226	7.06E-08	7.06E-08
PB-210	5.35E-12	5.35E-12
RA-226		
RA-226	1.09E-04	1.09E-04
PB-210	1.47E-08	1.47E-08
PB-210		
PB-210	3.10E-07	3.10E-07

Source: 5

Nuclide	Receptor 1	Total
TH-230		
TH-230	7.02E-08	7.02E-08
RA-226	7.06E-08	7.06E-08
PB-210	5.35E-12	5.35E-12
RA-226		
RA-226	1.09E-04	1.09E-04
PB-210	1.47E-08	1.47E-08
PB-210		
PB-210	3.10E-07	3.10E-07

Source: 6

Nuclide	Receptor 1	Total
TH-230		
TH-230	7.02E-08	7.02E-08
RA-226	7.06E-08	7.06E-08
PB-210	5.35E-12	5.35E-12
RA-226		
RA-226	1.09E-04	1.09E-04
PB-210	1.47E-08	1.47E-08
PB-210		
PB-210	3.10E-07	3.10E-07

```
□
** RESRAD-BUILD Program Output, Version 3.1 03/06/02 10:02  Page:  21
**
Title : Th-230 through end of chain with ICRP72
Input File : C:\Winbld\Tc230b.bld
Full Summary

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                íííí                                          íííí
                íííí     RESRAD-BUILD Dose (Time) Tables      íííí
                íííí                                          íííí
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                Receptor Doses Received for the Exposure Duration
                íííííííííííííííííííííííííííííííííííííííííííííííí
                                     (mrem)

                                Evaluation Time [yr]
        0.00E+00  1.00E+00
        ÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄ
   1    1.92E-03  1.24E-03


                Receptor Dose/Yr Averaged Over Exposure Duration
                íííííííííííííííííííííííííííííííííííííííííííííííí
                                     (mrem/yr)

                                Evaluation Time [yr]
        0.00E+00  1.00E+00
        ÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄ
   1    1.92E-03  1.24E-03
```