SOFTWARE RELEASE NOTICE

1. SRN Number: **PA-SRN-286**

2. Project Title: **PCSA Tool Development** | Project No. **20.06002.01.103**

3. SRN Title: **RSAC Version 6.1**

4. Originator/Requestor: **Roland Benke** | Date: **1/08/2003**

5. Summary of Actions

- ■ Release of new software
- □ Change of access software
- □ Release of modified software:
- □ Software Retirement
  - □ Enhancements made
  - □ Corrections made

6. Validation Status

- □ Validated
- □ Limited Validation
- ■ Not Validated — Explain: **To be determined**

7. Persons Authorized Access

Name	Read Only/Read-Write	Addition/Change/Delete
Roland Benke	**RO**	
Asad Chowdhury	**RO**	
Biswajit Dasgupta	**RO**	
Lane Howard	**RO**	
Oleg Povetko	**RO**	
Igor Chichkov	**RO**	
Mike Smith	**RO**	
Patrick LaPlante	**RO**	
Gordon Wittmeyer	**RO**	

8. Element Manager Approval: [signature] Date: 2/4/0

9. Remarks:

CNWRA Form TOP-6 (09/01)

SOFTWARE SUMMARY FORM

01. Summary Date: **1/08/2003**	02. Summary prepared by (Name and phone) **Roland Benke (210)522.5250**	03. Summary Action: **NEW**
04. Software Date: **6/01/2001**	05. Short Title: **RSAC-V.6.1**	
06. Software Title: **Radiological Safety Analysis Computer Program, Version 6.1**		07. Internal Software ID: **NONE**

08. Software Type: ☐ Automated Data System ■ Computer Program ☐ Subroutine/Module	09. Processing Mode: ■ Interactive ☐ Batch ☐ Combination	10. Application Area a. General: ■ Scientific/Engineering ☐ Auxiliary Analyses ☐ Total System PA ☐ Subsystem PA ☐ Other b. Specific:

11. Submitting Organization and Address: **Idaho National Environmental and Engineering Laboratory** **P.O. Box 1625** **Idaho Falls, ID 83415-2503**	12. Technical Contact(s) and Phone: **Roland Benke (CNWRA) 210)522.5250**

13. Software Application:
RASC V.6.1 calculates consequences for atmosphere releases of radionuclides. Radionation doses can be calculated from the inhalation, ingestion, ground surface, and submersion pathways.

14. Computer Platform **PC**	15. Computer Operating System: **DOS based**	16. Programming Language(s): **None (executable)**	17. Number of Source Program Statements: **N/A**
18. Computer Memory Requirements: **450 KB**	19. Tape Drives: **N/A**	20. Disk Units: **8.81 MB**	21. Graphics: **N/A**

22. Other Operational Requirements: **Windows 95, 98, NT, or 2000**

23. Software Availability: ■ Available ☐ Limited ☐ In-House ONLY	24. Documentation Availability: ■ Available ☐ Preliminary ☐ In-House ONLY

25. **Developed by others, not at CNWRA**
Software Developer: Evaluator Roland R. Benke Date: 2/04/2003

CENTER FOR NUCLEAR WASTE REGULATORY ANALYSES
QA VERIFICATION REPORT
FOR
→ *ACQUIRED SOFTWARE NOT TO BE MODIFIED* ←

Software Title/Name: RSAC

Version: 6.1

Demonstration workstation: Windows NT Phoenix

Operating System: ↓

User: Roland Benke

NOTE: Acquired software may or may not meet all requirements and will be evaluated on a case-by-case basis.

Installation Testing [TOP-018, Section 5.6]

Has *installation testing* been conducted for each intended computer platform and operating system?
Yes: ☑ No: ☐ N/A: ☐

Computer Platforms: PC Operating Systems: Windows

Location of ~~Acceptance~~ Test Results: See memo Benke to Folk dated 01/31/03.

Comments:. Revised 7/3/02

Software Output [TOP-018, Section 5.5.4]

Is software designed so that individual runs are uniquely identified by date, time, name of software and version?
Yes: ☑ No: ☐ N/A: ☐

Date and Time Displayed: 02/04/03, 13:37

Name/Version Displayed: RSAC-6

Comments:

NOTE: Output identification content and format is typically taken as is.

Medium Documentation [TOP-018, Section 5.5.6]

The physical labeling of software medium (tapes, disks, etc.) contains: Program Name, Module/Name/Title, Module Revision, File type (ASCII, OBJ, EXE), Recording Date, and Operating System(s)?
Yes: ☑ No: ☐ N/A: ☐

Comments:

CENTER FOR NUCLEAR WASTE REGULATORY ANALYSES
QA VERIFICATION REPORT
FOR
→ *ACQUIRED SOFTWARE NOT TO BE MODIFIED* ←

User Documentation [TOP-018, Section 5.5.7]

Is there a Users' Manual for the software and is it up-to-date?

Yes: ☑ No: ☐ N/A: ☐

User's Manual Version and Date: INEEL/EXT-01-00540, 2001

Comments: See enclosed CD.

Are there basic instructions for the *installation* and *use* of the software?

Yes: ☑ No: ☐ N/A: ☐

Location of Instructions: See enclosed CD & attached printout from users manual.

Comments:

Configuration Control [TOP-018, Section 5.7, 5.9.3]

Is the Software Summary Form (Form TOP-4-1) completed and signed?

Yes: ☑ No: ☐ N/A: ☐

Date of Approval: 02/04/03

Is the list of files attached to the Software Summary Form complete and accurate?

Yes: ☑ No: ☐ N/A: ☐

Comments:

Is the source code available or, is the executable code available in the case of (acquired/commercial codes)?

Yes: ☑ No: ☐ N/A: ☐

Location of Source Code: See enclosed CD

Comments:

.

Have all the script/make files and executable files been submitted to the Software Custodian?

Only the executable files are being submitted.

Yes: ☑ No: ☐ N/A: ☐

Location of executable files: See enclosed CD.

Comments:

CENTER FOR NUCLEAR WASTE REGULATORY ANALYSES
QA VERIFICATION REPORT
FOR
→ *ACQUIRED SOFTWARE NOT TO BE MODIFIED* ←

Software Release [TOP-018, Section 5.9]

Upon acceptance of the software as verified above, has a Software Release Notice (SRN), Form TOP-6 been issued and does the version number of the software match the documentation?

Yes: ☑ No: ☐ N/A: ☐

SRN Number: 206

Comments:

Software Validation [TOP-018, Section 5.10]

Has a Software Validation Test Plan (SVTP) been prepared for the ***range of application*** of the software?

Yes: ☐ No: ☑ N/A: ☐

Version and Date of SVTP: ___

Date Reviewed and Approved via QAP-002: ___ TBD

Comments:

Has a Software Validation Test Report (SVTR) been prepared that documents the results of the validation cases, interpretation of the results, and determination if the software has been validated?

Yes: ☐ No: ☑ N/A: ☐

Version and Date of SVTR: ____

Date Reviewed and Approved via QAP-002: _____ TBD.

Comments.:

Additional Comments:

Roland R. Dale 2/04/2003
Software Evaluator/User/Date

02/04/03
Software Custodian/Date

MEMORANDUM

Date: January 31, 2003

To: Randy Folck

From: Roland Benke

Subject: Installation test for RSAC Version 6.1, acquired software "not-to-be-modified"

Attachments:
1. Printouts of the four example output files (*Example2.out, Example3.out, Example4.out,* and *Example5.out*)
2. Printouts of the published solutions for the four examples
3. CD containing RSAC Version 6.1 executables and supporting files, code manuals, and installation test files

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Installation Test

The RSAC Version 6.1 software is DOS-based for use on an IBM-compatible personal computer. RSAC Version 6.1 is acquired software "not-to-be-modified." An installation test was performed for RSAC Version 6.1 and is described below.

Four examples (Examples 2, 3, 4, and 5) were selected for the installation test because they exercised the four main dose pathways (inhalation, ingestion, ground surface, and submersion, respectively). The four example input files were executed using RSAC Version 6.1, and the resulting output files (named *Example2.out, Example3.out, Example4.out,* and *Example5.out*) were compared to the solutions published in Section 5 of the RSAC-6 Users' Manual (located in */Rsac6/Manual Pdfs* directory). Printouts of the published solutions are also attached to this memo. The output files for the installation test are contained in the */Rsac6/Installation Test Files* directory. Because each of the output files showed the same results as the published solution, RSAC Version 6.1 passed the installation test.

Installation and Execution Instructions

1) Copy the folder /Rsac6 from the attached CD to the C: drive.
2) Execute the software by double-clicking on the executable *RP.exe*.

2. INSTALLING RSAC-6

Printed from User's manual.

This section describes the installation procedures for loading RSAC-6 onto a personal computer. The minimum hardware and software requirements are listed.

The section also identifies the point-of-contact for questions about the program and a summary of quality assurance activities conducted to ensure the integrity of RSAC.

2.1 Hardware and Software Requirements

RSAC-6 runs on an IBM personal computer or compatible computer running Windows 95/98 or NT. This code has not been validated using Windows ME or 2000.

2.2 Loading Instructions

Place the RSAC-6 CD in the CD reader. Double click on "My Computer," Double click on the drive letter for your CD reader. Double click on "Setup" and answer the questions.

2.3 Point-of-Contact

For information on how to obtain a copy of RSAC-6 or to resolve problems encountered running RSAC-6, contact

B.J. Schrader
Idaho National Engineering and Environmental Laboratory
P.O. Box 1625
Idaho Falls, ID 83415-2503
(208) 526-3399
email: bschrade@inel.gov

2.4 Quality Assurance

2.4.1 Configuration Control

Configuration control is maintained by issuing copies of RSAC-6 with a unique serial number. Only binary copies of RSAC-6 and its libraries are issued to users to prevent user changes to the program that would invalidate the extensive validation and verification. Each page of RSAC-6 output contains the program version number, the program serial number, and the date and time the run was made.

2.4.2 Verification and Validation

RSAC-6 has been subjected to extensive independent verification and validation (V&V) for use in performing safety-related dose calculations to support safety analysis reports and emergency response conditions (INEEL 2001). This V&V is an extension of the V&V performed on RSAC-5 by Shonka Research Associates, Inc. (SRA 1993). SRA conducted this verification and validation in accordance with the guidelines presented in ANSI/ANS-10.4, "American National Standard Guidelines for the Verification and Validation of Scientific and Engineering Programs for the Nuclear Industry" (ANSI/ANS 1987). The same standards were used to V&V RSAC-6. The executive summary of the V&V is available from the authors.

RSAC, 6.1

```
 Volume in drive R is NEW
 Volume Serial Number is F495-417D


 Directory of R:\

01/01/01  12:00a        <DIR>          .
01/01/01  12:00a        <DIR>          ..
01/31/03  05:47p        <DIR>          RSAC6
01/31/03  10:47a             3,159,577 rsac6.zip
               4 File(s)      3,159,577 bytes

 Directory of R:\RSAC6

01/01/01  12:00a        <DIR>          .
01/01/01  12:00a        <DIR>          ..
05/30/01  08:11a                 1,673 Check.bat
05/30/01  09:09a                    29 Copyfile.bat
01/31/03  04:58p                   224 DFH.DAT
04/20/00  07:36p                 4,768 DeIsL1.1
04/20/00  07:36p                 4,768 DeIsL1.2
01/31/03  04:54p                 5,619 DeIsL1.isu
01/31/03  04:58p        <DIR>          EXAMPLES
09/15/93  12:00p                   311 Ex9src
04/25/01  08:08a                 1,755 Example1
04/25/01  08:27a                 7,226 Example1.dtt
01/31/03  04:54p                   374 Example2
01/31/03  04:54p                 6,551 Example2.dtt
04/25/01  12:36p                 4,336 Example3
04/25/01  09:29a                 7,226 Example3.dtt
04/25/01  12:36p                 2,494 Example4
04/25/01  09:38a                 5,651 Example4.dtt
04/25/01  12:36p                 3,781 Example5
04/25/01  09:47a                 4,526 Example5.dtt
04/25/01  10:04a                 2,594 Example6
04/25/01  09:50a                15,326 Example6.dtt
04/25/01  12:36p                 3,912 Example7
04/25/01  10:05a                 5,201 Example7.dtt
04/25/01  12:22p                14,196 Example8
04/25/01  12:26p                17,351 Example8.dtt
04/25/01  12:33p                 4,015 Example9
04/25/01  12:34p                13,976 Example9.dtt
01/31/01  09:06a               576,383 Extfgr
09/10/92  10:17a                40,584 F771.eer
06/21/93  04:13p                40,584 F7713.eer
03/03/99  10:29a                 1,605 Fones
06/05/99  09:49p               109,856 Ineel.bmp
01/31/03  04:58p                 3,649 Input.dat
01/31/03  06:10p        <DIR>          Installation Test Files
01/31/01  08:46a               576,383 Intfgr
03/23/99  09:12a                28,672 IsStub32.exe
03/23/99  09:12a                28,672 IsUn32Ex.exe
01/31/03  04:59p        <DIR>          Manual Pdfs
01/31/01  09:11a               432,383 Modfgr
01/31/01  09:28a               125,710 Nuclib
```

```
04/25/01  12:26p                59,849 Nuclide.dat
01/31/03  04:59p        <DIR>          PROBLEMS
04/17/97  12:00p                     4 Pgfeed
09/15/93  12:00p                 1,894 Popcq
09/15/93  12:00p                 9,476 Popcq.dxt
06/01/01  10:05a               767,460 Rp.exe
05/17/01  11:18a                 1,029 Rs.bat
03/15/01  03:11p               771,992 Rsac6.exe
05/17/01  11:24a                   941 Rsrp.bat
01/31/03  04:59p                   374 TESTER1
01/31/03  04:58p                 6,551 TESTER1.DTT
04/20/00  07:36p                   147 _deisreg.isr
04/08/99  11:18a                49,152 _isreg32.dll
06/12/01  11:27a                 4,158 rsac6.ico
06/05/01  07:04a                   593 rsac6key
              56 File(s)      3,775,984 bytes

 Directory of R:\RSAC6\EXAMPLES

01/01/01  12:00a        <DIR>          .
01/01/01  12:00a        <DIR>          ..
09/15/93  12:00p                   311 Ex9src
04/19/01  10:18a                 7,226 Example1.dtt
09/15/93  12:00p                 6,551 Example2.dtt
09/15/93  12:00p                 6,326 Example3.dtt
09/15/93  12:00p                 5,651 Example4.dtt
09/15/93  12:00p                 4,526 Example5.dtt
04/19/01  09:52a                15,326 Example6.dtt
09/15/93  12:00p                 5,201 Example7.dtt
09/15/93  12:00p                13,526 Example8.dtt
09/15/93  12:00p                13,976 Example9.dtt
09/15/93  12:00p                 1,894 Popcq
09/15/93  12:00p                 9,476 Popcq.dxt
05/30/99  06:08p                   268 example1
06/01/99  02:35p                11,036 example1.out
05/30/99  09:13p                 3,209 example2
06/01/99  02:30p                14,339 example2.out
05/30/99  09:54p                 4,336 example3
06/01/99  02:31p                25,198 example3.out
05/30/99  10:51p                 2,494 example4
06/01/99  02:31p                10,885 example4.out
05/31/99  09:45a                 3,781 example5
06/01/99  02:31p                13,481 example5.out
05/31/99  11:47a                 2,571 example6
06/01/99  02:32p                44,754 example6.out
05/31/99  12:04p                 3,912 example7
06/01/99  02:32p                12,066 example7.out
05/31/99  08:42p                14,200 example8
06/01/99  02:33p                41,249 example8.out
05/31/99  05:33p                 4,073 example9
06/01/99  02:33p                28,561 example9.out
              32 File(s)        330,403 bytes

 Directory of R:\RSAC6\Installation Test Files

01/01/01  12:00a        <DIR>          .
01/01/01  12:00a        <DIR>          ..
```

```
01/08/03  12:26p                11,003 EXAMPLE2.OUT
01/08/03  12:26p                19,348 EXAMPLE3.OUT
01/08/03  12:27p                 7,543 EXAMPLE4.OUT
01/08/03  12:27p                 8,150 EXAMPLE5.OUT
01/31/03  06:08p                 6,975 install_test_memo.wpd
               7 File(s)         53,019 bytes

 Directory of R:\RSAC6\Manual Pdfs

01/01/01  12:00a        <DIR>           .
01/01/01  12:00a        <DIR>           ..
06/04/01  10:00a               192,105 Appa.pdf
06/04/01  10:00a                51,741 Appb.pdf
06/04/01  10:00a               109,924 Appc.pdf
06/04/01  10:00a                31,953 Appd.pdf
06/04/01  10:00a                63,545 Index.pdf
06/04/01  10:00a                23,867 Intro.pdf
06/04/01  10:00a                54,276 Manual.pdf
06/04/01  10:04a                   933 R6index.pdx
06/04/01  10:00a               236,739 Sect1.pdf
06/04/01  10:00a                10,687 Sect2.pdf
06/04/01  10:00a               190,936 Sect3.pdf
06/04/01  10:00a               264,732 Sect4.pdf
06/04/01  10:00a               211,526 Sect5.pdf
06/04/01  10:00a                22,113 Sect6.pdf
              16 File(s)     1,465,077 bytes

 Directory of R:\RSAC6\PROBLEMS

01/01/01  12:00a        <DIR>           .
01/01/01  12:00a        <DIR>           ..
06/04/01  03:38p                 5,651 CLASS4.dtt
06/04/01  11:56a                 7,226 Class1a.dtt
06/04/01  11:56a                11,036 Class1a.out
06/04/01  11:58a                 7,226 Class1b.dtt
06/04/01  11:58a                51,441 Class1b.out
06/04/01  02:52p                 7,226 Class1c.dtt
06/04/01  02:52p                 7,668 Class1c.out
06/04/01  03:10p                 6,551 Class2a.dtt
06/04/01  03:10p               161,296 Class2a.out
06/05/01  12:08p                 6,551 Class2b.dtt
06/05/01  12:08p                16,940 Class2b.out
06/04/01  03:36p                 7,451 Class3.dtt
06/04/01  03:29p                16,018 Class3.out
06/04/01  03:38p                 7,543 Class4.out
06/04/01  03:45p                 4,526 Class5.dtt
06/04/01  03:45p                 7,799 Class5.out
06/04/01  04:01p                15,326 Class6.dtt
06/04/01  04:02p                41,578 Class6.out
06/04/01  04:05p                 5,201 Class7.dtt
06/04/01  04:05p                 7,125 Class7.out
06/11/01  01:56p                 6,326 Class8.dtt
06/11/01  02:04p                 3,873 Class8.out
06/04/01  04:02p                 1,148 newcq
06/04/01  04:02p                 9,476 newcq.dxt
              26 File(s)        422,202 bytes
```

```
Total Files Listed:
        141 File(s)      9,206,262 bytes
                                 0 bytes free
```

SOFTWARE VALIDATION REPORT FOR RSAC VERSION 6.1

October 2003

Center for Nuclear Waste Regulatory Analyses
Southwest Research Institute
San Antonio, Texas

Author

Roland R. Benke

Roland Benke

10/22/2003

Date

Element Manager

for AHC

Asadul Chowdhury

10/22/2003

Date

1.0 Scope of the Validation

This software validation report was derived from the software validation test plan for the RSAC Version 5.2 code (Revision 1, November 2001). An installation test was performed for RSAC Version 6.1 and documented by a Memo (Installation test for RSAC Version 6.1, acquired software not-to-be modified") to Randy Folck from Roland Benke dated January 31, 2003. The installation test was rerun with the updated data libraries (see section 3.0) and passed. Printouts of this installation test are attached to this report, and the RSAC files are included on the attached CD.

RSAC Version 6.1 is an acquired software not to be modified and is under configuration control at the Center for Nuclear Waste Regulatory Analyses, software release number PA-SRN-286. RSAC Version 6.1 (Wenzel and Schrader, 2001) was developed by Idaho National Engineering and Environmental Laboratory in Idaho Falls, Idaho. RSAC Version 6.1 can be obtained under the CCC-125 code package designation from the Radiation Safety Information Computational Center (Radiation Safety Information Computational Center, Oak Ridge National Laboratory, PO Box 2008, Oak Ridge, TN 37381-6362).

The validation tests the RSAC dose calculation for the pathways of inhalation, ingestion, ground surface exposure, and submersion. This validation test exercises the following modules (called series in the RSAC documentation): fission product inventory calculation, radionuclide inventory input, meteorological data input, internal/external dose calculation; and cloud gamma dose calculation. This validation test does not exercise the following RSAC modules: dose summary; definition of radionuclide data constants; post-release radioactive decay; and fifty-mile radius dose calculation.

RSAC has been independently verified and validated for use in performing safety-related dose calculations (Idaho National Engineering and Environmental Laboratory, 2001). This work was an extension of the verification and validation performed by Shonka Research Associates, Inc. (Shonka Research Associates, 1993) in accordance with ANSI/ANS-10.4, "American National Standard Guidelines for the Verification and Validation of Scientific and Engineering Programs for the Nuclear Industry" (American National Standards Institute, Inc./American Nuclear Society, 1987). The Shonka Research Associates Executive Summary Report (Shonka Research Associates, 1993) is part of the QA software control packet for RSAC Version 5.2 at the Center for Nuclear Waste Regulatory Analyses (software release number 226). Shonka Research Associates denied requests for more detailed documentation of their verification and validation for RSAC Version 5.2. For this reason, no previous work is relied on for the validation of RSAC Version 6.1.

RSAC Version 6.1 calculates the radiological consequences from the atmospheric release of radioactive material. Internal doses were calculated for the pathways of inhalation and ingestion, and the external doses were computed for the pathways of ground surface exposure and submersion. The RSAC code is currently being used, and expected to be used in the future, to calculate radiological doses from these four pathways.

Testing of RSAC was performed on the installed version 6.1 for an example scenario to verify the resulting doses produced were in agreement with simplified hand calculations. The following simplified hand calculations of dose will be performed in a spreadsheet for the four pathways: inhalation, ground surface exposure, submersion, and ingestion. In many cases, the RSAC code includes added complexity (especially for the ingestion pathway), and for that reason, these simplified hand calculations are not expected to reproduce the RSAC results exactly.

2.0 References

American National Standards Institute, Inc./American Nuclear Society (ANSI/ANS). American National Standard Guidelines for the Verification and Validation of Scientific and Engineering Programs for the Nuclear Industry, ANSI/ANS-10.4. 1987.

INEEL. Verification and Validation of RSAC-6. Idaho National Engineering and Environmental Laboratory: Idaho Falls, Idaho. 2001.

Shonka Research Associates, Inc. Software Verification and Validation Report for WINCO RSAC-5 Code. Marietta, Georgia. 1993.

Wenzel, D.R. and Schrader B. J. The Radiological Safety Analysis Computer Program (RSAC-6) User's Manual, INEEL/EXT-01-00540. Idaho National Engineering and Environmental Laboratory: Idaho Falls, Idaho. 2001.

3.0 Environment

3.1 Software

RSAC Version 6.1 is DOS-based. The validation test will be conducted under a Windows NT Version 4.0 operating system. The following list of files are required for the test.

Rp.exe	Fones	Nuclide.k01
Rsac5.exe	Modint	Nuclide.k02
Dfh.dat	Popcq	Nuclide.k03
Input.dat	Read1	Nuclide.k04
Nuclide.dat	Stdext	Rs.bat
Clarion.dmp	Stdint	Rsrp.bat
Read1.dtt	Stdnuc	Read1.out
Popcq.dxt	Trancon	Valrsac6
F771.eer	Ex_3x2.k01	Valrsac6.dtt
F7713.eer	Input.k01	Valrsac6.out
Ex9src	Read1.k01	

The following updated data libraries must also be copied into the RSAC6 directory. These files are contained in the enclosed CD in the \RSAC 6.1 Validation\Updated Data Libraries directory.
Nuclib
Modfgr
Intfgr
Extfgr

3.2 Hardware

The hardware required is an IBM-compatible computer with a hard drive named C:.

4.0 Prerequisites

The files, listed in section 3.1, must be located in a directory, named RSAC6. It is recommended that the RSAC6 directory be located in the root directory of the C: drive.

5.0 Assumptions and Constraints

None. Assumptions of the hand calculation are presented in section 6.1.1.

6.0 Test Case (Pathway Test)

RSAC Version 6.1 will be incorporated into Version 3 of the PCSA Tool, a code developed at the Center for Nuclear Waste and Regulatory Analyses. However, not all modules of the RSAC code will be incorporated into the PCSA Tool. This test simulates an instantaneous radionuclide release into the atmosphere and downwind transport of the radioactive plume and calculates the doses to a receptor via four pathways: inhalation, ground surface exposure, submersion, and ingestion. The objective of this test is to validate the

modules of the RSAC code that are utilized by the PCSA Tool. This validation test exercises the following modlues (called series in the RSAC documentation): fission product inventory calculation, radionuclide inventory input, meteorological data input, internal/external dose calculation; and cloud gamma dose calculation. This validation test does not exercise the following RSAC modules: dose summary; definition of radionuclide data constants; post-release radioactive decay; and fifty-mile radius dose calculation.

6.1 Test Input

The files required for the test are listed in section 3.1 Software, and the setup of the test input is described in section 4.0 Prerequisites. Specifically, the test input for the RSAC Version 6.1 code can be viewed in the file named Valrsac6. For the RSAC calculation of ingestion doses resulting from the acute releases in the validation test, the RSAC default of 7 days was used for the harvest duration, the time period crops are exposed to contamination during the growing season was set equal to the harvest duration (7 days), and the times for vegetables and forage exposure to the airborne plume were set to one half of the harvest duration (3.5 days). These values were selected so that the contamination fractions based on the timing of an acute release would not exceed a factor of two. Section A-3.2 of the RSAC-6 User's Manual (Wenzel and Schrader, 2001) shows the complexity of the ingestion dose calculation for acute releases.

6.2 Test Procedure

6.2.1 Running the RSAC code

The seven steps for running RSAC are listed below.

(1) Execute the batch file *RP.exe* and enter *Valrsac6* after the input file prompt
(2) Select the 'A)' option to edit the file
(3) Press Enter twice to avoid editing the title
(4) Select the 'Run RSAC-6 with file currently in memory' from the menu options
(5) Press Enter when prompted after the calculation
(6) Select the 'Browse RSAC-6 output file' option
(7) Compare the dose results for each radionuclide to those doses from the hand calculation.

6.2.2 Simplified Hand Calculations for Validation

The nine steps for the simplified hand calculations are presented next. Following the nine steps yields doses for the pathways of inhalation, ground surface exposure, submersion, and ingestion (these four doses are referred to as the "pathway doses"). Some of the nine steps calculate intermediate quantities, which are used in the calculation of the pathway doses. Validation comparisons are performed on the four pathway doses for each of the calculated radionuclides (inhalation, ground surface exposure, submersion, and ingestion).

(1) Calculate Airborne Concentration

Neglecting dry plume depletion and reflection from the mixing layer height, calculate airborne concentration downwind:

$$\chi = \frac{Q}{\pi u \sigma_y(x)\sigma_z(x)} \exp\left(-\frac{h^2}{2\sigma_z^2}\right)$$

where
χ represents the airborne concentration (Ci/m^3) at a downwind distance x (m),
Q represents the released activity release rate (Ci/s)
u represents the average wind speed (m/s),
$\sigma_y(x)$ represents the standard deviation of horizontal dispersion (m) at a downwind distance x,

$\sigma_z(x)$ represents the standard deviation of vertical dispersion (m) at a downwind distance x, and
h represents the stack height (m).

(2) Calculate Inhalation Dose

The inhalation committed effective dose equivalent (CEDE) is calculated in Sv from the following expression:

$$\text{Inhalation CEDE} = \left(\frac{3.7 \times 10^{10}\,\text{Bq}}{1\text{Ci}}\right)\left(\text{DCF}_{\text{inh}} \times \chi \times \text{BR} \times t_r\right)$$

where
DCF_{inh} represents the dose conversion factor for inhalation of the radionuclide of interest (Sv/Bq),
BR represents the breathing rate (m^3/s), and
t_r represents the release duration (s).

Note, this calculation assumes the same duration for release and exposure.

(3) Calculate Ground Surface Dose

The effective dose equivalent (EDE) from ground surface exposure is calculated from the following relationship:

$$\text{Ground Surface EDE} = \text{DRCF}_{\text{gs}} \times \frac{\chi}{Q} \times V_d \times f_{shield} \times \frac{A_0}{\lambda}\left[1 - e^{-\lambda t_e}\right]$$

where
DRCF_{gs} represents the dose rate conversion factor due to ground surface exposure from the radionuclide of interest (Sv m^2/Bq s),
V_d represents the deposition velocity (m/s),
f_{shield} represents the building shielding factor (unitless),
A_0 represents the undecayed activity released (Bq),
λ represents the radioactive decay constant for the radionuclide of interest (1/s), and
t_e represents the ground surface exposure time (s).

(4) Calculate Air Submersion Dose

Assuming negligible radioactive decay during plume transport, the effective dose equivalent (EDE) from air submersion is calculated from the following relationship:

$$\text{Submersion EDE} = \text{DRCF}_{\text{sub}} \times \frac{\chi}{Q} \times A_0$$

where
DRCF_{sub} represents the dose rate conversion factor due to air submersion from the radionuclide of interest (Sv m^3/Bq s).

(5) Calculate Ground Concentration

Assuming negligible radioactive decay during plume transport, the ground concentration, G (Bq/m^2), is calculated:

$$G = \left(\frac{3.7 \times 10^{10} \text{ Bq}}{1 \text{ Ci}} \right) \left(\chi \times v_d \times t_r \right)$$

where
v_d represents the deposition velocity (m/s).

(6) Calculate Ingestion Dose from Leafy Vegetables

The ingestion dose from leafy vegetables, $D_{leafyveg}$ (Sv), is calculated from the following relationship, which includes contributions from deposited activity on foliage and root uptake:

$$D_{leafyveg} = \text{DCF}_{\text{ing}} \text{U}_{\text{leafyveg}} \left(\frac{f_{contam} \times f_{trans,leafveg} \times f_{\text{int,veg}}}{Y_{veg}} + \frac{B_{produce}}{\phi} \right) G$$

where
DCF_{ing} represents the dose conversion factor for ingestion (Sv/Bq),
$\text{U}_{\text{leafyveg}}$ represents the leafy vegetable consumption rate (kg/yr),
f_{contam} represents the fraction of crops contaminated (unitless),
$f_{trans,leafveg}$ represents the translocation fraction of the deposited activity for leafy vegetables (unitless),
$f_{int,veg}$ represents the interception fraction for radionuclide deposition on vegetable foliage (unitless),
Y_{veg} represents the crop yield for vegetables (kg/m^2),
$B_{produce}$ represents the conversion factor for root uptake from contaminated soil to edible portion of crop for produce (Bq/kg crop per Bq/kg soil), and
ϕ represents the effective surface soil density (kg/m^2 soil).

(7) Calculate Ingestion Dose from Nonleafy Vegetables

The ingestion dose from nonleafy vegetables, $D_{nonleafyveg}$ (Sv), is calculated from the following relationship for root uptake:

$$D_{nonleafyveg} = \text{DCF}_{\text{ing}} \text{U}_{\text{nonleafyveg}} \left(\frac{f_{contam} \times f_{trans,nonleaf} \times f_{\text{int,veg}}}{Y_{veg}} + \frac{B_{produce}}{\phi} \right) G$$

where
$\text{U}_{\text{nonleafyveg}}$ represents the nonleafy vegetable consumption rate (kg/yr), and
$f_{trans,nonleaf}$ represents the fraction of the deposited activity translocated to the edible portion of the nonleafy vegetable (unitless),

(8) Calculate Ingestion Dose from Milk

Assuming livestock feeds entirely on forage, the ingestion dose from milk, D_{milk} (Sv), is calculated from the following relationship:

$$D_{milk} = \text{DCF}_{\text{ing}} \text{U}_{\text{milk}} \text{F}_{\text{milk}} \text{U}_{\text{feed}} \left(\frac{f_{contam} \times f_{trans,forage} \times f_{\text{int,forage}}}{Y_{forage}} + \frac{B_{forage}}{\phi} \right) G$$

where
U_{milk} represents the milk consumption rate (L/yr),
F_{milk} represents the bioconversion factor for animal's intake of radioactivity to radioactivity in milk (Bq/L milk per Bq/day intake = day/L),
U_{feed} represents the animal's consumption rate of feed (kg/day), and
$f_{int,forage}$ represents the interception fraction for radionuclide deposition on forage (unitless), and
Y_{forage} represents the crop yield for forage (kg/m^2), and

B_{forage} represents the conversion factor for root uptake from contaminated soil to edible portion of crop for forage (Bq/kg crop per Bq/kg soil).

(9) Calculate Ingestion Dose from Meat

Assuming livestock feeds entirely on forage, the ingestion dose from meat, D_{meat} (Sv), is calculated from the following relationship:

$$D_{meat} = DCF_{ing} U_{meat} F_{meat} U_{feed} \left(\frac{f_{contam} \times f_{trans,forage} \times f_{int,forage}}{Y_{forage}} + \frac{B_{forage}}{\phi} \right) G$$

where
U_{meat} represents the meat consumption rate (kg/yr),
F_{meat} represents the bioconversion factor for animal's intake of radioactivity to radioactivity in meat (Bq/kg meat per Bq/day intake = day/kg), and
U_{feed} represents the animal's consumption rate of feed (kg/day).

The total ingestion dose is calculated as the sum of ingestion doses from leafy vegetables, nonleafy vegetables, milk, and meat.

If the dose outputs for a selected number of individual radionuclides from the RSAC Version 6.1 code are in reasonable agreement (i.e., within a factor of 2) with the results from the simplified hand calculations, the validation test is passed.

6.3 Test Results

Three radionuclides (I-129, H-3, and Co-60) were selected for the validation test based on their significance to the radiological pathway doses during preclosure spent nuclear fuel handling and operations. The nine steps from the previous section were followed, and the results for the four pathway doses are presented in Tables 1–4. The pathway doses were within a factor of 2 for each radionuclide calculated by RSAC, and therefore, the validation test was passed.

Table 1. Results for Inhalation Dose.

Radionuclide	Inhalation Committed Effective Dose Equivalent (Sv)		Ratio (Validation Calculation to RSAC Version 6.1)
	Validation Calculation	RSAC Version 6.1	
I-129	8.90×10^{-6}	8.08×10^{-6}	1.1
H-3	3.28×10^{-9}	5.19×10^{-9}	0.63
Co-60	1.12×10^{-5}	1.17×10^{-5}	1.0

Table 2. Results for Ground Surface Exposure Dose.

Radionuclide	Ground Surface Effective Dose Equivalent (Sv)		Ratio (Validation Calculation to RSAC Version 6.1)
	Validation Calculation	RSAC Version 6.1	
I-129	3.25×10^{-6}	3.22×10^{-6}	1.0
H-3	$0.00\times10^{+0}$	$0.00\times10^{+0}$	(same value)
Co-60	2.77×10^{-5}	3.15×10^{-5}	0.88

Table 3. Results for Submersion Dose.

Radionuclide	Submersion Effective Dose Equivalent (Sv)		Ratio (Validation Calculation to RSAC Version 6.1)
	Validation Calculation	RSAC Version 6.1	
I-129	2.17×10^{-10}	2.15×10^{-10}	1.0
H-3	1.89×10^{-13}	none	not applicable*
Co-60	7.18×10^{-8}	8.16×10^{-8}	0.88

*RSAC Version 6.1 does not calculate a submersion dose for H-3, so a quantitative comparison cannot be made. The submersion dose rate conversion factor and resulting effective dose equivalent for H-3 are orders of magnitude smaller than those for the other radionuclides.

Table 4. Results for Ingestion Dose.

Radionuclide	Ingestion Committed Effective Dose Equivalent (Sv)		Ratio (Validation Calculation to RSAC Version 6.1)
	Validation Calculation	RSAC Version 6.1	
I-129	9.90×10^{-2}	6.51×10^{-2}	1.5
H-3	6.31×10^{-7}	7.70×10^{-7}	0.82
Co-60	2.37×10^{-4}	4.50×10^{-4}	0.53

7.0 Notes

Doses are not calculated for chronic releases. Therefore, a specialized dose calculation for tritium (H-3), to account for tritiated water reaching equilibrium with the water in plants, was not performed.

There are four attachments to this validation report.

Attachments:
1. Printout of the RSAC Version 6.1 output file, Valrsac6.out (41 pages)
2. Printout of the Validation Test Spreadsheet, RSAC6_ValidationSpreedsheet.xls (2 pages)
3. Printouts for the Installation Test performed with the updated data libraries (53 pages)
4. CD containing the following files:

\RSAC 6.1 Validation\RSAC Files\Valrsac6
\RSAC 6.1 Validation\RSAC Files\Valrsac6.dtt
\RSAC 6.1 Validation\RSAC Files\Valrsac6.out

\RSAC 6.1 Validation\Validation Report\RSAC6.1_Validation.wpd

\RSAC 6.1 Validation\Validation Spreadsheet\RSAC6_ValidationSpreedsheet.xls

\RSAC 6.1 Validation\Updated Data Libraries\Nuclib
\RSAC 6.1 Validation\Updated Data Libraries\Modfgr
\RSAC 6.1 Validation\Updated Data Libraries\Intfgr
\RSAC 6.1 Validation\Updated Data Libraries\Extfgr

\RSAC 6.1 Validation\Installation Test Files\Example2
\RSAC 6.1 Validation\Installation Test Files\Example2.dtt
\RSAC 6.1 Validation\Installation Test Files\Example2.out

\RSAC 6.1 Validation\Installation Test Files\Example3
\RSAC 6.1 Validation\Installation Test Files\Example3.dtt
\RSAC 6.1 Validation\Installation Test Files\Example3.out
\RSAC 6.1 Validation\Installation Test Files\Example4
\RSAC 6.1 Validation\Installation Test Files\Example4.dtt
\RSAC 6.1 Validation\Installation Test Files\Example4.out
\RSAC 6.1 Validation\Installation Test Files\Example5
\RSAC 6.1 Validation\Installation Test Files\Example5.dtt
\RSAC 6.1 Validation\Installation Test Files\Example5.out

ATTACHMENT # 1

```
 VALRSAC6     RSAC-6 INPUT     08/29/03     17:12
0        1         2         3         4         5         6         7
12345678901234567890123456789012345678901234567890123456789012345678901234567890123456789

* Validation Test for RSAC V.6.1
# Release of 1 Ci for I-129, H-3, and Co-60
2000,0
H  3,1.
CO 60,1.
I129,1.
2999
# Meteorological Inputs
5000,0
5001,1.,40.,1420.,1.099E3,0,1
5002,.001,.01,0.,.001,.001
5101,10000.
5201,1.,0
5400,2,0,0
5410,1,6,0
5999
# Inhalation Dose Calculation
7000,0,1,2,0,1
7001,3.33E-4,0,0,0
7999
# Ground Surface Dose Calculation
7000,4,1,2,0,1
7001,0,0,1.,0.7
7999
# Submersion Dose Calculation
7000,5,1,2,0,1
7001,0,0,0,0
7999
# Ingestion Dose Calculation
7000,3,1,2,0,1
7001,0,0,1.,0
7004,1,2,7.,7.
7051,520.,64.,110.,310.,1.,1.
7052,0.57,0.2,1.,0,3.5,3.5,100.
7053,225.,0,0,16.,0,0
7054,0,0,0,2.,0.28,4.9
7055,1.,1.,1.,1.
7999
10000

0        1         2         3         4         5         6         7
12345678901234567890123456789012345678901234567890123456789012345678901234567890123456789
            RADIOLOGICAL SAFETY ANALYSIS COMPUTER PROGRAM (RSAC-6)
(RSAC-6, REV 6.1, 03/07/01)  SERIAL 9999  DATE 08/29/2003  TIME 17:12 PAGE   1
VALRSAC6:  Validation Test for RSAC V.6.1

***DIRECT RADIONUCLIDE INPUT

        ANY PREVIOUS INVENTORY HAS BEEN ZEROED

     NUCLIDE          HALF LIFE       CURIES

   10030   H  3    1.233E+01  yr    1.000E+00
```

270600	Co 60	5.271E+00	yr	1.000E+00
531290	I129	1.570E+07	yr	1.000E+00

***METEOROLOGICAL DATA

MEAN WIND SPEED = 1.000E+00 (m/s) STACK HEIGHT = 4.000E+01 (m)
MIXING LAYER HEIGHT = 1.420E+03 (m) AIR DENSITY = 1.099E+03 (g/cu m)
WET DEPOSITION SCAVENGING COEFFICIENT = 0.000E+00 (1/S)

PLUME DEPLETION BY FALLOUT IS INCLUDED

DRY DEPOSITION VELOCITIES (m/s)
SOLIDS = 1.000E-03 HALOGENS = 1.000E-02 NOBLE GASES = 0.000E+00
CESIUM = 1.000E-03 RUTHENIUM = 1.000E-03

THERE IS 1 SET OF LEAKAGE CONSTANTS (K1,K2)
1.000E+00 0.000E+00

PASQUILL CLASS F METEOROLOGY, H-G SIGMA VALUES

DOWNWIND DISTANCE	STACK HEIGHT (m)	SIGY (m)	SIGZ (m)	CHI/Q (s/cu m)
1.000E+04	4.000E+01	2.876E+02	4.818E+01	1.627E-05

FRACTION OF PLUME REMAINING FOLLOWING DEPLETION BY DEPOSITION

DOWNWIND DISTANCE	SOLIDS	HALOGENS	CESIUM	RUTHENIUM
1.000E+04	9.850E-01	8.595E-01	9.850E-01	9.850E-01

*** INHALATION DOSE EQUIVALENT CALCULATION

USING DOSE CONVERSION FACTORS FROM FEDERAL GUIDANCE REPORT 11

RESPIRABLE FRACTION = 1.000E+00
BREATHING RATE = 3.330E-04 (cu m/s)
RELEASE TIME FOR EXPONENTIAL DECAY FUNCTION = 1.000E+00 (s)
INTERNAL EXPOSURE TIME PERIOD = 5.000E+01 (yr)

PARTICLE SIZE = 1.0 MICRON AMAD
LUNG DEPOSITION FRACTIONS: N-P = 0.300 T-B = 0.080 P = 0.250

DEFAULT ELEMENT LUNG CLEARANCE CLASSES SELECTED TO GIVE MAXIMUM DOSE
LUNG CLEARANCE CLASSES USED IN CALCULATIONS

ELEMENT		CLASS	ELEMENT		CLASS	ELEMENT		CLASS
1	H	HTO	4	Be	Y	6	C	ORG
9	F	D	11	Na	D	12	Mg	W
13	Al	D	14	Si	Y	15	P	W
16	S	W	17	Cl	D	19	K	D
20	Ca	W	21	Sc	Y	22	Ti	Y
23	V	W	24	Cr	Y	25	Mn	W
26	Fe	D	27	Co	Y	28	Ni	W
29	Cu	Y	30	Zn	Y	31	Ga	W
32	Ge	D	33	As	W	34	Se	W

35	Br	W	37	Rb	D	38	Sr	Y
39	Y	Y	40	Zr	D	41	Nb	Y
42	Mo	Y	43	Tc	W	44	Ru	Y
45	Rh	Y	46	Pd	Y	47	Ag	Y
48	Cd	D	49	In	D	50	Sn	W
51	Sb	W	52	Te	W	53	I	D
55	Cs	D	56	Ba	D	57	La	W
58	Ce	Y	59	Pr	Y	60	Nd	Y
61	Pm	Y	62	Sm	W	63	Eu	W
64	Gd	D	65	Tb	W	66	Dy	W
67	Ho	W	68	Er	W	69	Tm	W
70	Yb	Y	71	Lu	Y	72	Hf	D
73	Ta	Y	74	W	D	75	Re	W
76	Os	Y	77	Ir	Y	78	Pt	D
79	Au	D	80	Hg	W	81	Tl	D
82	Pb	D	83	Bi	W	84	Po	D
85	At	W	87	Fr	D	88	Ra	W
89	Ac	D	90	Th	W	91	Pa	Y
92	U	Y	93	Np	W	94	Pu	W
95	Am	W	96	Cm	W	97	Bk	W
98	Cf	Y	99	Es	W	100	Fm	W

DOWNWIND DISTANCE = 1.000E+04 (m) PLUME TRAVEL TIME = 1.000E+04 (s)
CHI/Q = 1.627E-05 (s/cu m)

LUNGS	INHALATION	ISOTOPE	NUCLIDE	CDE (Sv)	WCDE (Sv)
		H - 3	10030	5.19E-09	6.23E-10
		TOTAL H (ATOMIC NO 1)		5.19E-09	6.23E-10
		Co - 60	270600	6.81E-05	8.18E-06
		TOTAL Co (ATOMIC NO 27)		6.81E-05	8.18E-06
		I - 129	531290	5.41E-08	6.49E-09
		TOTAL I (ATOMIC NO 53)		5.41E-08	6.49E-09

DOWNWIND DISTANCE = 1.000E+04 LUNGS INHALATION DOSE EQUIVALENT

		TOTAL LUNGS INHALATION =		6.82E-05	8.18E-06

S WALL	INHALATION	ISOTOPE	NUCLIDE	CDE (Sv)	WCDE (Sv)
		H - 3	10030	5.19E-09	3.12E-10
		TOTAL H (ATOMIC NO 1)		5.19E-09	3.12E-10
		Co - 60	270600	5.39E-06	3.24E-07
		TOTAL Co (ATOMIC NO 27)		5.39E-06	3.24E-07

I - 129	531290	1.71E-08	1.02E-09
TOTAL I (ATOMIC NO 53)		1.71E-08	1.02E-09
TOTAL S WALL INHALATION =		5.41E-06	3.25E-07

SI WALL INHALATION	ISOTOPE	NUCLIDE	CDE (Sv)	WCDE (Sv)
H - 3		10030	5.19E-09	3.12E-10
TOTAL H (ATOMIC NO 1)			5.19E-09	3.12E-10
Co - 60		270600	1.39E-06	8.35E-08
TOTAL Co (ATOMIC NO 27)			1.39E-06	8.35E-08
I - 129		531290	1.53E-08	9.18E-10
TOTAL I (ATOMIC NO 53)			1.53E-08	9.18E-10
TOTAL SI WALL INHALATION =			1.41E-06	8.48E-08

ULI WALL INHALATION	ISOTOPE	NUCLIDE	CDE (Sv)	WCDE (Sv)
H - 3		10030	5.19E-09	3.12E-10
TOTAL H (ATOMIC NO 1)			5.19E-09	3.12E-10
Co - 60		270600	1.92E-06	1.15E-07
TOTAL Co (ATOMIC NO 27)			1.92E-06	1.15E-07

DOWNWIND DISTANCE = 1.000E+04 ULI WALL INHALATION DOSE EQUIVALENT

ULI WALL INHALATION	ISOTOPE	NUCLIDE	CDE (Sv)	WCDE (Sv)
I - 129		531290	1.54E-08	9.21E-10
TOTAL I (ATOMIC NO 53)			1.54E-08	9.21E-10
TOTAL ULI WALL INHALATION =			1.94E-06	1.16E-07

LLI WALL INHALATION	ISOTOPE	NUCLIDE	CDE (Sv)	WCDE (Sv)
H - 3		10030	5.19E-09	3.12E-10
TOTAL H (ATOMIC NO 1)			5.19E-09	3.12E-10
Co - 60		270600	1.57E-06	9.40E-08
TOTAL Co (ATOMIC NO 27)			1.57E-06	9.40E-08
I - 129		531290	1.51E-08	9.07E-10

		TOTAL I (ATOMIC NO 53)	1.51E-08	9.07E-10
		TOTAL LLI WALL INHALATION =	1.59E-06	9.52E-08
TESTES	INHALATION	ISOTOPE NUCLIDE	CDE (Sv)	WCDE (Sv)
		H - 3 10030	5.19E-09	1.30E-09
		TOTAL H (ATOMIC NO 1)	5.19E-09	1.30E-09
		Co - 60 270600	3.36E-07	8.39E-08
		TOTAL Co (ATOMIC NO 27)	3.36E-07	8.39E-08
		I - 129 531290	1.40E-08	3.49E-09
		TOTAL I (ATOMIC NO 53)	1.40E-08	3.49E-09
		TOTAL TESTES INHALATION =	3.55E-07	8.87E-08
BREASTS	INHALATION	ISOTOPE NUCLIDE	CDE (Sv)	WCDE (Sv)
		H - 3 10030	5.19E-09	7.79E-10
		TOTAL H (ATOMIC NO 1)	5.19E-09	7.79E-10

DOWNWIND DISTANCE = 1.000E+04 BREASTS INHALATION DOSE EQUIVALENT

BREASTS	INHALATION	ISOTOPE	NUCLIDE	CDE (Sv)	WCDE (Sv)
		Co - 60	270600	3.63E-06	5.45E-07
		TOTAL Co (ATOMIC NO 27)		3.63E-06	5.45E-07
		I - 129	531290	3.60E-08	5.40E-09
		TOTAL I (ATOMIC NO 53)		3.60E-08	5.40E-09
		TOTAL BREASTS INHALATION =		3.68E-06	5.51E-07
BONE SUR	INHALATION	ISOTOPE	NUCLIDE	CDE (Sv)	WCDE (Sv)
		H - 3	10030	5.19E-09	1.56E-10
		TOTAL H (ATOMIC NO 1)		5.19E-09	1.56E-10
		Co - 60	270600	2.67E-06	8.00E-08
		TOTAL Co (ATOMIC NO 27)		2.67E-06	8.00E-08
		I - 129	531290	2.38E-08	7.13E-10

	TOTAL I (ATOMIC NO 53)		2.38E-08	7.13E-10
	TOTAL BONE SUR INHALATION =		2.70E-06	8.09E-08
R MARROW INHALATION	ISOTOPE	NUCLIDE	CDE (Sv)	WCDE (Sv)
	H - 3	10030	5.19E-09	6.23E-10
	TOTAL H (ATOMIC NO 1)		5.19E-09	6.23E-10
	Co - 60	270600	3.40E-06	4.08E-07
	TOTAL Co (ATOMIC NO 27)		3.40E-06	4.08E-07
	I - 129	531290	2.41E-08	2.90E-09
	TOTAL I (ATOMIC NO 53)		2.41E-08	2.90E-09
	TOTAL R MARROW INHALATION =		3.43E-06	4.11E-07

DOWNWIND DISTANCE = 1.000E+04 THYROID INHALATION DOSE EQUIVALENT

THYROID INHALATION	ISOTOPE	NUCLIDE	CDE (Sv)	WCDE (Sv)
	H - 3	10030	5.19E-09	1.56E-10
	TOTAL H (ATOMIC NO 1)		5.19E-09	1.56E-10
	Co - 60	270600	3.20E-06	9.60E-08
	TOTAL Co (ATOMIC NO 27)		3.20E-06	9.60E-08
	I - 129	531290	2.69E-04	8.07E-06
	TOTAL I (ATOMIC NO 53)		2.69E-04	8.07E-06
	TOTAL THYROID INHALATION =		2.72E-04	8.16E-06
KIDNEYS INHALATION	ISOTOPE	NUCLIDE	CDE (Sv)	WCDE (Sv)
	H - 3	10030	5.19E-09	3.12E-10
	TOTAL H (ATOMIC NO 1)		5.19E-09	3.12E-10
	Co - 60	270600	3.08E-06	1.85E-07
	TOTAL Co (ATOMIC NO 27)		3.08E-06	1.85E-07
	I - 129	531290	1.45E-08	8.73E-10
	TOTAL I (ATOMIC NO 53)		1.45E-08	8.73E-10
	TOTAL KIDNEYS INHALATION =		3.10E-06	1.86E-07

LIVER	INHALATION	ISOTOPE	NUCLIDE	CDE (Sv)	WCDE (Sv)
		H - 3	10030	5.19E-09	3.12E-10
		TOTAL H (ATOMIC NO 1)		5.19E-09	3.12E-10
		Co - 60	270600	6.62E-06	3.97E-07
		TOTAL Co (ATOMIC NO 27)		6.62E-06	3.97E-07
		I - 129	531290	1.52E-08	9.11E-10
		TOTAL I (ATOMIC NO 53)		1.52E-08	9.11E-10
		TOTAL LIVER INHALATION =		6.64E-06	3.98E-07

DOWNWIND DISTANCE = 1.000E+04 SPLEEN INHALATION DOSE EQUIVALENT

SPLEEN	INHALATION	ISOTOPE	NUCLIDE	CDE (Sv)	WCDE (Sv)
		H - 3	10030	5.19E-09	3.12E-10
		TOTAL H (ATOMIC NO 1)		5.19E-09	3.12E-10
		Co - 60	270600	5.33E-06	3.20E-07
		TOTAL Co (ATOMIC NO 27)		5.33E-06	3.20E-07
		I - 129	531290	1.53E-08	9.15E-10
		TOTAL I (ATOMIC NO 53)		1.53E-08	9.15E-10
		TOTAL SPLEEN INHALATION =		5.35E-06	3.21E-07
PANCREAS	INHALATION	ISOTOPE	NUCLIDE	CDE (Sv)	WCDE (Sv)
		H - 3	10030	5.19E-09	3.12E-10
		TOTAL H (ATOMIC NO 1)		5.19E-09	3.12E-10
		Co - 60	270600	6.26E-06	3.76E-07
		TOTAL Co (ATOMIC NO 27)		6.26E-06	3.76E-07
		I - 129	531290	1.53E-08	9.16E-10
		TOTAL I (ATOMIC NO 53)		1.53E-08	9.16E-10
		TOTAL PANCREAS INHALATION =		6.28E-06	3.77E-07
MUSCLE	INHALATION	ISOTOPE	NUCLIDE	CDE (Sv)	WCDE (Sv)
		H - 3	10030	5.19E-09	3.12E-10

TOTAL H (ATOMIC NO 1)			5.19E-09	3.12E-10
Co - 60	270600		3.63E-06	2.18E-07
TOTAL Co (ATOMIC NO 27)			3.63E-06	2.18E-07
I - 129	531290		3.60E-08	2.16E-09
TOTAL I (ATOMIC NO 53)			3.60E-08	2.16E-09
TOTAL MUSCLE INHALATION =			3.68E-06	2.21E-07

DOWNWIND DISTANCE = 1.000E+04 SKIN INHALATION DOSE EQUIVALENT

SKIN	INHALATION	ISOTOPE	NUCLIDE	CDE (Sv)	WCDE (Sv)
		H - 3	10030	5.19E-09	5.19E-11
		TOTAL H (ATOMIC NO 1)		5.19E-09	5.19E-11
		Co - 60	270600	2.01E-06	2.01E-08
		TOTAL Co (ATOMIC NO 27)		2.01E-06	2.01E-08
		I - 129	531290	2.29E-08	2.29E-10
		TOTAL I (ATOMIC NO 53)		2.29E-08	2.29E-10
		TOTAL SKIN INHALATION =		2.04E-06	2.04E-08
BRAIN	INHALATION	ISOTOPE	NUCLIDE	CDE (Sv)	WCDE (Sv)
		H - 3	10030	5.19E-09	3.12E-10
		TOTAL H (ATOMIC NO 1)		5.19E-09	3.12E-10
		TOTAL BRAIN INHALATION =		5.19E-09	3.12E-10
THYMUS	INHALATION	ISOTOPE	NUCLIDE	CDE (Sv)	WCDE (Sv)
		H - 3	10030	5.19E-09	3.12E-10
		TOTAL H (ATOMIC NO 1)		5.19E-09	3.12E-10
		Co - 60	270600	1.14E-05	6.81E-07
		TOTAL Co (ATOMIC NO 27)		1.14E-05	6.81E-07
		I - 129	531290	3.83E-08	2.30E-09
		TOTAL I (ATOMIC NO 53)		3.83E-08	2.30E-09
		TOTAL THYMUS INHALATION =		1.14E-05	6.84E-07

BL WALL INHALATION	ISOTOPE	NUCLIDE	CDE (Sv)	WCDE (Sv)
	H - 3	10030	5.19E-09	3.12E-10
	TOTAL H (ATOMIC NO 1)		5.19E-09	3.12E-10
	Co - 60	270600	5.83E-07	3.50E-08

DOWNWIND DISTANCE = 1.000E+04 BL WALL INHALATION DOSE EQUIVALENT

BL WALL INHALATION	ISOTOPE	NUCLIDE	CEDE (Sv)	
	TOTAL Co (ATOMIC NO 27)		5.83E-07	3.50E-08
	I - 129	531290	1.47E-08	8.82E-10
	TOTAL I (ATOMIC NO 53)		1.47E-08	8.82E-10
	TOTAL BL WALL INHALATION =		6.03E-07	3.62E-08

ADRENALS INHALATION	ISOTOPE	NUCLIDE	CDE (Sv)	WCDE (Sv)
	H - 3	10030	5.19E-09	3.12E-10
	TOTAL H (ATOMIC NO 1)		5.19E-09	3.12E-10
	Co - 60	270600	5.93E-06	3.56E-07
	TOTAL Co (ATOMIC NO 27)		5.93E-06	3.56E-07
	I - 129	531290	1.44E-08	8.65E-10
	TOTAL I (ATOMIC NO 53)		1.44E-08	8.65E-10
	TOTAL ADRENALS INHALATION =		5.94E-06	3.57E-07

ESOPHAGU INHALATION	ISOTOPE	NUCLIDE	CDE (Sv)	WCDE (Sv)
	H - 3	10030	5.19E-09	3.12E-10
	TOTAL H (ATOMIC NO 1)		5.19E-09	3.12E-10
	Co - 60	270600	1.14E-05	6.81E-07
	TOTAL Co (ATOMIC NO 27)		1.14E-05	6.81E-07
	I - 129	531290	3.83E-08	2.30E-09
	TOTAL I (ATOMIC NO 53)		3.83E-08	2.30E-09
	TOTAL ESOPHAGU INHALATION =		1.14E-05	6.84E-07

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DOWNWIND DISTANCE = 1.000E+04 OVARIES INHALATION DOSE EQUIVALENT

OVARIES	INHALATION	ISOTOPE	NUCLIDE	CDE (Sv)	WCDE (Sv)
		H - 3	10030	5.19E-09	1.30E-09
		TOTAL H (ATOMIC NO 1)		5.19E-09	1.30E-09
		Co - 60	270600	9.40E-07	2.35E-07
		TOTAL Co (ATOMIC NO 27)		9.40E-07	2.35E-07
		I - 129	531290	1.50E-08	3.74E-09
		TOTAL I (ATOMIC NO 53)		1.50E-08	3.74E-09
		TOTAL OVARIES INHALATION =		9.60E-07	2.40E-07
UTERUS	INHALATION	ISOTOPE	NUCLIDE	CDE (Sv)	WCDE (Sv)
		H - 3	10030	5.19E-09	3.12E-10
		TOTAL H (ATOMIC NO 1)		5.19E-09	3.12E-10
		Co - 60	270600	9.12E-07	5.47E-08
		TOTAL Co (ATOMIC NO 27)		9.12E-07	5.47E-08
		I - 129	531290	1.50E-08	9.02E-10
		TOTAL I (ATOMIC NO 53)		1.50E-08	9.02E-10
		TOTAL UTERUS INHALATION =		9.33E-07	5.60E-08

CEDE	INHALATION	ISOTOPE	NUCLIDE	CEDE (Sv)
		H - 3	10030	5.19E-09
		TOTAL H (ATOMIC NO 1)		5.19E-09
		Co - 60	270600	1.17E-05
		TOTAL Co (ATOMIC NO 27)		1.17E-05
		I - 129	531290	8.08E-06
		TOTAL I (ATOMIC NO 53)		8.08E-06
		TOTAL CEDE INHALATION =		1.98E-05

&& INHALATION COMMITTED DOSE EQUIVALENTS ORDERED BY ORGAN (Sv)

ORGAN	NO.	DOWNWIND DISTANCES (m) 1.00E+04
LUNGS	1	6.82E-05
S WALL	2	5.41E-06
SI WALL	3	1.41E-06
ULI WALL	4	1.94E-06
LLI WALL	5	1.59E-06
TESTES	6	3.55E-07
BREASTS	7	3.68E-06
BONE SUR	8	2.70E-06
R MARROW	9	3.43E-06
THYROID	10	2.72E-04
KIDNEYS	11	3.10E-06
LIVER	12	6.64E-06
SPLEEN	13	5.35E-06
PANCREAS	14	6.28E-06
MUSCLE	15	3.68E-06
SKIN	16	2.04E-06
BRAIN	17	5.19E-09
THYMUS	18	1.14E-05
BL WALL	19	6.03E-07
ADRENALS	20	5.94E-06
ESOPHAGU	21	1.14E-05
OVARIES	22	9.60E-07
UTERUS	23	9.33E-07

&& INHALATION COMMITTED DOSE EQUIVALENCES ORDERED BYDOSE (Sv)

ORGAN	NO.	DOWNWIND DISTANCES (m) 1.00E+04
THYROID	10	2.72E-04
LUNGS	1	6.82E-05
THYMUS	18	1.14E-05
ESOPHAGU	21	1.14E-05
LIVER	12	6.64E-06
PANCREAS	14	6.28E-06
ADRENALS	20	5.94E-06
S WALL	2	5.41E-06
SPLEEN	13	5.35E-06
BREASTS	7	3.68E-06
MUSCLE	15	3.68E-06
R MARROW	9	3.43E-06
KIDNEYS	11	3.10E-06
BONE SUR	8	2.70E-06
SKIN	16	2.04E-06
ULI WALL	4	1.94E-06
LLI WALL	5	1.59E-06
SI WALL	3	1.41E-06
OVARIES	22	9.60E-07
UTERUS	23	9.33E-07
BL WALL	19	6.03E-07
TESTES	6	3.55E-07

BRAIN 17 5.19E-09

&& INHALATION WEIGHTED COMMITTED DOSE EQUIVALENTS (Sv)

ORGAN	NO.	DOWNWIND DISTANCES (m) 1.00E+04
LUNGS	1	8.18E-06
S WALL	2	3.25E-07
SI WALL	3	8.48E-08
ULI WALL	4	1.16E-07
LLI WALL	5	9.52E-08
TESTES	6	8.87E-08
BREASTS	7	5.51E-07
BONE SUR	8	8.09E-08
R MARROW	9	4.11E-07
THYROID	10	8.16E-06
KIDNEYS	11	1.86E-07
LIVER	12	3.98E-07
SPLEEN	13	3.21E-07
PANCREAS	14	3.77E-07
MUSCLE	15	2.21E-07
SKIN	16	2.04E-08
BRAIN	17	3.12E-10
THYMUS	18	6.84E-07
BL WALL	19	3.62E-08
ADRENALS	20	3.57E-07
ESOPHAGU	21	6.84E-07
OVARIES	22	2.40E-07
UTERUS	23	5.60E-08
CEDE	24	1.98E-05

*** GROUND SURFACE DEPOSITION DOSE EQUIVALENT CALCULATION

USING DOSE RATE CONVERSION FACTORS FROM FEDERAL GUIDANCE REPORT 12

OCCUPANCY FACTOR = 1.000E+00
TIME RECEPTOR IS EXPOSED TO CONTAMINATED SOIL = 1.000E+00 (yr)
BUILDING SHIELDING FACTOR = 7.000E-01
RELEASE TIME FOR EXPONENTIAL DECAY FUNCTION = 1.000E+00 SECONDS

DOWNWIND DISTANCE = 1.000E+04 (m) PLUME TRAVEL TIME = 1.000E+04 (s)
CHI/Q = 1.627E-05 (s/cu m)

Lungs	GROUND SUR	ISOTOPE	NUCLIDE	D.E. (Sv)	WEIGHTED (Sv)	INITIAL (Sv/h) (W/0 BSF)	INITIAL micro-Ci PER sq m
		Co - 60	270600	3.04E-05	3.65E-06	0.00E+00	1.60E-02
	TOTAL Co (ATOMIC NO 27)			3.04E-05	3.65E-06		

VALRSAC6: Validation Test for RSAC V.6.1

DOWNWIND DISTANCE = 1.000E+04 Lungs GROUND SURFACE DOSE EQUIVALENT

Lungs	GROUND SUR	ISOTOPE	NUCLIDE	D.E. (Sv)	WEIGHTED (Sv)	INITIAL (Sv/h) (W/0 BSF)	INITIAL micro-Ci PER SQ m
		I - 129	531290	1.85E-06	2.22E-07	0.00E+00	1.40E-01
	TOTAL I (ATOMIC NO 53)			1.85E-06	2.22E-07		
TOTAL Lungs GROUND SURFACE =				3.23E-05	3.87E-06		

S Wall	GROUND SUR	ISOTOPE	NUCLIDE	D.E. (Sv)	WEIGHTED (Sv)	INITIAL (Sv/h) (W/0 BSF)	INITIAL micro-Ci PER sq m
		Co - 60	270600	2.92E-05	1.75E-06	0.00E+00	1.60E-02
	TOTAL Co (ATOMIC NO 27)			2.92E-05	1.75E-06		
		I - 129	531290	1.54E-06	9.21E-08	0.00E+00	1.40E-01
	TOTAL I (ATOMIC NO 53)			1.54E-06	9.21E-08		
TOTAL S Wall GROUND SURFACE =				3.08E-05	1.85E-06		

SI Wall	GROUND SUR	ISOTOPE	NUCLIDE	D.E. (Sv)	WEIGHTED (Sv)	INITIAL (Sv/h) (W/0 BSF)	INITIAL micro-Ci PER sq m
		Co - 60	270600	2.91E-05	1.75E-06	0.00E+00	1.60E-02
	TOTAL Co (ATOMIC NO 27)			2.91E-05	1.75E-06		
		I - 129	531290	7.98E-07	4.79E-08	0.00E+00	1.40E-01
	TOTAL I (ATOMIC NO 53)			7.98E-07	4.79E-08		
TOTAL SI Wall GROUND SURFACE =				2.99E-05	1.79E-06		

ULI Wall	GROUND SUR	ISOTOPE	NUCLIDE	D.E. (Sv)	WEIGHTED (Sv)	INITIAL (Sv/h) (W/0 BSF)	INITIAL micro-Ci PER sq m
		Co - 60	270600	2.92E-05	1.75E-06	0.00E+00	1.60E-02
	TOTAL Co (ATOMIC NO 27)			2.92E-05	1.75E-06		
		I - 129	531290	1.02E-06	6.10E-08	0.00E+00	1.40E-01

VALRSAC6: Validation Test for RSAC V.6.1

DOWNWIND DISTANCE = 1.000E+04 ULI Wall GROUND SURFACE DOSE EQUIVALENT

ULI Wall GROUND SUR	ISOTOPE	NUCLIDE	D.E. (Sv)	WEIGHTED (Sv)
TOTAL I (ATOMIC NO 53)			1.02E-06	6.10E-08
TOTAL ULI Wall GROUND SURFACE =			3.02E-05	1.81E-06

LLI Wall GROUND SUR	ISOTOPE	NUCLIDE	D.E. (Sv)	WEIGHTED (Sv)	INITIAL (Sv/h) (W/0 BSF)	INITIAL micro-Ci PER sq m
	Co - 60	270600	3.02E-05	1.81E-06	0.00E+00	1.60E-02
TOTAL Co (ATOMIC NO 27)			3.02E-05	1.81E-06		
	I - 129	531290	8.19E-07	4.91E-08	0.00E+00	1.40E-01
TOTAL I (ATOMIC NO 53)			8.19E-07	4.91E-08		
TOTAL LLI Wall GROUND SURFACE =			3.10E-05	1.86E-06		

Testes GROUND SUR	ISOTOPE	NUCLIDE	D.E. (Sv)	WEIGHTED (Sv)	INITIAL (Sv/h) (W/0 BSF)	INITIAL micro-Ci PER sq m
	Co - 60	270600	3.28E-05	8.21E-06	0.00E+00	1.60E-02
TOTAL Co (ATOMIC NO 27)			3.28E-05	8.21E-06		
	I - 129	531290	4.43E-06	1.11E-06	0.00E+00	1.40E-01
TOTAL I (ATOMIC NO 53)			4.43E-06	1.11E-06		
TOTAL Testes GROUND SURFACE =			3.73E-05	9.32E-06		

Breast GROUND SUR	ISOTOPE	NUCLIDE	D.E. (Sv)	WEIGHTED (Sv)	INITIAL (Sv/h) (W/0 BSF)	INITIAL micro-Ci PER sq m
	Co - 60	270600	3.14E-05	4.71E-06	0.00E+00	1.60E-02
TOTAL Co (ATOMIC NO 27)			3.14E-05	4.71E-06		
	I - 129	531290	4.79E-06	7.19E-07	0.00E+00	1.40E-01
TOTAL I (ATOMIC NO 53)			4.79E-06	7.19E-07		

DOWNWIND DISTANCE = 1.000E+04 Breast GROUND SURFACE DOSE EQUIVALENT

TOTAL Breast GROUND SURFACE =			3.62E-05	5.42E-06		

			D.E.	WEIGHTED	INITIAL	INITIAL

BSurface GROUND SUR	ISOTOPE	NUCLIDE	D.E. (Sv)	WEIGHTED (Sv)	INITIAL (Sv/h) (W/0 BSF)	INITIAL micro-Ci PER sq m
	Co - 60	270600	4.17E-05	1.25E-06	0.00E+00	1.60E-02
TOTAL Co (ATOMIC NO 27)			4.17E-05	1.25E-06		
	I - 129	531290	9.87E-06	2.96E-07	0.00E+00	1.40E-01
TOTAL I (ATOMIC NO 53)			9.87E-06	2.96E-07		
TOTAL BSurface GROUND SURFACE =			5.16E-05	1.55E-06		

R Marrow GROUND SUR	ISOTOPE	NUCLIDE	D.E. (Sv)	WEIGHTED (Sv)	INITIAL (Sv/h) (W/0 BSF)	INITIAL micro-Ci PER sq m
	Co - 60	270600	3.12E-05	3.75E-06	0.00E+00	1.60E-02
TOTAL Co (ATOMIC NO 27)			3.12E-05	3.75E-06		
	I - 129	531290	1.34E-06	1.60E-07	0.00E+00	1.40E-01
TOTAL I (ATOMIC NO 53)			1.34E-06	1.60E-07		
TOTAL R Marrow GROUND SURFACE =			3.26E-05	3.91E-06		

Thyroid GROUND SUR	ISOTOPE	NUCLIDE	D.E. (Sv)	WEIGHTED (Sv)	INITIAL (Sv/h) (W/0 BSF)	INITIAL micro-Ci PER sq m
	Co - 60	270600	3.02E-05	9.05E-07	0.00E+00	1.60E-02
TOTAL Co (ATOMIC NO 27)			3.02E-05	9.05E-07		
	I - 129	531290	2.85E-06	8.54E-08	0.00E+00	1.40E-01
TOTAL I (ATOMIC NO 53)			2.85E-06	8.54E-08		
TOTAL Thyroid GROUND SURFACE =			3.30E-05	9.90E-07		

DOWNWIND DISTANCE = 1.000E+04 Kidney GROUND SURFACE DOSE EQUIVALENT

Kidney GROUND SUR	ISOTOPE	NUCLIDE	D.E. (Sv)	WEIGHTED (Sv)	INITIAL (Sv/h) (W/0 BSF)	INITIAL micro-Ci PER sq m
	Co - 60	270600	2.98E-05	1.79E-06	0.00E+00	1.60E-02
TOTAL Co (ATOMIC NO 27)			2.98E-05	1.79E-06		
	I - 129	531290	2.15E-06	1.29E-07	0.00E+00	1.40E-01
TOTAL I (ATOMIC NO 53)			2.15E-06	1.29E-07		

TOTAL Kidney GROUND SURFACE = 3.19E-05 1.91E-06

Liver	GROUND SUR	ISOTOPE	NUCLIDE	D.E. (Sv)	WEIGHTED (Sv)	INITIAL (Sv/h) (W/0 BSF)	INITIAL micro-Ci PER sq m
		Co - 60	270600	2.94E-05	1.76E-06	0.00E+00	1.60E-02
	TOTAL Co	(ATOMIC NO 27)		2.94E-05	1.76E-06		
		I - 129	531290	1.52E-06	9.14E-08	0.00E+00	1.40E-01
	TOTAL I	(ATOMIC NO 53)		1.52E-06	9.14E-08		

TOTAL Liver GROUND SURFACE = 3.09E-05 1.85E-06

Spleen	GROUND SUR	ISOTOPE	NUCLIDE	D.E. (Sv)	WEIGHTED (Sv)	INITIAL (Sv/h) (W/0 BSF)	INITIAL micro-Ci PER sq m
		Co - 60	270600	2.94E-05	1.76E-06	0.00E+00	1.60E-02
	TOTAL Co	(ATOMIC NO 27)		2.94E-05	1.76E-06		
		I - 129	531290	1.47E-06	8.84E-08	0.00E+00	1.40E-01
	TOTAL I	(ATOMIC NO 53)		1.47E-06	8.84E-08		

TOTAL Spleen GROUND SURFACE = 3.08E-05 1.85E-06

Pancreas	GROUND SUR	ISOTOPE	NUCLIDE	D.E. (Sv)	WEIGHTED (Sv)	INITIAL (Sv/h) (W/0 BSF)	INITIAL micro-Ci PER sq m
		Co - 60	270600	2.73E-05	1.64E-06	0.00E+00	1.60E-02
	TOTAL Co	(ATOMIC NO 27)		2.73E-05	1.64E-06		
		I - 129	531290	1.09E-06	6.55E-08	0.00E+00	1.40E-01

DOWNWIND DISTANCE = 1.000E+04 Pancreas GROUND SURFACE DOSE EQUIVALENT

Pancreas	GROUND SUR	ISOTOPE	NUCLIDE	D.E. (Sv)	WEIGHTED (Sv)
	TOTAL I	(ATOMIC NO 53)		1.09E-06	6.55E-08

TOTAL Pancreas GROUND SURFACE = 2.84E-05 1.71E-06

Muscle	GROUND SUR	ISOTOPE	NUCLIDE	D.E. (Sv)	WEIGHTED (Sv)	INITIAL (Sv/h) (W/0 BSF)	INITIAL micro-Ci PER sq m

		Co - 60	270600	2.75E-05	1.65E-06	0.00E+00	1.60E-02
	TOTAL Co	(ATOMIC NO 27)		2.75E-05	1.65E-06		
		I - 129	531290	5.83E-07	3.50E-08	0.00E+00	1.40E-01
	TOTAL I	(ATOMIC NO 53)		5.83E-07	3.50E-08		
TOTAL Muscle	GROUND SURFACE =			2.81E-05	1.68E-06		

Skin	GROUND SUR	ISOTOPE	NUCLIDE	D.E. (Sv)	WEIGHTED (Sv)	INITIAL (Sv/h) (W/0 BSF)	INITIAL micro-Ci PER sq m
		Co - 60	270600	3.70E-05	3.70E-07	0.00E+00	1.60E-02
	TOTAL Co	(ATOMIC NO 27)		3.70E-05	3.70E-07		
		I - 129	531290	7.24E-06	7.24E-08	0.00E+00	1.40E-01
	TOTAL I	(ATOMIC NO 53)		7.24E-06	7.24E-08		
TOTAL Skin	GROUND SURFACE =			4.42E-05	4.42E-07		

Brain	GROUND SUR	ISOTOPE	NUCLIDE	D.E. (Sv)	WEIGHTED (Sv)	INITIAL (Sv/h) (W/0 BSF)	INITIAL micro-Ci PER sq m
		Co - 60	270600	2.90E-05	1.74E-06	0.00E+00	1.60E-02
	TOTAL Co	(ATOMIC NO 27)		2.90E-05	1.74E-06		
		I - 129	531290	9.05E-07	5.43E-08	0.00E+00	1.40E-01
	TOTAL I	(ATOMIC NO 53)		9.05E-07	5.43E-08		

DOWNWIND DISTANCE = 1.000E+04 Brain GROUND SURFACE DOSE EQUIVALENT

TOTAL Brain	GROUND SURFACE =			2.99E-05	1.79E-06	

Thymus	GROUND SUR	ISOTOPE	NUCLIDE	D.E. (Sv)	WEIGHTED (Sv)	INITIAL (Sv/h) (W/0 BSF)	INITIAL micro-Ci PER sq m
		Co - 60	270600	2.82E-05	1.69E-06	0.00E+00	1.60E-02
	TOTAL Co	(ATOMIC NO 27)		2.82E-05	1.69E-06		
		I - 129	531290	1.98E-06	1.19E-07	0.00E+00	1.40E-01
	TOTAL I	(ATOMIC NO 53)		1.98E-06	1.19E-07		

TOTAL Thymus GROUND SURFACE = 3.01E-05 1.81E-06

U Bladd GROUND SUR	ISOTOPE	NUCLIDE	D.E. (Sv)	WEIGHTED (Sv)	INITIAL (Sv/h) (W/0 BSF)	INITIAL micro-Ci PER sq m
	Co - 60	270600	2.98E-05	1.79E-06	0.00E+00	1.60E-02
TOTAL Co (ATOMIC NO 27)			2.98E-05	1.79E-06		
	I - 129	531290	1.60E-06	9.59E-08	0.00E+00	1.40E-01
TOTAL I (ATOMIC NO 53)			1.60E-06	9.59E-08		

TOTAL U Bladd GROUND SURFACE = 3.14E-05 1.88E-06

Adrenal GROUND SUR	ISOTOPE	NUCLIDE	D.E. (Sv)	WEIGHTED (Sv)	INITIAL (Sv/h) (W/0 BSF)	INITIAL micro-Ci PER sq m
	Co - 60	270600	3.28E-05	1.97E-06	0.00E+00	1.60E-02
TOTAL Co (ATOMIC NO 27)			3.28E-05	1.97E-06		
	I - 129	531290	3.31E-06	1.98E-07	0.00E+00	1.40E-01
TOTAL I (ATOMIC NO 53)			3.31E-06	1.98E-07		

TOTAL Adrenal GROUND SURFACE = 3.62E-05 2.17E-06

DOWNWIND DISTANCE = 1.000E+04 Esophagu GROUND SURFACE DOSE EQUIVALENT

Esophagu GROUND SUR	ISOTOPE	NUCLIDE	D.E. (Sv)	WEIGHTED (Sv)	INITIAL (Sv/h) (W/0 BSF)	INITIAL micro-Ci PER sq m
	Co - 60	270600	2.65E-05	1.59E-06	0.00E+00	1.60E-02
TOTAL Co (ATOMIC NO 27)			2.65E-05	1.59E-06		
	I - 129	531290	3.98E-07	2.39E-08	0.00E+00	1.40E-01
TOTAL I (ATOMIC NO 53)			3.98E-07	2.39E-08		

TOTAL Esophagu GROUND SURFACE = 2.69E-05 1.62E-06

Ovaries GROUND SUR	ISOTOPE	NUCLIDE	D.E. (Sv)	WEIGHTED (Sv)	INITIAL (Sv/h) (W/0 BSF)	INITIAL micro-Ci PER sq m
	Co - 60	270600	2.73E-05	6.84E-06	0.00E+00	1.60E-02
TOTAL Co (ATOMIC NO 27)			2.73E-05	6.84E-06		

		I - 129	531290	5.99E-07	1.50E-07	0.00E+00	1.40E-01
	TOTAL I (ATOMIC NO 53)			5.99E-07	1.50E-07		
TOTAL Ovaries GROUND SURFACE =				2.79E-05	6.99E-06		

Uterus	GROUND SUR	ISOTOPE	NUCLIDE	D.E. (Sv)	WEIGHTED (Sv)	INITIAL (Sv/h) (W/0 BSF)	INITIAL micro-Ci PER sq m
		Co - 60	270600	2.86E-05	1.71E-06	0.00E+00	1.60E-02
	TOTAL Co (ATOMIC NO 27)			2.86E-05	1.71E-06		
		I - 129	531290	7.14E-07	4.28E-08	0.00E+00	1.40E-01
	TOTAL I (ATOMIC NO 53)			7.14E-07	4.28E-08		
TOTAL Uterus GROUND SURFACE =				2.93E-05	1.76E-06		

EXT EDE	GROUND SUR	ISOTOPE	NUCLIDE	D.E. (Sv)	WEIGHTED (Sv)
		Co - 60	270600	3.15E-05	
	TOTAL Co (ATOMIC NO 27)			3.15E-05	
		I - 129	531290	3.22E-06	

DOWNWIND DISTANCE = 1.000E+04 EXT EDE GROUND SURFACE DOSE EQUIVALENT

EXT EDE	GROUND SUR	ISOTOPE	NUCLIDE	D.E. (Sv)	WEIGHTED (Sv)
	TOTAL I (ATOMIC NO 53)			3.22E-06	
TOTAL EXT EDE GROUND SURFACE =				3.47E-05	

&& GROUND SURFACE DOSE EQUIVALENTS ORDERED BY ORGAN (Sv)

		DOWNWIND DISTANCES (m)
ORGAN	NO.	1.00E+04
Lungs	1	3.23E-05
S Wall	2	3.08E-05
SI Wall	3	2.99E-05
ULI Wall	4	3.02E-05
LLI Wall	5	3.10E-05
Testes	6	3.73E-05
Breast	7	3.62E-05
BSurface	8	5.16E-05
R Marrow	9	3.26E-05
Thyroid	10	3.30E-05

Kidney	11	3.19E-05
Liver	12	3.09E-05
Spleen	13	3.08E-05
Pancreas	14	2.84E-05
Muscle	15	2.81E-05
Skin	16	4.42E-05
Brain	17	2.99E-05
Thymus	18	3.01E-05
U Bladd	19	3.14E-05
Adrenal	20	3.62E-05
Esophagu	21	2.69E-05
Ovaries	22	2.79E-05
Uterus	23	2.93E-05

&& GROUND SURFACE DOSE EQUIVALENCES ORDERED BY DOSE (Sv)

		DOWNWIND DISTANCES (m)
ORGAN	NO.	1.00E+04
BSurface	8	5.16E-05
Skin	16	4.42E-05
Testes	6	3.73E-05
Breast	7	3.62E-05
Adrenal	20	3.62E-05
Thyroid	10	3.30E-05
R Marrow	9	3.26E-05
Lungs	1	3.23E-05
Kidney	11	3.19E-05
U Bladd	19	3.14E-05
LLI Wall	5	3.10E-05
Liver	12	3.09E-05
Spleen	13	3.08E-05
S Wall	2	3.08E-05
ULI Wall	4	3.02E-05
Thymus	18	3.01E-05
SI Wall	3	2.99E-05
Brain	17	2.99E-05
Uterus	23	2.93E-05
Pancreas	14	2.84E-05
Muscle	15	2.81E-05
Ovaries	22	2.79E-05
Esophagu	21	2.69E-05

&& GROUND SURFACE WEIGHTED DOSE EQUIVALENTS (Sv)

		DOWNWIND DISTANCES (m)
ORGAN	NO.	1.00E+04
Lungs	1	3.87E-06
S Wall	2	1.85E-06
SI Wall	3	1.79E-06

ULI Wall	4	1.81E-06
LLI Wall	5	1.86E-06
Testes	6	9.32E-06
Breast	7	5.42E-06
BSurface	8	1.55E-06
R Marrow	9	3.91E-06
Thyroid	10	9.90E-07
Kidney	11	1.91E-06
Liver	12	1.85E-06
Spleen	13	1.85E-06
Pancreas	14	1.71E-06
Muscle	15	1.68E-06
Skin	16	4.42E-07
Brain	17	1.79E-06
Thymus	18	1.81E-06
U Bladd	19	1.88E-06
Adrenal	20	2.17E-06
Esophagu	21	1.62E-06
Ovaries	22	6.99E-06
Uterus	23	1.76E-06
EXT EDE	24	3.47E-05

*** AIR IMMERSION DOSE EQUIVALENT CALCULATION

USING DOSE RATE CONVERSION FACTORS FROM FEDERAL GUIDANCE REPORT 12

RELEASE TIME FOR EXPONENTIAL DECAY FUNCTION = 1.000E+00 SECONDS

DOWNWIND DISTANCE = 1.000E+04 (m) PLUME TRAVEL TIME = 1.000E+04 (s)
CHI/Q = 1.627E-05 (s/cu m)

Lungs AIR IMMERSION	ISOTOPE	NUCLIDE	DE (Sv)	WDE (Sv)
	Co - 60	270600	8.03E-08	9.64E-09
	TOTAL Co (ATOMIC NO 27)		8.03E-08	9.64E-09
	I - 129	531290	1.21E-10	1.45E-11
	TOTAL I (ATOMIC NO 53)		1.21E-10	1.45E-11

DOWNWIND DISTANCE = 1.000E+04 Lungs AIR IMMERSION DOSE EQUIVALENT

TOTAL Lungs AIR IMMERSION =			8.04E-08	9.65E-09
S Wall AIR IMMERSION	ISOTOPE	NUCLIDE	DE (Sv)	WDE (Sv)
	Co - 60	270600	7.19E-08	4.31E-09
	TOTAL Co (ATOMIC NO 27)		7.19E-08	4.31E-09
	I - 129	531290	9.32E-11	5.59E-12

	TOTAL I (ATOMIC NO 53)		9.32E-11	5.59E-12
TOTAL S Wall AIR IMMERSION =			7.20E-08	4.32E-09
SI Wall AIR IMMERSION	ISOTOPE	NUCLIDE	DE (Sv)	WDE (Sv)
	Co - 60	270600	6.67E-08	4.00E-09
	TOTAL Co (ATOMIC NO 27)		6.67E-08	4.00E-09
	I - 129	531290	4.43E-11	2.66E-12
	TOTAL I (ATOMIC NO 53)		4.43E-11	2.66E-12
TOTAL SI Wall AIR IMMERSION =			6.67E-08	4.00E-09
ULI Wall AIR IMMERSION	ISOTOPE	NUCLIDE	DE (Sv)	WDE (Sv)
	Co - 60	270600	6.80E-08	4.08E-09
	TOTAL Co (ATOMIC NO 27)		6.80E-08	4.08E-09
	I - 129	531290	5.82E-11	3.49E-12
	TOTAL I (ATOMIC NO 53)		5.82E-11	3.49E-12
TOTAL ULI Wall AIR IMMERSION =			6.81E-08	4.08E-09

DOWNWIND DISTANCE = 1.000E+04 LLI Wall AIR IMMERSION DOSE EQUIVALENT

LLI Wall AIR IMMERSION	ISOTOPE	NUCLIDE	DE (Sv)	WDE (Sv)
	Co - 60	270600	6.80E-08	4.08E-09
	TOTAL Co (ATOMIC NO 27)		6.80E-08	4.08E-09
	I - 129	531290	4.38E-11	2.63E-12
	TOTAL I (ATOMIC NO 53)		4.38E-11	2.63E-12
TOTAL LLI Wall AIR IMMERSION =			6.80E-08	4.08E-09
Testes AIR IMMERSION	ISOTOPE	NUCLIDE	DE (Sv)	WDE (Sv)
	Co - 60	270600	7.97E-08	1.99E-08
	TOTAL Co (ATOMIC NO 27)		7.97E-08	1.99E-08
	I - 129	531290	2.73E-10	6.82E-11
	TOTAL I (ATOMIC NO 53)		2.73E-10	6.82E-11
TOTAL Testes AIR IMMERSION =			7.99E-08	2.00E-08

Breast AIR IMMERSION	ISOTOPE	NUCLIDE	DE (Sv)	WDE (Sv)
	Co - 60	270600	9.00E-08	1.35E-08
	TOTAL Co (ATOMIC NO 27)		9.00E-08	1.35E-08
	I - 129	531290	3.76E-10	5.65E-11
	TOTAL I (ATOMIC NO 53)		3.76E-10	5.65E-11
TOTAL Breast AIR IMMERSION =			9.04E-08	1.36E-08
BSurface AIR IMMERSION	ISOTOPE	NUCLIDE	DE (Sv)	WDE (Sv)
	Co - 60	270600	1.15E-07	3.46E-09
	TOTAL Co (ATOMIC NO 27)		1.15E-07	3.46E-09
	I - 129	531290	6.22E-10	1.86E-11
	TOTAL I (ATOMIC NO 53)		6.22E-10	1.86E-11

DOWNWIND DISTANCE = 1.000E+04 BSurface AIR IMMERSION DOSE EQUIVALENT

TOTAL BSurface AIR IMMERSION =			1.16E-07	3.48E-09
R Marrow AIR IMMERSION	ISOTOPE	NUCLIDE	DE (Sv)	WDE (Sv)
	Co - 60	270600	7.97E-08	9.56E-09
	TOTAL Co (ATOMIC NO 27)		7.97E-08	9.56E-09
	I - 129	531290	9.27E-11	1.11E-11
	TOTAL I (ATOMIC NO 53)		9.27E-11	1.11E-11
TOTAL R Marrow AIR IMMERSION =			7.97E-08	9.57E-09
Thyroid AIR IMMERSION	ISOTOPE	NUCLIDE	DE (Sv)	WDE (Sv)
	Co - 60	270600	8.22E-08	2.47E-09
	TOTAL Co (ATOMIC NO 27)		8.22E-08	2.47E-09
	I - 129	531290	2.18E-10	6.54E-12
	TOTAL I (ATOMIC NO 53)		2.18E-10	6.54E-12
TOTAL Thyroid AIR IMMERSION =			8.25E-08	2.47E-09
Kidney AIR IMMERSION	ISOTOPE	NUCLIDE	DE (Sv)	WDE (Sv)
	Co - 60	270600	7.25E-08	4.35E-09

	TOTAL Co (ATOMIC NO 27)		7.25E-08	4.35E-09
	I - 129	531290	1.31E-10	7.87E-12
	TOTAL I (ATOMIC NO 53)		1.31E-10	7.87E-12
TOTAL Kidney AIR IMMERSION =			7.27E-08	4.36E-09

DOWNWIND DISTANCE = 1.000E+04 Liver AIR IMMERSION DOSE EQUIVALENT

Liver AIR IMMERSION	ISOTOPE	NUCLIDE	DE (Sv)	WDE (Sv)
	Co - 60	270600	7.32E-08	4.39E-09
	TOTAL Co (ATOMIC NO 27)		7.32E-08	4.39E-09
	I - 129	531290	9.32E-11	5.59E-12
	TOTAL I (ATOMIC NO 53)		9.32E-11	5.59E-12
TOTAL Liver AIR IMMERSION =			7.33E-08	4.40E-09

Spleen AIR IMMERSION	ISOTOPE	NUCLIDE	DE (Sv)	WDE (Sv)
	Co - 60	270600	7.32E-08	4.39E-09
	TOTAL Co (ATOMIC NO 27)		7.32E-08	4.39E-09
	I - 129	531290	8.70E-11	5.22E-12
	TOTAL I (ATOMIC NO 53)		8.70E-11	5.22E-12
TOTAL Spleen AIR IMMERSION =			7.33E-08	4.40E-09

Pancreas AIR IMMERSION	ISOTOPE	NUCLIDE	DE (Sv)	WDE (Sv)
	Co - 60	270600	6.74E-08	4.04E-09
	TOTAL Co (ATOMIC NO 27)		6.74E-08	4.04E-09
	I - 129	531290	6.33E-11	3.80E-12
	TOTAL I (ATOMIC NO 53)		6.33E-11	3.80E-12
TOTAL Pancreas AIR IMMERSION =			6.74E-08	4.04E-09

Muscle AIR IMMERSION	ISOTOPE	NUCLIDE	DE (Sv)	WDE (Sv)
	Co - 60	270600	6.54E-08	3.92E-09
	TOTAL Co (ATOMIC NO 27)		6.54E-08	3.92E-09
	I - 129	531290	3.21E-11	1.93E-12

		TOTAL I (ATOMIC NO 53)	3.21E-11	1.93E-12

DOWNWIND DISTANCE = 1.000E+04 Muscle AIR IMMERSION DOSE EQUIVALENT

		TOTAL Muscle AIR IMMERSION =		6.54E-08	3.93E-09
Skin	AIR IMMERSION	ISOTOPE	NUCLIDE	DE (Sv)	WDE (Sv)
		Co - 60	270600	9.39E-08	9.39E-10
		TOTAL Co (ATOMIC NO 27)		9.39E-08	9.39E-10
		I - 129	531290	6.22E-10	6.22E-12
		TOTAL I (ATOMIC NO 53)		6.22E-10	6.22E-12
		TOTAL Skin AIR IMMERSION =		9.45E-08	9.45E-10
Brain	AIR IMMERSION	ISOTOPE	NUCLIDE	DE (Sv)	WDE (Sv)
		Co - 60	270600	8.68E-08	5.21E-09
		TOTAL Co (ATOMIC NO 27)		8.68E-08	5.21E-09
		I - 129	531290	8.87E-11	5.32E-12
		TOTAL I (ATOMIC NO 53)		8.87E-11	5.32E-12
		TOTAL Brain AIR IMMERSION =		8.69E-08	5.21E-09
Thymus	AIR IMMERSION	ISOTOPE	NUCLIDE	DE (Sv)	WDE (Sv)
		Co - 60	270600	7.58E-08	4.55E-09
		TOTAL Co (ATOMIC NO 27)		7.58E-08	4.55E-09
		I - 129	531290	1.36E-10	8.14E-12
		TOTAL I (ATOMIC NO 53)		1.36E-10	8.14E-12
		TOTAL Thymus AIR IMMERSION =		7.59E-08	4.55E-09

DOWNWIND DISTANCE = 1.000E+04 U Bladd AIR IMMERSION DOSE EQUIVALENT

U Bladd	AIR IMMERSION	ISOTOPE	NUCLIDE	DE (Sv)	WDE (Sv)
		Co - 60	270600	6.74E-08	4.04E-09
		TOTAL Co (ATOMIC NO 27)		6.74E-08	4.04E-09

		I - 129	531290	8.93E-11	5.36E-12
		TOTAL I (ATOMIC NO 53)		8.93E-11	5.36E-12
		TOTAL U Bladd AIR IMMERSION =		6.74E-08	4.05E-09
Adrenal	AIR IMMERSION	ISOTOPE	NUCLIDE	DE (Sv)	WDE (Sv)
		Co - 60	270600	7.84E-08	4.70E-09
		TOTAL Co (ATOMIC NO 27)		7.84E-08	4.70E-09
		I - 129	531290	1.98E-10	1.19E-11
		TOTAL I (ATOMIC NO 53)		1.98E-10	1.19E-11
		TOTAL Adrenal AIR IMMERSION =		7.86E-08	4.71E-09
Esophagu	AIR IMMERSION	ISOTOPE	NUCLIDE	DE (Sv)	WDE (Sv)
		Co - 60	270600	6.93E-08	4.16E-09
		TOTAL Co (ATOMIC NO 27)		6.93E-08	4.16E-09
		I - 129	531290	3.13E-11	1.88E-12
		TOTAL I (ATOMIC NO 53)		3.13E-11	1.88E-12
		TOTAL Esophagu AIR IMMERSION =		6.93E-08	4.16E-09
Ovaries	AIR IMMERSION	ISOTOPE	NUCLIDE	DE (Sv)	WDE (Sv)
		Co - 60	270600	6.93E-08	1.73E-08
		TOTAL Co (ATOMIC NO 27)		6.93E-08	1.73E-08
		I - 129	531290	2.91E-11	7.28E-12
		TOTAL I (ATOMIC NO 53)		2.91E-11	7.28E-12

DOWNWIND DISTANCE = 1.000E+04 Ovaries AIR IMMERSION DOSE EQUIVALENT

		TOTAL Ovaries AIR IMMERSION =		6.93E-08	1.73E-08
Uterus	AIR IMMERSION	ISOTOPE	NUCLIDE	DE (Sv)	WDE (Sv)
		Co - 60	270600	6.48E-08	3.89E-09
		TOTAL Co (ATOMIC NO 27)		6.48E-08	3.89E-09
		I - 129	531290	3.70E-11	2.22E-12

TOTAL I (ATOMIC NO 53)		3.70E-11	2.22E-12
TOTAL Uterus AIR IMMERSION =		6.48E-08	3.89E-09

EXT EDE AIR IMMERSION	ISOTOPE	NUCLIDE	DE (Sv)
	Co - 60	270600	8.16E-08
	TOTAL Co (ATOMIC NO 27)		8.16E-08
	I - 129	531290	2.15E-10
	TOTAL I (ATOMIC NO 53)		2.15E-10
	TOTAL EXT EDE AIR IMMERSION =		8.18E-08

&& AIR IMMERSION DOSE EQUIVALENTS ORDERED BY ORGAN (Sv)

ORGAN	NO.	DOWNWIND DISTANCES (m) 1.00E+04
Lungs	1	8.04E-08
S Wall	2	7.20E-08
SI Wall	3	6.67E-08
ULI Wall	4	6.81E-08
LLI Wall	5	6.80E-08
Testes	6	7.99E-08
Breast	7	9.04E-08
BSurface	8	1.16E-07
R Marrow	9	7.97E-08
Thyroid	10	8.25E-08
Kidney	11	7.27E-08
Liver	12	7.33E-08
Spleen	13	7.33E-08
Pancreas	14	6.74E-08
Muscle	15	6.54E-08
Skin	16	9.45E-08
Brain	17	8.69E-08
Thymus	18	7.59E-08
U Bladd	19	6.74E-08
Adrenal	20	7.86E-08
Esophagu	21	6.93E-08
Ovaries	22	6.93E-08
Uterus	23	6.48E-08

&& AIR IMMERSION DOSE EQUIVALENCES ORDERED BY DOSE (Sv)

ORGAN	NO.	DOWNWIND DISTANCES (m) 1.00E+04
BSurface	8	1.16E-07

Skin	16	9.45E-08
Breast	7	9.04E-08
Brain	17	8.69E-08
Thyroid	10	8.25E-08
Lungs	1	8.04E-08
Testes	6	7.99E-08
R Marrow	9	7.97E-08
Adrenal	20	7.86E-08
Thymus	18	7.59E-08
Liver	12	7.33E-08
Spleen	13	7.33E-08
Kidney	11	7.27E-08
S Wall	2	7.20E-08
Esophagu	21	6.93E-08
Ovaries	22	6.93E-08
ULI Wall	4	6.81E-08
LLI Wall	5	6.80E-08
U Bladd	19	6.74E-08
Pancreas	14	6.74E-08
SI Wall	3	6.67E-08
Muscle	15	6.54E-08
Uterus	23	6.48E-08

&& AIR IMMERSION WEIGHTED DOSE EQUIVALENTS (Sv)

		DOWNWIND DISTANCES (m)
ORGAN	NO.	1.00E+04
Lungs	1	9.65E-09
S Wall	2	4.32E-09
SI Wall	3	4.00E-09
ULI Wall	4	4.08E-09
LLI Wall	5	4.08E-09
Testes	6	2.00E-08
Breast	7	1.36E-08
BSurface	8	3.48E-09
R Marrow	9	9.57E-09
Thyroid	10	2.47E-09
Kidney	11	4.36E-09
Liver	12	4.40E-09
Spleen	13	4.40E-09
Pancreas	14	4.04E-09
Muscle	15	3.93E-09
Skin	16	9.45E-10
Brain	17	5.21E-09
Thymus	18	4.55E-09
U Bladd	19	4.05E-09
Adrenal	20	4.71E-09
Esophagu	21	4.16E-09
Ovaries	22	1.73E-08
Uterus	23	3.89E-09
EXT EDE	24	8.18E-08

*** INGESTION DOSE EQUIVALENT CALCULATION

USING DOSE CONVERSION FACTORS FROM FEDERAL GUIDANCE REPORT 11

RELEASE TIME FOR EXPONENTIAL DECAY FUNCTION = 1.000E+00 (s)
INTERNAL EXPOSURE TIME PERIOD = 5.000E+01 (yr)

INGESTION CALCULATIONS MADE USING USER SUPPLIED CONSTANTS

INGESTION CONSTANTS:
5.20E+02 STORED VEGETABLE USAGE FACTOR (Kg/yr)
6.40E+01 FRESH VEGETABLE USAGE FACTOR (Kg/yr)
1.10E+02 MEAT USAGE FACTOR (Kg/yr)
3.10E+02 MILK USAGE FACTOR (L/yr)
1.00E+00 FRACTION OF STORED VEGETABLES FROM GARDEN
1.00E+00 FRACTION OF FRESH VEGETABLES FROM GARDEN

5.70E-01 RETENTION FACTOR FOR ACTIVITY ON FORAGE
2.00E-01 RETENTION FACTOR FOR ACTIVITY ON VEGETABLES
1.00E+00 RETENTION FACTOR FOR IODINES
0.00E+00 REMOVAL RATE CONSTANT FOR CROPS (1/h)
3.50E+00 VEGETABLE EXPOSURE TIME TO PLUME FOR CHRONIC RELEASE (d)
3.50E+00 FORAGE EXPOSURE TIME TO PLUME FOR CHRONIC RELEASE (d)
1.00E+02 HTO REMOVAL HALF TIME (d)
2.25E+02 EFFECTIVE SURFACE SOIL DENSITY (Kg/sq m)
0.00E+00 STORED VEGETABLE HOLDUP TIME AFTER HARVEST (d)
0.00E+00 FRESH VEGETABLE HOLDUP TIME AFTER HARVEST (d)
1.60E+01 ANIMALS DAILY FORAGE FEED (Kg/d)
0.00E+00 FEED-MILK-RECEPTOR TRANSFER TIME (d)
0.00E+00 SLAUGHTER TO CONSUMPTION TIME (d)
0.00E+00 FRACTION OF YEAR ON PASTURE
0.00E+00 PASTURE FEED FRACTION
0.00E+00 STORED FEED STORAGE TIME
2.00E+00 VEGETABLE VEGETATION YIELD (Kg/sq m)
2.80E-01 FORAGE VEGETATION YIELD (Kg/sq m)
4.90E+00 ABSOLUTE HUMIDITY (g/cu m)

ACUTE RELEASE OVER 7.000E+00 (d)
HARVEST DURATION TIME OF 0.000E+00 (d) AFTER ACUTE RELEASE
CONSUMPTION OF CROPS GROWN ON CONTAMINATED SOIL FOR 1.000E+00 (Y)

FRACTIONS OF ANNUAL VEGETABLES AND FORAGE CONTAMINATED BY ACUTE RELEASE
1.0E+00 STORED VEGETABLES
1.0E+00 FRESH VEGETABLES
1.0E+00 STORED FEED
1.0E+00 PASTURE FEED

INGESTION TRANSFER CONSTANTS

ELEMENT		BV1 FORAGE/ SOIL (dry)	BV2 VEG/SOIL (wet)	FM MILK (d/L)	FF MEAT (d/kg)	TRANS-LOCATION
H	1	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.0E+00
He	2	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.0E+00
Li	3	2.5E-02	1.7E-03	2.0E-02	1.0E-02	1.0E+00

Be	4	1.0E-02	6.4E-04	9.0E-07	1.0E-03	1.0E+00
B	5	4.0E+00	8.6E-01	1.5E-03	8.0E-04	1.0E+00
C	6	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.0E+00
N	7	3.0E+01	1.3E+01	2.5E-02	7.5E-02	1.0E+00
O	8	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.0E+00
F	9	6.0E-02	2.6E-03	1.0E-03	1.5E-01	1.0E+00
Ne	10	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.0E+00
Na	11	7.5E-02	2.4E-02	3.5E-02	5.5E-02	1.0E+00
Mg	12	1.0E+00	2.4E-01	4.0E-03	5.0E-03	1.0E+00
Al	13	4.0E-03	2.8E-04	2.0E-04	1.5E-03	1.0E+00
Si	14	3.5E-01	3.0E-02	2.0E-05	4.0E-05	1.0E+00
P	15	3.5E+00	1.5E+00	1.5E-02	5.5E-02	1.0E+00
S	16	1.5E+00	6.4E-01	1.5E-02	1.0E-01	1.0E+00
Cl	17	7.0E+01	3.0E+01	1.5E-02	8.0E-02	1.0E+00
Ar	18	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.0E+00
K	19	1.0E+00	2.4E-01	7.0E-03	2.0E-02	1.0E+00
Ca	20	3.5E+00	1.5E-01	1.0E-02	7.0E-04	1.0E+00

ELEMENT		BV1 FORAGE/ SOIL (dry)	BV2 VEG/SOIL (wet)	FM MILK (d/L)	FF MEAT (d/kg)	TRANS- LOCATION
Sc	21	6.0E-03	4.3E-04	5.0E-06	1.5E-02	1.0E+00
Ti	22	5.5E-03	1.3E-03	1.0E-02	3.0E-02	1.0E+00
V	23	5.5E-03	1.3E-03	2.0E-05	2.5E-03	1.0E+00
Cr	24	7.5E-03	1.9E-03	1.5E-03	5.5E-03	1.0E+00
Mn	25	2.5E-01	2.1E-02	3.5E-04	4.0E-04	1.0E+00
Fe	26	4.0E-03	4.3E-04	2.5E-04	2.0E-02	1.0E+00
Co	27	2.0E-02	3.0E-03	2.0E-03	2.0E-02	1.0E+00
Ni	28	6.0E-02	2.6E-02	1.0E-03	6.0E-03	1.0E+00
Cu	29	4.0E-01	1.1E-01	1.5E-03	1.0E-02	1.0E+00
Zn	30	1.5E+00	3.9E-01	1.0E-02	1.0E-01	1.0E+00
Ga	31	4.0E-03	1.7E-04	5.0E-05	5.0E-04	1.0E+00
Ge	32	4.0E-01	3.4E-02	7.0E-02	7.0E-01	1.0E+00
As	33	4.0E-02	2.6E-03	6.0E-05	2.0E-03	1.0E+00
Se	34	2.5E-02	1.1E-02	4.0E-03	1.5E-02	1.0E+00
Br	35	1.5E+00	6.4E-01	2.0E-02	2.5E-02	1.0E+00
Kr	36	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.0E+00
Rb	37	1.5E-01	3.0E-02	1.0E-02	1.5E-02	1.0E+00
Sr	38	2.5E+00	1.1E-01	1.5E-03	3.0E-04	1.5E-01
Y	39	1.5E-02	2.6E-03	2.0E-05	3.0E-04	1.0E+00
Zr	40	2.0E-03	2.1E-04	3.0E-05	5.5E-03	1.0E+00
Nb	41	2.0E-02	2.1E-03	2.0E-02	2.5E-01	1.0E+00
Mo	42	2.5E-01	2.6E-02	1.5E-03	6.0E-03	1.0E+00
Tc	43	9.5E+00	6.4E-01	1.0E-02	8.5E-03	1.0E+00
Ru	44	7.5E-02	8.6E-03	6.0E-07	2.0E-03	5.0E-02
Rh	45	1.5E-01	1.7E-02	1.0E-02	2.0E-03	1.0E+00
Pd	46	1.5E-01	1.7E-02	1.0E-02	4.0E-03	1.0E+00
Ag	47	4.0E-01	4.3E-02	2.0E-02	3.0E-03	1.0E+00
Cd	48	5.5E-01	6.4E-02	1.0E-03	5.5E-04	1.0E+00
In	49	4.0E-03	1.7E-04	1.0E-04	8.0E-03	1.0E+00
Sn	50	3.0E-02	2.6E-03	1.0E-03	8.0E-02	1.0E+00
Sb	51	2.0E-01	1.3E-02	1.0E-04	1.0E-03	1.0E+00
Te	52	2.5E-02	1.7E-03	2.0E-04	1.5E-02	1.0E+00

I	53	1.5E-01	2.1E-02	1.0E-02	7.0E-03	1.0E-01
Xe	54	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.0E+00
Cs	55	8.0E-02	1.3E-02	7.0E-03	2.0E-02	5.0E-01
Ba	56	1.5E-01	6.4E-03	3.5E-04	1.5E-04	1.0E+00
La	57	1.0E-02	1.7E-03	2.0E-05	3.0E-04	1.0E+00
Ce	58	1.0E-02	1.7E-03	2.0E-05	7.5E-04	3.0E-01
Pr	59	1.0E-02	1.7E-03	2.0E-05	3.0E-04	1.0E+00
Nd	60	1.0E-02	1.7E-03	2.0E-05	3.0E-04	1.0E+00
Pm	61	1.0E-02	1.7E-03	2.0E-05	5.0E-03	1.0E+00
Sm	62	1.0E-02	1.7E-03	2.0E-05	5.0E-03	1.0E+00
Eu	63	1.0E-02	1.7E-03	2.0E-05	5.0E-03	1.0E+00
Gd	64	1.0E-02	1.7E-03	2.0E-05	3.5E-03	1.0E+00
Tb	65	1.0E-02	1.7E-03	2.0E-05	4.5E-03	1.0E+00
Dy	66	1.0E-02	1.7E-03	2.0E-05	5.5E-03	1.0E+00
Ho	67	1.0E-02	1.7E-03	2.0E-05	4.5E-03	1.0E+00
Er	68	1.0E-02	1.7E-03	2.0E-05	4.0E-03	1.0E+00

ELEMENT		BV1 FORAGE/ SOIL (dry)	BV2 VEG/SOIL (wet)	FM MILK (d/L)	FF MEAT (d/kg)	TRANS-LOCATION
Tm	69	1.0E-02	1.7E-03	2.0E-05	4.5E-03	1.0E+00
Yb	70	1.0E-02	1.7E-03	2.0E-05	4.0E-03	1.0E+00
Lu	71	1.0E-02	1.7E-03	2.0E-05	4.5E-03	1.0E+00
Hf	72	3.5E-03	3.6E-04	5.0E-06	1.0E-03	1.0E+00
Ta	73	1.0E-02	1.1E-03	3.0E-06	6.0E-04	1.0E+00
W	74	4.5E-02	4.3E-03	3.0E-04	4.5E-02	1.0E+00
Re	75	1.5E+00	1.5E-01	1.5E-03	8.0E-03	1.0E+00
Os	76	1.5E-02	1.5E-03	5.0E-03	4.0E-01	1.0E+00
Ir	77	5.5E-02	6.4E-03	2.0E-06	1.5E-03	1.0E+00
Pt	78	9.5E-02	1.1E-02	5.0E-03	4.0E-03	1.0E+00
Au	79	4.0E-01	4.3E-02	5.5E-06	8.0E-03	1.0E+00
Hg	80	9.0E-01	8.6E-02	4.5E-04	2.5E-01	1.0E+00
Tl	81	4.0E-03	1.7E-04	2.0E-03	4.0E-02	1.0E+00
Pb	82	4.5E-02	3.9E-03	2.5E-04	3.0E-04	1.0E+00
Bi	83	3.5E-02	2.1E-03	5.0E-04	4.0E-04	1.0E+00
Po	84	2.5E-03	1.7E-04	3.5E-04	9.5E-05	1.0E+00
At	85	1.0E+00	6.4E-02	1.0E-02	1.0E-02	1.0E+00
Rn	86	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.0E+00
Fr	87	3.0E-02	3.4E-03	2.0E-02	2.5E-03	1.0E+00
Ra	88	1.5E-02	6.4E-04	4.5E-04	2.5E-04	1.0E+00
Ac	89	3.5E-03	1.5E-04	2.0E-05	2.5E-05	1.0E+00
Th	90	8.5E-04	3.6E-05	5.0E-06	6.0E-06	1.0E+00
Pa	91	2.5E-03	1.1E-04	5.0E-06	1.0E-05	1.0E+00
U	92	8.5E-03	1.7E-03	6.0E-04	2.0E-04	1.0E+00
Np	93	1.0E-01	4.3E-03	5.0E-06	5.5E-05	1.0E+00
Pu	94	4.5E-04	1.9E-05	1.0E-07	5.0E-07	1.0E-02
Am	95	5.5E-03	1.1E-04	4.0E-07	3.5E-06	3.0E-01
Cm	96	8.5E-04	6.4E-06	2.0E-05	3.5E-06	3.0E-01
Bk	97	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cf	98	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Es	99	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Fm	100	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

DOWNWIND DISTANCE = 1.000E+04 (m) PLUME TRAVEL TIME = 1.000E+04 (s)
CHI/Q = 1.627E-05 (s/cu m)

LUNGS	INGESTION	ISOTOPE	NUCLIDE	CDE (Sv)	WCDE (Sv)
		H - 3	10030	7.70E-07	9.24E-08
		TOTAL H (ATOMIC NO 1)		7.70E-07	9.24E-08
		Co - 60	270600	3.07E-04	3.68E-05
		TOTAL Co (ATOMIC NO 27)		3.07E-04	3.68E-05
		I - 129	531290	1.44E-04	1.73E-05

DOWNWIND DISTANCE = 1.000E+04 LUNGS INGESTION DOSE EQUIVALENT

LUNGS	INGESTION	ISOTOPE	NUCLIDE	CEDE (Sv)	
		TOTAL I (ATOMIC NO 53)		1.44E-04	1.73E-05
		TOTAL LUNGS INGESTION =		4.51E-04	5.42E-05
S WALL	INGESTION	ISOTOPE	NUCLIDE	CDE (Sv)	WCDE (Sv)
		H - 3	10030	7.70E-07	4.62E-08
		TOTAL H (ATOMIC NO 1)		7.70E-07	4.62E-08
		Co - 60	270600	3.62E-04	2.17E-05
		TOTAL Co (ATOMIC NO 27)		3.62E-04	2.17E-05
		I - 129	531290	1.91E-04	1.15E-05
		TOTAL I (ATOMIC NO 53)		1.91E-04	1.15E-05
		TOTAL S WALL INGESTION =		5.54E-04	3.32E-05
SI WALL	INGESTION	ISOTOPE	NUCLIDE	CDE (Sv)	WCDE (Sv)
		H - 3	10030	7.70E-07	4.62E-08
		TOTAL H (ATOMIC NO 1)		7.70E-07	4.62E-08
		Co - 60	270600	5.06E-04	3.03E-05
		TOTAL Co (ATOMIC NO 27)		5.06E-04	3.03E-05
		I - 129	531290	1.23E-04	7.38E-06
		TOTAL I (ATOMIC NO 53)		1.23E-04	7.38E-06

TOTAL SI WALL INGESTION =			6.30E-04	3.78E-05
ULI WALL INGESTION	ISOTOPE	NUCLIDE	CDE (Sv)	WCDE (Sv)
	H - 3	10030	7.70E-07	4.62E-08
TOTAL H (ATOMIC NO 1)			7.70E-07	4.62E-08

DOWNWIND DISTANCE = 1.000E+04 ULI WALL INGESTION DOSE EQUIVALENT

ULI WALL INGESTION	ISOTOPE	NUCLIDE	CDE (Sv)	WCDE (Sv)
	Co - 60	270600	5.92E-04	3.55E-05
TOTAL Co (ATOMIC NO 27)			5.92E-04	3.55E-05
	I - 129	531290	1.24E-04	7.44E-06
TOTAL I (ATOMIC NO 53)			1.24E-04	7.44E-06
TOTAL ULI WALL INGESTION =			7.17E-04	4.30E-05
LLI WALL INGESTION	ISOTOPE	NUCLIDE	CDE (Sv)	WCDE (Sv)
	H - 3	10030	7.70E-07	4.62E-08
TOTAL H (ATOMIC NO 1)			7.70E-07	4.62E-08
	Co - 60	270600	8.35E-04	5.01E-05
TOTAL Co (ATOMIC NO 27)			8.35E-04	5.01E-05
	I - 129	531290	1.21E-04	7.28E-06
TOTAL I (ATOMIC NO 53)			1.21E-04	7.28E-06
TOTAL LLI WALL INGESTION =			9.57E-04	5.74E-05
TESTES INGESTION	ISOTOPE	NUCLIDE	CDE (Sv)	WCDE (Sv)
	H - 3	10030	7.70E-07	1.92E-07
TOTAL H (ATOMIC NO 1)			7.70E-07	1.92E-07
	Co - 60	270600	3.35E-04	8.38E-05
TOTAL Co (ATOMIC NO 27)			3.35E-04	8.38E-05
	I - 129	531290	1.13E-04	2.82E-05
TOTAL I (ATOMIC NO 53)			1.13E-04	2.82E-05
TOTAL TESTES INGESTION =			4.48E-04	1.12E-04

DOWNWIND DISTANCE = 1.000E+04 BREASTS INGESTION DOSE EQUIVALENT

BREASTS	INGESTION	ISOTOPE	NUCLIDE	CDE (Sv)	WCDE (Sv)
		H - 3	10030	7.70E-07	1.15E-07
		TOTAL H (ATOMIC NO 1)		7.70E-07	1.15E-07
		Co - 60	270600	3.14E-04	4.71E-05
		TOTAL Co (ATOMIC NO 27)		3.14E-04	4.71E-05
		I - 129	531290	2.89E-04	4.33E-05
		TOTAL I (ATOMIC NO 53)		2.89E-04	4.33E-05
		TOTAL BREASTS INGESTION =		6.04E-04	9.06E-05
BONE SUR	INGESTION	ISOTOPE	NUCLIDE	CDE (Sv)	WCDE (Sv)
		H - 3	10030	7.70E-07	2.31E-08
		TOTAL H (ATOMIC NO 1)		7.70E-07	2.31E-08
		Co - 60	270600	2.97E-04	8.92E-06
		TOTAL Co (ATOMIC NO 27)		2.97E-04	8.92E-06
		I - 129	531290	1.89E-04	5.68E-06
		TOTAL I (ATOMIC NO 53)		1.89E-04	5.68E-06
		TOTAL BONE SUR INGESTION =		4.88E-04	1.46E-05
R MARROW	INGESTION	ISOTOPE	NUCLIDE	CDE (Sv)	WCDE (Sv)
		H - 3	10030	7.70E-07	9.24E-08
		TOTAL H (ATOMIC NO 1)		7.70E-07	9.24E-08
		Co - 60	270600	3.39E-04	4.07E-05
		TOTAL Co (ATOMIC NO 27)		3.39E-04	4.07E-05
		I - 129	531290	1.93E-04	2.31E-05
		TOTAL I (ATOMIC NO 53)		1.93E-04	2.31E-05
		TOTAL R MARROW INGESTION =		5.33E-04	6.40E-05

DOWNWIND DISTANCE = 1.000E+04 THYROID INGESTION DOSE EQUIVALENT

THYROID INGESTION	ISOTOPE	NUCLIDE	CDE (Sv)	WCDE (Sv)
	H - 3	10030	7.70E-07	2.31E-08
	TOTAL H (ATOMIC NO 1)		7.70E-07	2.31E-08
	Co - 60	270600	2.89E-04	8.68E-06
	TOTAL Co (ATOMIC NO 27)		2.89E-04	8.68E-06
	I - 129	531290	2.16E+00	6.49E-02
	TOTAL I (ATOMIC NO 53)		2.16E+00	6.49E-02
	TOTAL THYROID INGESTION =		2.17E+00	6.50E-02

KIDNEYS INGESTION	ISOTOPE	NUCLIDE	CDE (Sv)	WCDE (Sv)
	H - 3	10030	7.70E-07	4.62E-08
	TOTAL H (ATOMIC NO 1)		7.70E-07	4.62E-08
	Co - 60	270600	3.96E-04	2.38E-05
	TOTAL Co (ATOMIC NO 27)		3.96E-04	2.38E-05
	I - 129	531290	1.17E-04	7.02E-06
	TOTAL I (ATOMIC NO 53)		1.17E-04	7.02E-06
	TOTAL KIDNEYS INGESTION =		5.14E-04	3.08E-05

LIVER INGESTION	ISOTOPE	NUCLIDE	CDE (Sv)	WCDE (Sv)
	H - 3	10030	7.70E-07	4.62E-08
	TOTAL H (ATOMIC NO 1)		7.70E-07	4.62E-08
	Co - 60	270600	7.91E-04	4.75E-05
	TOTAL Co (ATOMIC NO 27)		7.91E-04	4.75E-05
	I - 129	531290	1.20E-04	7.23E-06
	TOTAL I (ATOMIC NO 53)		1.20E-04	7.23E-06
	TOTAL LIVER INGESTION =		9.13E-04	5.48E-05

DOWNWIND DISTANCE = 1.000E+04 SPLEEN INGESTION DOSE EQUIVALENT

SPLEEN INGESTION	ISOTOPE	NUCLIDE	CDE (Sv)	WCDE (Sv)

	H - 3	10030	7.70E-07	4.62E-08
	TOTAL H (ATOMIC NO 1)		7.70E-07	4.62E-08
	Co - 60	270600	3.45E-04	2.07E-05
	TOTAL Co (ATOMIC NO 27)		3.45E-04	2.07E-05
	I - 129	531290	1.22E-04	7.33E-06
	TOTAL I (ATOMIC NO 53)		1.22E-04	7.33E-06
	TOTAL SPLEEN INGESTION =		4.68E-04	2.81E-05

PANCREAS	INGESTION	ISOTOPE	NUCLIDE	CDE (Sv)	WCDE (Sv)
		H - 3	10030	7.70E-07	4.62E-08
		TOTAL H (ATOMIC NO 1)		7.70E-07	4.62E-08
		Co - 60	270600	3.85E-04	2.31E-05
		TOTAL Co (ATOMIC NO 27)		3.85E-04	2.31E-05
		I - 129	531290	1.23E-04	7.38E-06
		TOTAL I (ATOMIC NO 53)		1.23E-04	7.38E-06
		TOTAL PANCREAS INGESTION =		5.09E-04	3.05E-05

MUSCLE	INGESTION	ISOTOPE	NUCLIDE	CDE (Sv)	WCDE (Sv)
		H - 3	10030	7.70E-07	4.62E-08
		TOTAL H (ATOMIC NO 1)		7.70E-07	4.62E-08
		Co - 60	270600	3.14E-04	1.88E-05
		TOTAL Co (ATOMIC NO 27)		3.14E-04	1.88E-05
		I - 129	531290	2.89E-04	1.73E-05
		TOTAL I (ATOMIC NO 53)		2.89E-04	1.73E-05
		TOTAL MUSCLE INGESTION =		6.04E-04	3.62E-05

DOWNWIND DISTANCE = 1.000E+04 SKIN INGESTION DOSE EQUIVALENT

SKIN	INGESTION	ISOTOPE	NUCLIDE	CDE (Sv)	WCDE (Sv)
		H - 3	10030	7.70E-07	7.70E-09
		TOTAL H (ATOMIC NO 1)		7.70E-07	7.70E-09

	Co - 60	270600	2.19E-04	2.19E-06
	TOTAL Co (ATOMIC NO 27)		2.19E-04	2.19E-06
	I - 129	531290	1.84E-04	1.84E-06
	TOTAL I (ATOMIC NO 53)		1.84E-04	1.84E-06
TOTAL SKIN	INGESTION =		4.04E-04	4.04E-06

BRAIN	INGESTION	ISOTOPE	NUCLIDE	CDE (Sv)	WCDE (Sv)
		H - 3	10030	7.70E-07	4.62E-08
		TOTAL H (ATOMIC NO 1)		7.70E-07	4.62E-08
	TOTAL BRAIN		INGESTION =	7.70E-07	4.62E-08

THYMUS	INGESTION	ISOTOPE	NUCLIDE	CDE (Sv)	WCDE (Sv)
		H - 3	10030	7.70E-07	4.62E-08
		TOTAL H (ATOMIC NO 1)		7.70E-07	4.62E-08
		Co - 60	270600	3.26E-04	1.95E-05
		TOTAL Co (ATOMIC NO 27)		3.26E-04	1.95E-05
		I - 129	531290	3.06E-04	1.84E-05
		TOTAL I (ATOMIC NO 53)		3.06E-04	1.84E-05
	TOTAL THYMUS		INGESTION =	6.33E-04	3.80E-05

BL WALL	INGESTION	ISOTOPE	NUCLIDE	CDE (Sv)	WCDE (Sv)
		H - 3	10030	7.70E-07	4.62E-08
		TOTAL H (ATOMIC NO 1)		7.70E-07	4.62E-08
		Co - 60	270600	4.10E-04	2.46E-05

DOWNWIND DISTANCE = 1.000E+04 BL WALL INGESTION DOSE EQUIVALENT

BL WALL	INGESTION	ISOTOPE	NUCLIDE	CEDE (Sv)	
		TOTAL Co (ATOMIC NO 27)		4.10E-04	2.46E-05
		I - 129	531290	1.18E-04	7.07E-06
		TOTAL I (ATOMIC NO 53)		1.18E-04	7.07E-06
	TOTAL BL WALL		INGESTION =	5.29E-04	3.17E-05

ADRENALS INGESTION	ISOTOPE	NUCLIDE	CDE (Sv)	WCDE (Sv)
	H - 3	10030	7.70E-07	4.62E-08
	TOTAL H (ATOMIC NO 1)		7.70E-07	4.62E-08
	Co - 60	270600	5.40E-04	3.24E-05
	TOTAL Co (ATOMIC NO 27)		5.40E-04	3.24E-05
	I - 129	531290	1.15E-04	6.91E-06
	TOTAL I (ATOMIC NO 53)		1.15E-04	6.91E-06
	TOTAL ADRENALS INGESTION =		6.56E-04	3.94E-05

ESOPHAGU INGESTION	ISOTOPE	NUCLIDE	CDE (Sv)	WCDE (Sv)
	H - 3	10030	7.70E-07	4.62E-08
	TOTAL H (ATOMIC NO 1)		7.70E-07	4.62E-08
	Co - 60	270600	3.26E-04	1.95E-05
	TOTAL Co (ATOMIC NO 27)		3.26E-04	1.95E-05
	I - 129	531290	3.06E-04	1.84E-05
	TOTAL I (ATOMIC NO 53)		3.06E-04	1.84E-05
	TOTAL ESOPHAGU INGESTION =		6.33E-04	3.80E-05

DOWNWIND DISTANCE = 1.000E+04 OVARIES INGESTION DOSE EQUIVALENT

OVARIES INGESTION	ISOTOPE	NUCLIDE	CDE (Sv)	WCDE (Sv)
	H - 3	10030	7.70E-07	1.92E-07
	TOTAL H (ATOMIC NO 1)		7.70E-07	1.92E-07
	Co - 60	270600	4.47E-04	1.12E-04
	TOTAL Co (ATOMIC NO 27)		4.47E-04	1.12E-04
	I - 129	531290	1.20E-04	3.01E-05
	TOTAL I (ATOMIC NO 53)		1.20E-04	3.01E-05
	TOTAL OVARIES INGESTION =		5.68E-04	1.42E-04

UTERUS INGESTION	ISOTOPE	NUCLIDE	CDE (Sv)	WCDE (Sv)
	H - 3	10030	7.70E-07	4.62E-08

	TOTAL H (ATOMIC NO 1)		7.70E-07	4.62E-08
	Co - 60	270600	4.41E-04	2.64E-05
	TOTAL Co (ATOMIC NO 27)		4.41E-04	2.64E-05
	I - 129	531290	1.20E-04	7.23E-06
	TOTAL I (ATOMIC NO 53)		1.20E-04	7.23E-06
	TOTAL UTERUS INGESTION =		5.62E-04	3.37E-05

CEDE	INGESTION	ISOTOPE	NUCLIDE	CEDE (Sv)
		H - 3	10030	7.70E-07
		TOTAL H (ATOMIC NO 1)		7.70E-07
		Co - 60	270600	4.50E-04
		TOTAL Co (ATOMIC NO 27)		4.50E-04
		I - 129	531290	6.51E-02
		TOTAL I (ATOMIC NO 53)		6.51E-02
		TOTAL CEDE INGESTION =		6.56E-02

&& INGESTION COMMITTED DOSE EQUIVALENTS ORDERED BY ORGAN (Sv)

ORGAN	NO.	DOWNWIND DISTANCES (m) 1.00E+04
LUNGS	1	4.51E-04
S WALL	2	5.54E-04
SI WALL	3	6.30E-04
ULI WALL	4	7.17E-04
LLI WALL	5	9.57E-04
TESTES	6	4.48E-04
BREASTS	7	6.04E-04
BONE SUR	8	4.88E-04
R MARROW	9	5.33E-04
THYROID	10	2.17E+00
KIDNEYS	11	5.14E-04
LIVER	12	9.13E-04
SPLEEN	13	4.68E-04
PANCREAS	14	5.09E-04
MUSCLE	15	6.04E-04
SKIN	16	4.04E-04
BRAIN	17	7.70E-07
THYMUS	18	6.33E-04
BL WALL	19	5.29E-04
ADRENALS	20	6.56E-04

ESOPHAGU	21	6.33E-04
OVARIES	22	5.68E-04
UTERUS	23	5.62E-04

&& INGESTION COMMITTED DOSE EQUIVALENCES ORDERED BYDOSE (Sv)

ORGAN	NO.	DOWNWIND DISTANCES (m) 1.00E+04
THYROID	10	2.17E+00
LLI WALL	5	9.57E-04
LIVER	12	9.13E-04
ULI WALL	4	7.17E-04
ADRENALS	20	6.56E-04
THYMUS	18	6.33E-04
ESOPHAGU	21	6.33E-04
SI WALL	3	6.30E-04
BREASTS	7	6.04E-04
MUSCLE	15	6.04E-04
OVARIES	22	5.68E-04
UTERUS	23	5.62E-04
S WALL	2	5.54E-04
R MARROW	9	5.33E-04
BL WALL	19	5.29E-04
KIDNEYS	11	5.14E-04
PANCREAS	14	5.09E-04
BONE SUR	8	4.88E-04
SPLEEN	13	4.68E-04
LUNGS	1	4.51E-04
TESTES	6	4.48E-04
SKIN	16	4.04E-04
BRAIN	17	7.70E-07

&& INGESTION WEIGHTED COMMITTED DOSE EQUIVALENTS (Sv)

ORGAN	NO.	DOWNWIND DISTANCES (m) 1.00E+04
LUNGS	1	5.42E-05
S WALL	2	3.32E-05
SI WALL	3	3.78E-05
ULI WALL	4	4.30E-05
LLI WALL	5	5.74E-05
TESTES	6	1.12E-04
BREASTS	7	9.06E-05
BONE SUR	8	1.46E-05
R MARROW	9	6.40E-05
THYROID	10	6.50E-02
KIDNEYS	11	3.08E-05
LIVER	12	5.48E-05
SPLEEN	13	2.81E-05

PANCREAS	14	3.05E-05
MUSCLE	15	3.62E-05
SKIN	16	4.04E-06
BRAIN	17	4.62E-08
THYMUS	18	3.80E-05
BL WALL	19	3.17E-05
ADRENALS	20	3.94E-05
ESOPHAGU	21	3.80E-05
OVARIES	22	1.42E-04
UTERUS	23	3.37E-05
CEDE	24	6.56E-02

EXECUTION TIME = 4.95E+00 SECONDS

ATTACHMENT # 2

INHALATION, see (1) and (2) in Section 6.2.2 of the software validation report

t_r	900	s	max duration for Hilsmeier-Gifford, see p. 4-18 of RSAC-6 manual
x	10,000	m	assumption
Q	0.001111111	Ci/s	assumed 1 Ci released over time duration, t_r
u	1	m/s	assumption
σ_y	300	m	from p. C-2 of RSAC-6 manual, Hilsmeier-Gifford
σ_z	50	m	from p. C-3 of RSAC-6 manual, Hilsmeier-Gifford
h	40	m	assumption
BR	3.33E-04	m^3/s	

Chi	1.71E-08	Ci/m^3
Chi/Q	1.54E-05	s/m^3

	I-129	H-3	Co-60	
DCF_{inh} (FGR-11)	4.69E-08	1.73E-11	5.91E-08	Sv/Bq

Inhalation CEDE (Sv) Results

	I-129	H-3	Co-60
Validation calculation	8.90E-06	3.28E-09	1.12E-05
RSAC6 result	8.08E-06	5.19E-09	1.17E-05
Validation-to-RSAC6 ratio	1.1	0.63	1.0

GROUND SURFACE (for 1 yr following the release), see (1) and (3) in Section 6.2.2 of the software validation report

t_e	31557600	s	assumed one-year exposure
f_{shield}	0.7	unitless	assumption
A_0	3.70E+10	Bq	assumed 1 Ci released

	I-129	H-3	Co-60	
$DRCF_{gs}$ (FGR-12)	2.58E-17	0.00E+00	2.35E-15	Sv m^2 / Bq s
V_d	0.01	0.01	0.001	m/s
λ (RHH, 1970)	2.20E-15	1.79E-09	4.17E-09	1/s

Ground Surface EDE (Sv) Results

	I-129	H-3	Co-60
Validation calculation	3.25E-06	0.00E+00	2.77E-05
RSAC6 result	3.22E-06	0.00E+00	3.15E-05
Validation-to-RSAC6 ratio	1.0	n/a	0.88

SUBMERSION, see (1) and (4) in Section 6.2.2 of the software validation report

	I-129	H-3	Co-60	
$DRCF_{sub}$ (FGR-12)	3.80E-16	3.31E-19	1.26E-13	Sv m^3 / Bq s

Submersion EDE (Sv) Results

	I-129	H-3	Co-60
Validation calculation	2.17E-10	1.89E-13	7.18E-08
RSAC6 result	2.15E-10	none	8.16E-08
Validation-to-RSAC6 ratio	1.0	n/a*	0.88

** RSAC6 does not calculate a submerison dose for H-3, so quantitative comparison cannot be made. It should be noted that the submersion DRCF and resulting EDE are orders of magnitude smaller than the other radionuclides.*

INGESTION (for 1 yr following the release), see (1) and (5)-(9) in Sec. 6.2.2 of the software validation report

f_{contam}	1	unitless	$U_{leafveg}$	64	kg/yr
Y_{veg}	2	kg/m^2	$U_{nonleafveg}$	520	kg/yr
Y_{forage}	0.28	kg/m^2	U_{milk}	310	L/yr
ϕ	225	kg/m^2	U_{meat}	110	kg/yr
			U_{feed}	16	kg/day

	I-129	H-3	Co-60	
DCF_{ing} (FGR-11)	7.46E-08	1.73E-11	2.77E-09	Sv/Bq
$f_{int,forage}$	1.00	0.57	0.57	unitless
$f_{int,veg}$	0.20	0.20	0.20	unitless
$f_{trans,leafveg}$	1.00	1.00	1.00	unitless
$f_{trans,nonleaf}$	0.10	1.00	1.00	unitless
$f_{trans,forage}$	1.00	1.00	1.00	unitless
$B_{produce}$	2.10E-02	0.00	3.00E-03	Bq/kg crop per Bq/kg soil
B_{forage}	1.50E-02	0.00	2.00E-02	Bq/kg crop per Bq/kg soil
F_{milk}	1.00E-02	0.00	2.00E-03	Bq/L milk per Bq/day feed
F_{meat}	7.00E-03	0.00	2.00E-02	Bq/kg meat per Bq/day feed
$D_{leafveg}$	2.72E-03	6.31E-07	1.01E-05	Sv for 1 year following the release
$D_{nonleafveg}$	2.23E-03	0.00E+00	8.21E-05	Sv for 1 year following the release
D_{milk}	7.53E-02	0.00E+00	3.19E-05	Sv for 1 year following the release
D_{meat}	1.87E-02	0.00E+00	1.13E-04	Sv for 1 year following the release

Ingestion CEDE (Sv) Results

	I-129	H-3	Co-60
Validation calculation	9.90E-02	6.31E-07	2.37E-04
RSAC6 result	6.51E-02	7.70E-07	4.50E-04
Validation-to-RSAC6 ratio	1.5	0.82	0.53

REFERENCES

FGR-11 EPA. Federal Guidance Report No. 11, EPA 520/1–88–020, "Limiting Values of Radionuclide Intake and Air Concentration and Dose Conversion Factors for Inhalation, Submersion, and Ingestion." Washington, DC: EPA. Office of Radiation Programs. 1988.

FGR-12 EPA. Federal Guidance Report No. 12, EPA 402–R–93–081, "External Exposure to Radionuclides in Air, Water, and Soil." Washington, DC: EPA. 1993.

RHH, 1970 U.S. Department of Health, Education, and Welfare. "Radiological Health Handbook." Rockville, Maryland: U.S. Department of Health, Education, and Welfare. Public Health Service. Bureau of Radiological Health. 1970

RSAC-6 manual Wenzel, D.R., Schrader, B.J. "The Radiological Safety Analysis Computer Program (RSAC–6) User's Manual." INEEL/EXT-01-00540. Idaho Falls, Idaho: Idaho National Engineering and Environmental Laboratory. 2001.

ATTACHMENT # 3

```
 EXAMPLE2     RSAC-6 INPUT     07/29/03     08:22
0        1         2         3         4         5         6         7
12345678901234567890123456789012345678901234567890123456789012345678901234567890123456789

* Calculation of inhalation dose
# Requesting direct input of only Sr-90 and Y-90
2000,0
SR 90,2.
Y 90,2.
2999
# Meteorological data input
5000
5001,4.5,0,1000.,1.099E3,0,0
5002,0.001,0.01,0,0.001,0.001
5101,1.E2,1.5E2
5201,0.001111,0
5400,1,40.,10.
5401,15.,8.,20.,11.
5999
# Calculate inhalation dose
7000,0,2,1,1,2
7001,3.33E-4,0,0,0,0.25
7002,1,4,5,24
7081,38,39
7999
10000

0        1         2         3         4         5         6         7
12345678901234567890123456789012345678901234567890123456789012345678901234567890123456789
              RADIOLOGICAL SAFETY ANALYSIS COMPUTER PROGRAM (RSAC-6)
 (RSAC-6, REV 6.1, 03/07/01)  SERIAL 9999  DATE 07/29/2003  TIME 08:22 PAGE   1
 EXAMPLE2:  Calculation of inhalation dose

***DIRECT RADIONUCLIDE INPUT

        ANY PREVIOUS INVENTORY HAS BEEN ZEROED

     NUCLIDE          HALF LIFE       CURIES

  380900  Sr 90    2.878E+01  yr    2.000E+00
  390900   Y 90    6.410E+01  h     2.000E+00

***METEOROLOGICAL DATA

        MEAN WIND SPEED = 4.500E+00 (m/s)    STACK HEIGHT = 0.000E+00 (m)
    MIXING LAYER HEIGHT = 1.000E+03 (m)       AIR DENSITY = 1.099E+03 (g/cu m)
    WET DEPOSITION SCAVENGING COEFFICIENT = 0.000E+00 (1/S)

    NO CORRECTION IS BEING MADE FOR PLUME DEPLETION BY FALLOUT

    DRY DEPOSITION VELOCITIES (m/s)
         SOLIDS = 1.000E-03    HALOGENS = 1.000E-02   NOBLE GASES = 0.000E+00
         CESIUM = 1.000E-03   RUTHENIUM = 1.000E-03

    THERE IS 1 SET OF LEAKAGE CONSTANTS (K1,K2)
          1.111E-03       0.000E+00
```

BUILDING WIDTH = 4.000E+01 (m) BUILDING HEIGHT = 1.000E+01 (m)

DOWNWIND DISTANCE	STACK HEIGHT (m)	EFFECTIVE SIGY (m)	EFFECTIVE SIGZ (m)	CHI/Q (s/cu m)
1.000E+02	0.000E+00	2.203E+01	9.315E+00	3.447E-04
1.500E+02	0.000E+00	3.114E+01	1.293E+01	1.757E-04

*** INHALATION DOSE EQUIVALENT CALCULATION

USING DOSE CONVERSION FACTORS FROM FEDERAL GUIDANCE REPORT 11

RESPIRABLE FRACTION = 2.500E-01
BREATHING RATE = 3.330E-04 (cu m/s)
RELEASE TIME FOR EXPONENTIAL DECAY FUNCTION = 9.001E+02 (s)
INTERNAL EXPOSURE TIME PERIOD = 5.000E+01 (yr)

PARTICLE SIZE = 1.0 MICRON AMAD
LUNG DEPOSITION FRACTIONS: N-P = 0.300 T-B = 0.080 P = 0.250

DEFAULT ELEMENT LUNG CLEARANCE CLASSES SELECTED TO GIVE MAXIMUM DOSE
LUNG CLEARANCE CLASSES USED IN CALCULATIONS

ELEMENT	CLASS	ELEMENT	CLASS
38 Sr	Y	39 Y	Y

DOWNWIND DISTANCE = 1.000E+02 (m) PLUME TRAVEL TIME = 2.222E+01 (s)
CHI/Q = 3.447E-04 (s/cu m)

LUNGS INHALATION	ISOTOPE	NUCLIDE	CDE(rem)	WCDE (rem)
	Sr - 90	380900	6.07E-01	7.29E-02
	TOTAL Sr (ATOMIC NO 38)		6.07E-01	7.29E-02
	Y - 90	390900	1.98E-03	2.37E-04
	TOTAL Y (ATOMIC NO 39)		1.98E-03	2.37E-04
TOTAL LUNGS INHALATION =			6.09E-01	7.31E-02

ULI WALL INHALATION	ISOTOPE	NUCLIDE	CDE(rem)	WCDE (rem)
	Sr - 90	380900	1.29E-03	7.73E-05
	TOTAL Sr (ATOMIC NO 38)		1.29E-03	7.73E-05
	Y - 90	390900	1.12E-03	6.74E-05
	TOTAL Y (ATOMIC NO 39)		1.12E-03	6.74E-05
TOTAL ULI WALL INHALATION =			2.41E-03	1.45E-04

LLI WALL INHALATION	ISOTOPE	NUCLIDE	CDE(rem)	WCDE (rem)

	Sr - 90	380900	4.37E-03	2.62E-04
	TOTAL Sr (ATOMIC NO 38)		4.37E-03	2.62E-04
	Y - 90	390900	2.68E-03	1.61E-04
	TOTAL Y (ATOMIC NO 39)		2.68E-03	1.61E-04
	TOTAL LLI WALL INHALATION =		7.05E-03	4.23E-04

CEDE INHALATION	ISOTOPE	NUCLIDE	CEDE(rem)
	Sr - 90	380900	7.45E-02
	TOTAL Sr (ATOMIC NO 38)		7.45E-02
	Y - 90	390900	4.84E-04
	TOTAL Y (ATOMIC NO 39)		4.84E-04

DOWNWIND DISTANCE = 1.000E+02 CEDE INHALATION DOSE EQUIVALENT

TOTAL CEDE INHALATION = 7.50E-02

DOWNWIND DISTANCE = 1.500E+02 (m) PLUME TRAVEL TIME = 3.333E+01 (s)
CHI/Q = 1.757E-04 (s/cu m)

LUNGS INHALATION	ISOTOPE	NUCLIDE	CDE(rem)	WCDE (rem)
	Sr - 90	380900	3.10E-01	3.71E-02
	TOTAL Sr (ATOMIC NO 38)		3.10E-01	3.71E-02
	Y - 90	390900	1.01E-03	1.21E-04
	TOTAL Y (ATOMIC NO 39)		1.01E-03	1.21E-04
	TOTAL LUNGS INHALATION =		3.11E-01	3.73E-02

ULI WALL INHALATION	ISOTOPE	NUCLIDE	CDE(rem)	WCDE (rem)
	Sr - 90	380900	6.57E-04	3.94E-05
	TOTAL Sr (ATOMIC NO 38)		6.57E-04	3.94E-05
	Y - 90	390900	5.73E-04	3.44E-05
	TOTAL Y (ATOMIC NO 39)		5.73E-04	3.44E-05
	TOTAL ULI WALL INHALATION =		1.23E-03	7.38E-05

LLI WALL INHALATION	ISOTOPE	NUCLIDE	CDE(rem)	WCDE (rem)

Sr - 90	380900	2.23E-03	1.34E-04
TOTAL Sr (ATOMIC NO 38)		2.23E-03	1.34E-04
Y - 90	390900	1.36E-03	8.18E-05
TOTAL Y (ATOMIC NO 39)		1.36E-03	8.18E-05
TOTAL LLI WALL INHALATION =		3.59E-03	2.16E-04

DOWNWIND DISTANCE = 1.500E+02 CEDE INHALATION DOSE EQUIVALENT

CEDE INHALATION	ISOTOPE	NUCLIDE	CEDE(rem)
Sr - 90		380900	3.80E-02
TOTAL Sr (ATOMIC NO 38)			3.80E-02
Y - 90		390900	2.47E-04
TOTAL Y (ATOMIC NO 39)			2.47E-04
TOTAL CEDE INHALATION =			3.82E-02

&& INHALATION COMMITTED DOSE EQUIVALENTS ORDERED BY ORGAN (rem)

		DOWNWIND DISTANCES (m)	
ORGAN	NO.	1.00E+02	1.50E+02
LUNGS	1	6.09E-01	3.11E-01
ULI WALL	4	2.41E-03	1.23E-03
LLI WALL	5	7.05E-03	3.59E-03

&& INHALATION COMMITTED DOSE EQUIVALENCES ORDERED BYDOSE (rem)

		DOWNWIND DISTANCES (m)	
ORGAN	NO.	1.00E+02	1.50E+02
LUNGS	1	6.09E-01	3.11E-01
ULI WALL	4	2.41E-03	1.23E-03
LLI WALL	5	7.05E-03	3.59E-03

&& INHALATION WEIGHTED COMMITTED DOSE EQUIVALENTS (rem)

		DOWNWIND DISTANCES (m)	
ORGAN	NO.	1.00E+02	1.50E+02
LUNGS	1	7.31E-02	3.73E-02
ULI WALL	4	1.45E-04	7.38E-05
LLI WALL	5	4.23E-04	2.16E-04

CEDE 24 7.50E-02 3.82E-02

EXECUTION TIME = 1.70E-01 SECONDS

```
 EXAMPLE3     RSAC-6 INPUT     07/29/03     08:23
0        1         2         3         4         5         6         7
12345678901234567890123456789012345678901234567890123456789012345678901234567890123456789

* Ingestion dose calculation from an acute release
# Direct input of Pu-238, Pu-239 and Am-141
2000,0
PU238,0.72
PU239,0.18
AM241,0.045
2999
# Decay radionuclide inventory
1000
1001,1,0,0
1003,6.3115E8,0,0
1999
# Meteorological data
5000
5001,4.,0,2000.,1.099E3,0,0
5002,0.001,0.01,0,0.001,0.001
5101,1.E4,5.E4
5201,1.,0
5400,3,0,0,0
5421,2.1E-6,3.2E-7
5999
# Ingestion dose calculation
7000,3,-2,2,1,1
7001,3.33E-4,0,0,0
7004,1,2,1.,7.
7051,520.,64.,110.,310.,0.5,0.75
7052,0.57,0.2,1.,0.0021,60.,30.,1.
7053,225.,60.,1.,16.,2.,20.
7054,0.4,0.43,90.,2.,0.28,4.9
7055,.5,.33,0.5,.33
7081,94,95
7999
10000

0        1         2         3         4         5         6         7
12345678901234567890123456789012345678901234567890123456789012345678901234567890123456789
              RADIOLOGICAL SAFETY ANALYSIS COMPUTER PROGRAM (RSAC-6)
 (RSAC-6, REV 6.1, 03/07/01)  SERIAL 9999  DATE 07/29/2003  TIME 08:23 PAGE   1
 EXAMPLE3:  Ingestion dose calculation from an acute release

***DIRECT RADIONUCLIDE INPUT

        ANY PREVIOUS INVENTORY HAS BEEN ZEROED

     NUCLIDE          HALF LIFE       CURIES

  942380  Pu238    8.770E+01  yr    7.200E-01
  942390  Pu239    2.411E+04  yr    1.800E-01
  952410  Am241    4.322E+02  yr    4.500E-02

***FISSION PRODUCT CALCULATION

    RADIONUCLIDE INVENTORY HAS BEEN DECAYED FOR  6.312E+08 SECONDS
```

TOTAL RADIONUCLIDE REMAINING = 3.101E+10 D/s OR 8.382E-01 Ci

***METEOROLOGICAL DATA

MEAN WIND SPEED = 4.000E+00 (m/s) STACK HEIGHT = 0.000E+00 (m)
MIXING LAYER HEIGHT = 2.000E+03 (m) AIR DENSITY = 1.099E+03 (g/cu m)
WET DEPOSITION SCAVENGING COEFFICIENT = 0.000E+00 (1/S)

NO CORRECTION IS BEING MADE FOR PLUME DEPLETION BY FALLOUT

DRY DEPOSITION VELOCITIES (m/s)
SOLIDS = 1.000E-03 HALOGENS = 1.000E-02 NOBLE GASES = 0.000E+00
CESIUM = 1.000E-03 RUTHENIUM = 1.000E-03

THERE IS 1 SET OF LEAKAGE CONSTANTS (K1,K2)
1.000E+00 0.000E+00

CHI/Q VALUES INPUT DIRECTLY

DOWNWIND DISTANCE	CHI/Q
1.000E+04	2.100E-06
5.000E+04	3.200E-07

*** INGESTION DOSE EQUIVALENT CALCULATION

USING DOSE CONVERSION FACTORS FROM FEDERAL GUIDANCE REPORT 11

RELEASE TIME FOR EXPONENTIAL DECAY FUNCTION = 1.000E+00 (s)
INTERNAL EXPOSURE TIME PERIOD = 5.000E+01 (yr)

INGESTION CALCULATIONS MADE USING USER SUPPLIED CONSTANTS

INGESTION CONSTANTS:
5.20E+02 STORED VEGETABLE USAGE FACTOR (Kg/yr)
6.40E+01 FRESH VEGETABLE USAGE FACTOR (Kg/yr)
1.10E+02 MEAT USAGE FACTOR (Kg/yr)
3.10E+02 MILK USAGE FACTOR (L/yr)
5.00E-01 FRACTION OF STORED VEGETABLES FROM GARDEN
7.50E-01 FRACTION OF FRESH VEGETABLES FROM GARDEN

5.70E-01 RETENTION FACTOR FOR ACTIVITY ON FORAGE
2.00E-01 RETENTION FACTOR FOR ACTIVITY ON VEGETABLES
1.00E+00 RETENTION FACTOR FOR IODINES
2.10E-03 REMOVAL RATE CONSTANT FOR CROPS (1/h)
6.00E+01 VEGETABLE EXPOSURE TIME TO PLUME FOR CHRONIC RELEASE (d)
3.00E+01 FORAGE EXPOSURE TIME TO PLUME FOR CHRONIC RELEASE (d)
1.00E+00 HTO REMOVAL HALF TIME (d)
2.25E+02 EFFECTIVE SURFACE SOIL DENSITY (Kg/sq m)
6.00E+01 STORED VEGETABLE HOLDUP TIME AFTER HARVEST (d)
1.00E+00 FRESH VEGETABLE HOLDUP TIME AFTER HARVEST (d)
1.60E+01 ANIMALS DAILY FORAGE FEED (Kg/d)
2.00E+00 FEED-MILK-RECEPTOR TRANSFER TIME (d)
2.00E+01 SLAUGHTER TO CONSUMPTION TIME (d)
4.00E-01 FRACTION OF YEAR ON PASTURE

4.30E-01 PASTURE FEED FRACTION
9.00E+01 STORED FEED STORAGE TIME
2.00E+00 VEGETABLE VEGETATION YIELD (Kg/sq m)
2.80E-01 FORAGE VEGETATION YIELD (Kg/sq m)
4.90E+00 ABSOLUTE HUMIDITY (g/cu m)

ACUTE RELEASE OVER 1.000E+00 (d)
HARVEST DURATION TIME OF 7.000E+00 (d) AFTER ACUTE RELEASE
CONSUMPTION OF CROPS GROWN ON CONTAMINATED SOIL FOR 1.500E+01 (Y)

FRACTIONS OF ANNUAL VEGETABLES AND FORAGE CONTAMINATED BY ACUTE RELEASE
5.0E-01 STORED VEGETABLES
3.3E-01 FRESH VEGETABLES
5.0E-01 STORED FEED
3.3E-01 PASTURE FEED

INGESTION TRANSFER CONSTANTS

ELEMENT		BV1 FORAGE/ SOIL (dry)	BV2 VEG/SOIL (wet)	FM MILK (d/L)	FF MEAT (d/kg)	TRANS-LOCATION
H	1	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.0E+00
He	2	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.0E+00
Li	3	2.5E-02	1.7E-03	2.0E-02	1.0E-02	1.0E+00
Be	4	1.0E-02	6.4E-04	9.0E-07	1.0E-03	1.0E+00
B	5	4.0E+00	8.6E-01	1.5E-03	8.0E-04	1.0E+00
C	6	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.0E+00
N	7	3.0E+01	1.3E+01	2.5E-02	7.5E-02	1.0E+00
O	8	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.0E+00
F	9	6.0E-02	2.6E-03	1.0E-03	1.5E-01	1.0E+00
Ne	10	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.0E+00
Na	11	7.5E-02	2.4E-02	3.5E-02	5.5E-02	1.0E+00
Mg	12	1.0E+00	2.4E-01	4.0E-03	5.0E-03	1.0E+00
Al	13	4.0E-03	2.8E-04	2.0E-04	1.5E-03	1.0E+00
Si	14	3.5E-01	3.0E-02	2.0E-05	4.0E-05	1.0E+00
P	15	3.5E+00	1.5E+00	1.5E-02	5.5E-02	1.0E+00
S	16	1.5E+00	6.4E-01	1.5E-02	1.0E-01	1.0E+00
Cl	17	7.0E+01	3.0E+01	1.5E-02	8.0E-02	1.0E+00
Ar	18	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.0E+00
K	19	1.0E+00	2.4E-01	7.0E-03	2.0E-02	1.0E+00
Ca	20	3.5E+00	1.5E-01	1.0E-02	7.0E-04	1.0E+00

ELEMENT		BV1 FORAGE/ SOIL (dry)	BV2 VEG/SOIL (wet)	FM MILK (d/L)	FF MEAT (d/kg)	TRANS-LOCATION
Sc	21	6.0E-03	4.3E-04	5.0E-06	1.5E-02	1.0E+00
Ti	22	5.5E-03	1.3E-03	1.0E-02	3.0E-02	1.0E+00
V	23	5.5E-03	1.3E-03	2.0E-05	2.5E-03	1.0E+00
Cr	24	7.5E-03	1.9E-03	1.5E-03	5.5E-03	1.0E+00
Mn	25	2.5E-01	2.1E-02	3.5E-04	4.0E-04	1.0E+00
Fe	26	4.0E-03	4.3E-04	2.5E-04	2.0E-02	1.0E+00
Co	27	2.0E-02	3.0E-03	2.0E-03	2.0E-02	1.0E+00

Ni	28	6.0E-02	2.6E-02	1.0E-03	6.0E-03	1.0E+00
Cu	29	4.0E-01	1.1E-01	1.5E-03	1.0E-02	1.0E+00
Zn	30	1.5E+00	3.9E-01	1.0E-02	1.0E-01	1.0E+00
Ga	31	4.0E-03	1.7E-04	5.0E-05	5.0E-04	1.0E+00
Ge	32	4.0E-01	3.4E-02	7.0E-02	7.0E-01	1.0E+00
As	33	4.0E-02	2.6E-03	6.0E-05	2.0E-03	1.0E+00
Se	34	2.5E-02	1.1E-02	4.0E-03	1.5E-02	1.0E+00
Br	35	1.5E+00	6.4E-01	2.0E-02	2.5E-02	1.0E+00
Kr	36	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.0E+00
Rb	37	1.5E-01	3.0E-02	1.0E-02	1.5E-02	1.0E+00
Sr	38	2.5E+00	1.1E-01	1.5E-03	3.0E-04	1.5E-01
Y	39	1.5E-02	2.6E-03	2.0E-05	3.0E-04	1.0E+00
Zr	40	2.0E-03	2.1E-04	3.0E-05	5.5E-03	1.0E+00
Nb	41	2.0E-02	2.1E-03	2.0E-02	2.5E-01	1.0E+00
Mo	42	2.5E-01	2.6E-02	1.5E-03	6.0E-03	1.0E+00
Tc	43	9.5E+00	6.4E-01	1.0E-02	8.5E-03	1.0E+00
Ru	44	7.5E-02	8.6E-03	6.0E-07	2.0E-03	5.0E-02
Rh	45	1.5E-01	1.7E-02	1.0E-02	2.0E-03	1.0E+00
Pd	46	1.5E-01	1.7E-02	1.0E-02	4.0E-03	1.0E+00
Ag	47	4.0E-01	4.3E-02	2.0E-02	3.0E-03	1.0E+00
Cd	48	5.5E-01	6.4E-02	1.0E-03	5.5E-04	1.0E+00
In	49	4.0E-03	1.7E-04	1.0E-04	8.0E-03	1.0E+00
Sn	50	3.0E-02	2.6E-03	1.0E-03	8.0E-02	1.0E+00
Sb	51	2.0E-01	1.3E-02	1.0E-04	1.0E-03	1.0E+00
Te	52	2.5E-02	1.7E-03	2.0E-04	1.5E-02	1.0E+00
I	53	1.5E-01	2.1E-02	1.0E-02	7.0E-03	1.0E-01
Xe	54	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.0E+00
Cs	55	8.0E-02	1.3E-02	7.0E-03	2.0E-02	5.0E-01
Ba	56	1.5E-01	6.4E-03	3.5E-04	1.5E-04	1.0E+00
La	57	1.0E-02	1.7E-03	2.0E-05	3.0E-04	1.0E+00
Ce	58	1.0E-02	1.7E-03	2.0E-05	7.5E-04	3.0E-01
Pr	59	1.0E-02	1.7E-03	2.0E-05	3.0E-04	1.0E+00
Nd	60	1.0E-02	1.7E-03	2.0E-05	3.0E-04	1.0E+00
Pm	61	1.0E-02	1.7E-03	2.0E-05	5.0E-03	1.0E+00
Sm	62	1.0E-02	1.7E-03	2.0E-05	5.0E-03	1.0E+00
Eu	63	1.0E-02	1.7E-03	2.0E-05	5.0E-03	1.0E+00
Gd	64	1.0E-02	1.7E-03	2.0E-05	3.5E-03	1.0E+00
Tb	65	1.0E-02	1.7E-03	2.0E-05	4.5E-03	1.0E+00
Dy	66	1.0E-02	1.7E-03	2.0E-05	5.5E-03	1.0E+00
Ho	67	1.0E-02	1.7E-03	2.0E-05	4.5E-03	1.0E+00
Er	68	1.0E-02	1.7E-03	2.0E-05	4.0E-03	1.0E+00

ELEMENT		BV1 FORAGE/ SOIL (dry)	BV2 VEG/SOIL (wet)	FM MILK (d/L)	FF MEAT (d/kg)	TRANS- LOCATION
Tm	69	1.0E-02	1.7E-03	2.0E-05	4.5E-03	1.0E+00
Yb	70	1.0E-02	1.7E-03	2.0E-05	4.0E-03	1.0E+00
Lu	71	1.0E-02	1.7E-03	2.0E-05	4.5E-03	1.0E+00
Hf	72	3.5E-03	3.6E-04	5.0E-06	1.0E-03	1.0E+00
Ta	73	1.0E-02	1.1E-03	3.0E-06	6.0E-04	1.0E+00
W	74	4.5E-02	4.3E-03	3.0E-04	4.5E-02	1.0E+00
Re	75	1.5E+00	1.5E-01	1.5E-03	8.0E-03	1.0E+00
Os	76	1.5E-02	1.5E-03	5.0E-03	4.0E-01	1.0E+00

Ir	77	5.5E-02	6.4E-03	2.0E-06	1.5E-03	1.0E+00
Pt	78	9.5E-02	1.1E-02	5.0E-03	4.0E-03	1.0E+00
Au	79	4.0E-01	4.3E-02	5.5E-06	8.0E-03	1.0E+00
Hg	80	9.0E-01	8.6E-02	4.5E-04	2.5E-01	1.0E+00
Tl	81	4.0E-03	1.7E-04	2.0E-03	4.0E-02	1.0E+00
Pb	82	4.5E-02	3.9E-03	2.5E-04	3.0E-04	1.0E+00
Bi	83	3.5E-02	2.1E-03	5.0E-04	4.0E-04	1.0E+00
Po	84	2.5E-03	1.7E-04	3.5E-04	9.5E-05	1.0E+00
At	85	1.0E+00	6.4E-02	1.0E-02	1.0E-02	1.0E+00
Rn	86	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.0E+00
Fr	87	3.0E-02	3.4E-03	2.0E-02	2.5E-03	1.0E+00
Ra	88	1.5E-02	6.4E-04	4.5E-04	2.5E-04	1.0E+00
Ac	89	3.5E-03	1.5E-04	2.0E-05	2.5E-05	1.0E+00
Th	90	8.5E-04	3.6E-05	5.0E-06	6.0E-06	1.0E+00
Pa	91	2.5E-03	1.1E-04	5.0E-06	1.0E-05	1.0E+00
U	92	8.5E-03	1.7E-03	6.0E-04	2.0E-04	1.0E+00
Np	93	1.0E-01	4.3E-03	5.0E-06	5.5E-05	1.0E+00
Pu	94	4.5E-04	1.9E-05	1.0E-07	5.0E-07	1.0E-02
Am	95	5.5E-03	1.1E-04	4.0E-07	3.5E-06	3.0E-01
Cm	96	8.5E-04	6.4E-06	2.0E-05	3.5E-06	3.0E-01
Bk	97	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cf	98	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Es	99	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Fm	100	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

DOWNWIND DISTANCE = 1.000E+04 (m) PLUME TRAVEL TIME = 2.500E+03 (s)
CHI/Q = 2.100E-06 (s/cu m)

DOWNWIND DISTANCE = 5.000E+04 (m) PLUME TRAVEL TIME = 1.250E+04 (s)
CHI/Q = 3.200E-07 (s/cu m)

&& INGESTION COMMITTED DOSE EQUIVALENTS ORDERED BY ORGAN (Sv)

		DOWNWIND DISTANCES (m)	
ORGAN	NO.	1.00E+04	5.00E+04
LUNGS	1	1.27E-09	1.93E-10
S WALL	2	1.34E-07	2.04E-08
SI WALL	3	3.33E-07	5.07E-08
ULI WALL	4	1.92E-06	2.93E-07
LLI WALL	5	5.88E-06	8.97E-07
TESTES	6	2.56E-05	3.90E-06
BREASTS	7	1.14E-09	1.74E-10
BONE SUR	8	1.73E-03	2.63E-04
R MARROW	9	1.39E-04	2.11E-05
THYROID	10	9.08E-10	1.38E-10
KIDNEYS	11	1.35E-09	2.05E-10
LIVER	12	3.15E-04	4.80E-05
SPLEEN	13	1.01E-09	1.54E-10
PANCREAS	14	1.39E-09	2.12E-10
MUSCLE	15	1.14E-09	1.74E-10
SKIN	16	9.66E-10	1.47E-10
BRAIN	17	1.08E-09	1.65E-10
THYMUS	18	9.16E-10	1.40E-10

BL WALL	19	1.06E-09	1.62E-10
ADRENALS	20	1.49E-09	2.27E-10
ESOPHAGU	21	9.16E-10	1.40E-10
OVARIES	22	2.56E-05	3.90E-06
UTERUS	23	1.18E-09	1.79E-10

&& INGESTION COMMITTED DOSE EQUIVALENCES ORDERED BYDOSE (Sv)

		DOWNWIND DISTANCES (m)	
ORGAN	NO.	1.00E+04	5.00E+04
BONE SUR	8	1.73E-03	2.63E-04
LIVER	12	3.15E-04	4.80E-05
R MARROW	9	1.39E-04	2.11E-05
TESTES	6	2.56E-05	3.90E-06
OVARIES	22	2.56E-05	3.90E-06
LLI WALL	5	5.88E-06	8.97E-07
ULI WALL	4	1.92E-06	2.93E-07
SI WALL	3	3.33E-07	5.07E-08
S WALL	2	1.34E-07	2.04E-08
ADRENALS	20	1.49E-09	2.27E-10
PANCREAS	14	1.39E-09	2.12E-10
KIDNEYS	11	1.35E-09	2.05E-10
LUNGS	1	1.27E-09	1.93E-10
UTERUS	23	1.18E-09	1.79E-10
BREASTS	7	1.14E-09	1.74E-10
MUSCLE	15	1.14E-09	1.74E-10
BRAIN	17	1.08E-09	1.65E-10
BL WALL	19	1.06E-09	1.62E-10
SPLEEN	13	1.01E-09	1.54E-10
SKIN	16	9.66E-10	1.47E-10
THYMUS	18	9.16E-10	1.40E-10
ESOPHAGU	21	9.16E-10	1.40E-10
THYROID	10	9.08E-10	1.38E-10

&& INGESTION WEIGHTED COMMITTED DOSE EQUIVALENTS (Sv)

		DOWNWIND DISTANCES (m)	
ORGAN	NO.	1.00E+04	5.00E+04
LUNGS	1	1.52E-10	2.32E-11
S WALL	2	8.04E-09	1.23E-09
SI WALL	3	2.00E-08	3.04E-09
ULI WALL	4	1.15E-07	1.76E-08
LLI WALL	5	3.53E-07	5.38E-08
TESTES	6	6.40E-06	9.75E-07
BREASTS	7	1.72E-10	2.61E-11
BONE SUR	8	5.18E-05	7.89E-06
R MARROW	9	1.66E-05	2.53E-06
THYROID	10	2.72E-11	4.15E-12
KIDNEYS	11	8.08E-11	1.23E-11

LIVER	12	1.89E-05	2.88E-06
SPLEEN	13	6.08E-11	9.27E-12
PANCREAS	14	8.34E-11	1.27E-11
MUSCLE	15	6.86E-11	1.05E-11
SKIN	16	9.66E-12	1.47E-12
BRAIN	17	6.48E-11	9.88E-12
THYMUS	18	5.50E-11	8.38E-12
BL WALL	19	6.38E-11	9.72E-12
ADRENALS	20	8.95E-11	1.36E-11
ESOPHAGU	21	5.50E-11	8.38E-12
OVARIES	22	6.40E-06	9.75E-07
UTERUS	23	7.05E-11	1.07E-11
CEDE	24	9.42E-05	1.44E-05

EXECUTION TIME = 2.20E-01 SECONDS

```
 EXAMPLE4     RSAC-6 INPUT     07/29/03     08:23
0        1         2         3         4         5         6         7
12345678901234567890123456789012345678901234567890123456789012345678901234567890123456789

* Ground surface dose calculation
# Direct input of Co-60
2000,0
CO 60,75.
2999
# fractionate inventory
1000
1001,1,0,0
1004,0,0.5
1999
# Meterological data input with user sigma's
5000
5001,6.,0,2000.,1.24E3,0,0
5002,0.001,0.01,0,0.001,0.001
5101,3.5E3
5201,1.,0
5400,2,0,0,0
5410,1,3,0
5999
# Ground surface dose calculation
7000,4,-2,1,1,1
7001,3.33E-4,0,1.,1.,0.2381
7081,27
7999
10000

0        1         2         3         4         5         6         7
12345678901234567890123456789012345678901234567890123456789012345678901234567890123456789
             RADIOLOGICAL SAFETY ANALYSIS COMPUTER PROGRAM (RSAC-6)
(RSAC-6, REV 6.1, 03/07/01)  SERIAL 9999  DATE 07/29/2003  TIME 08:23 PAGE   1
EXAMPLE4:  Ground surface dose calculation

***DIRECT RADIONUCLIDE INPUT

        ANY PREVIOUS INVENTORY HAS BEEN ZEROED

     NUCLIDE          HALF LIFE       CURIES

  270600  Co 60    5.271E+00  yr    7.500E+01

***FISSION PRODUCT CALCULATION

     FRACTION OF RADIONUCLIDE INVENTORY RELEASED =  5.000E-01

    TOTAL RADIONUCLIDE REMAINING =  1.388E+12  D/s OR  3.750E+01 Ci

***METEOROLOGICAL DATA

        MEAN WIND SPEED = 6.000E+00 (m/s)    STACK HEIGHT = 0.000E+00 (m)
    MIXING LAYER HEIGHT = 2.000E+03 (m)       AIR DENSITY = 1.240E+03 (g/cu m)
    WET DEPOSITION SCAVENGING COEFFICIENT = 0.000E+00 (1/S)

    NO CORRECTION IS BEING MADE FOR PLUME DEPLETION BY FALLOUT
```

DRY DEPOSITION VELOCITIES (m/s)
SOLIDS = 1.000E-03 HALOGENS = 1.000E-02 NOBLE GASES = 0.000E+00
CESIUM = 1.000E-03 RUTHENIUM = 1.000E-03

THERE IS 1 SET OF LEAKAGE CONSTANTS (K1,K2)
1.000E+00 0.000E+00

PASQUILL CLASS C METEOROLOGY, H-G SIGMA VALUES

NO BUILDING WAKE CORRECTION MADE

DOWNWIND DISTANCE	STACK HEIGHT (m)	SIGY (m)	SIGZ (m)	CHI/Q (s/cu m)
3.500E+03	0.000E+00	3.546E+02	1.979E+02	7.560E-07

*** GROUND SURFACE DEPOSITION DOSE EQUIVALENT CALCULATION

USING DOSE RATE CONVERSION FACTORS FROM FEDERAL GUIDANCE REPORT 12

OCCUPANCY FACTOR = 2.381E-01
TIME RECEPTOR IS EXPOSED TO CONTAMINATED SOIL = 1.000E+00 (yr)
BUILDING SHIELDING FACTOR = 1.000E+00
RELEASE TIME FOR EXPONENTIAL DECAY FUNCTION = 1.000E+00 SECONDS

DOWNWIND DISTANCE = 3.500E+03 (m) PLUME TRAVEL TIME = 5.833E+02 (s)
CHI/Q = 7.560E-07 (s/cu m)

&& GROUND SURFACE DOSE EQUIVALENTS ORDERED BY ORGAN (rem)

ORGAN	NO.	DOWNWIND DISTANCES (m) 3.50E+03
Lungs	1	1.62E-03
S Wall	2	1.56E-03
SI Wall	3	1.55E-03
ULI Wall	4	1.56E-03
LLI Wall	5	1.61E-03
Testes	6	1.75E-03
Breast	7	1.67E-03
BSurface	8	2.22E-03
R Marrow	9	1.67E-03
Thyroid	10	1.61E-03
Kidney	11	1.59E-03
Liver	12	1.57E-03
Spleen	13	1.57E-03
Pancreas	14	1.46E-03
Muscle	15	1.47E-03
Skin	16	1.97E-03
Brain	17	1.54E-03
Thymus	18	1.50E-03
U Bladd	19	1.59E-03
Adrenal	20	1.75E-03
Esophagu	21	1.42E-03

Ovaries	22	1.46E-03
Uterus	23	1.52E-03

EXAMPLE4: Ground surface dose calculation

&& GROUND SURFACE DOSE EQUIVALENCES ORDERED BY DOSE (rem)

		DOWNWIND DISTANCES (m)
ORGAN	NO.	3.50E+03
BSurface	8	2.22E-03
Skin	16	1.97E-03
Testes	6	1.75E-03
Adrenal	20	1.75E-03
Breast	7	1.67E-03
R Marrow	9	1.67E-03
Lungs	1	1.62E-03
LLI Wall	5	1.61E-03
Thyroid	10	1.61E-03
Kidney	11	1.59E-03
U Bladd	19	1.59E-03
Liver	12	1.57E-03
Spleen	13	1.57E-03
S Wall	2	1.56E-03
ULI Wall	4	1.56E-03
SI Wall	3	1.55E-03
Brain	17	1.54E-03
Uterus	23	1.52E-03
Thymus	18	1.50E-03
Muscle	15	1.47E-03
Pancreas	14	1.46E-03
Ovaries	22	1.46E-03
Esophagu	21	1.42E-03

EXAMPLE4: Ground surface dose calculation

&& GROUND SURFACE WEIGHTED DOSE EQUIVALENTS (rem)

		DOWNWIND DISTANCES (m)
ORGAN	NO.	3.50E+03
Lungs	1	1.95E-04
S Wall	2	9.35E-05
SI Wall	3	9.31E-05
ULI Wall	4	9.35E-05
LLI Wall	5	9.65E-05
Testes	6	4.38E-04
Breast	7	2.51E-04
BSurface	8	6.67E-05
R Marrow	9	2.00E-04
Thyroid	10	4.82E-05
Kidney	11	9.52E-05
Liver	12	9.39E-05
Spleen	13	9.39E-05
Pancreas	14	8.75E-05

Muscle	15	8.79E-05
Skin	16	1.97E-05
Brain	17	9.26E-05
Thymus	18	9.01E-05
U Bladd	19	9.52E-05
Adrenal	20	1.05E-04
Esophagu	21	8.49E-05
Ovaries	22	3.65E-04
Uterus	23	9.13E-05
EXT EDE	24	1.68E-03

EXECUTION TIME = 1.70E-01 SECONDS

```
 EXAMPLE5     RSAC-6 INPUT     07/29/03     08:24
0        1         2         3         4         5         6         7
12345678901234567890123456789012345678901234567890123456789012345678901234567890123456789

* Air immersion dose calculation
# Input of Xe-133 only
2000,0
XE133,1.E6
2999
# Meteorological data input
5000
5001,10.,50.,2500.,1.099E3,0,0
5101,1.E4,3.E4
5201,5.687E-5,5.687E-5
5400,2,0,0
5410,2,4,1
5411,1.22,0,20.,0
5999
# Air immersion, partial inventory release
7000,5,-2,1,1,1
7001,0,7.2E3,0,0
7081,54
7999
10000

0        1         2         3         4         5         6         7
12345678901234567890123456789012345678901234567890123456789012345678901234567890123456789
             RADIOLOGICAL SAFETY ANALYSIS COMPUTER PROGRAM (RSAC-6)
 (RSAC-6, REV 6.1, 03/07/01)  SERIAL 9999  DATE 07/29/2003  TIME 08:24 PAGE   1
 EXAMPLE5:  Air immersion dose calculation

***DIRECT RADIONUCLIDE INPUT

        ANY PREVIOUS INVENTORY HAS BEEN ZEROED

     NUCLIDE          HALF LIFE       CURIES

  541330  Xe133    5.243E+00  d     1.000E+06

***METEOROLOGICAL DATA

        MEAN WIND SPEED = 1.000E+01 (m/s)    STACK HEIGHT = 5.000E+01 (m)
    MIXING LAYER HEIGHT = 2.500E+03 (m)       AIR DENSITY = 1.099E+03 (g/cu m)
    WET DEPOSITION SCAVENGING COEFFICIENT = 0.000E+00 (1/S)

    NO CORRECTION IS BEING MADE FOR PLUME DEPLETION BY FALLOUT

    DRY DEPOSITION VELOCITIES (m/s)
         SOLIDS = 0.000E+00    HALOGENS = 0.000E+00   NOBLE GASES = 0.000E+00
         CESIUM = 0.000E+00   RUTHENIUM = 0.000E+00

    THERE IS 1 SET OF LEAKAGE CONSTANTS (K1,K2)
          5.687E-05       5.687E-05

    PASQUILL CLASS D METEOROLOGY, MARKEE SIGMA VALUES

    PLUME RISE CALCULATED USING JET CONDITIONS
```

STACK DIAMETER = 1.220E+00 (m)
EFFLUENT VELOCITY = 2.000E+01 (m/s)
RESTORING ACCELERATION = 0.000E+00 (1/sq s)

DOWNWIND DISTANCE	EFFECTIVE STACK HEIGHT (m)	SIGY (m)	SIGZ (m)	CHI/Q (s/cu m)
1.000E+04	5.732E+01	3.841E+02	2.998E+02	2.714E-07
3.000E+04	5.732E+01	8.322E+02	7.506E+02	5.081E-08

*** AIR IMMERSION DOSE EQUIVALENT CALCULATION

USING DOSE RATE CONVERSION FACTORS FROM FEDERAL GUIDANCE REPORT 12

RELEASE TIME FOR EXPONENTIAL DECAY FUNCTION = 7.200E+03 SECONDS
WARNING, EXPONENTIAL LEAKAGE CONSTANTS AND EXPONENTIAL DECAY TIME ARE NOT MATCHED, 3.36E+01 PERCENT OF INVENTORY RELEASED

DOWNWIND DISTANCE = 1.000E+04 (m) PLUME TRAVEL TIME = 1.000E+03 (s)
CHI/Q = 2.714E-07 (s/cu m)

DOWNWIND DISTANCE = 3.000E+04 (m) PLUME TRAVEL TIME = 3.000E+03 (s)
CHI/Q = 5.081E-08 (s/cu m)

&& AIR IMMERSION DOSE EQUIVALENTS ORDERED BY ORGAN (rem)

ORGAN	NO.	DOWNWIND DISTANCES (m) 1.00E+04	3.00E+04
Lungs	1	4.83E-04	9.02E-05
S Wall	2	4.03E-04	7.51E-05
SI Wall	3	3.10E-04	5.79E-05
ULI Wall	4	3.39E-04	6.33E-05
LLI Wall	5	3.14E-04	5.85E-05
Testes	6	5.89E-04	1.10E-04
Breast	7	7.17E-04	1.34E-04
BSurface	8	1.88E-03	3.50E-04
R Marrow	9	3.92E-04	7.31E-05
Thyroid	10	5.53E-04	1.03E-04
Kidney	11	4.35E-04	8.13E-05
Liver	12	4.10E-04	7.65E-05
Spleen	13	4.06E-04	7.58E-05
Pancreas	14	3.38E-04	6.31E-05
Muscle	15	2.96E-04	5.53E-05
Skin	16	1.82E-03	3.39E-04
Brain	17	4.54E-04	8.47E-05
Thymus	18	4.65E-04	8.67E-05
U Bladd	19	3.81E-04	7.10E-05
Adrenal	20	5.09E-04	9.49E-05
Esophagu	21	2.93E-04	5.48E-05
Ovaries	22	2.83E-04	5.29E-05
Uterus	23	2.98E-04	5.55E-05

EXAMPLE5: Air immersion dose calculation

&& AIR IMMERSION DOSE EQUIVALENCES ORDERED BY DOSE (rem)

ORGAN	NO.	DOWNWIND DISTANCES (m) 1.00E+04	3.00E+04
BSurface	8	1.88E-03	3.50E-04
Skin	16	1.82E-03	3.39E-04
Breast	7	7.17E-04	1.34E-04
Testes	6	5.89E-04	1.10E-04
Thyroid	10	5.53E-04	1.03E-04
Adrenal	20	5.09E-04	9.49E-05
Lungs	1	4.83E-04	9.02E-05
Thymus	18	4.65E-04	8.67E-05
Brain	17	4.54E-04	8.47E-05
Kidney	11	4.35E-04	8.13E-05
Liver	12	4.10E-04	7.65E-05
Spleen	13	4.06E-04	7.58E-05
S Wall	2	4.03E-04	7.51E-05
R Marrow	9	3.92E-04	7.31E-05
U Bladd	19	3.81E-04	7.10E-05
ULI Wall	4	3.39E-04	6.33E-05
Pancreas	14	3.38E-04	6.31E-05
LLI Wall	5	3.14E-04	5.85E-05
SI Wall	3	3.10E-04	5.79E-05
Uterus	23	2.98E-04	5.55E-05
Muscle	15	2.96E-04	5.53E-05
Esophagu	21	2.93E-04	5.48E-05
Ovaries	22	2.83E-04	5.29E-05

&& AIR IMMERSION WEIGHTED DOSE EQUIVALENTS (rem)

ORGAN	NO.	DOWNWIND DISTANCES (m) 1.00E+04	3.00E+04
Lungs	1	5.80E-05	1.08E-05
S Wall	2	2.42E-05	4.51E-06
SI Wall	3	1.86E-05	3.48E-06
ULI Wall	4	2.04E-05	3.80E-06
LLI Wall	5	1.88E-05	3.51E-06
Testes	6	1.47E-04	2.75E-05
Breast	7	1.08E-04	2.01E-05
BSurface	8	5.63E-05	1.05E-05
R Marrow	9	4.70E-05	8.77E-06
Thyroid	10	1.66E-05	3.09E-06
Kidney	11	2.61E-05	4.88E-06
Liver	12	2.46E-05	4.59E-06
Spleen	13	2.44E-05	4.55E-06
Pancreas	14	2.03E-05	3.79E-06
Muscle	15	1.78E-05	3.32E-06
Skin	16	1.82E-05	3.39E-06
Brain	17	2.72E-05	5.08E-06
Thymus	18	2.79E-05	5.20E-06

U Bladd	19	2.28E-05	4.26E-06
Adrenal	20	3.05E-05	5.70E-06
Esophagu	21	1.76E-05	3.29E-06
Ovaries	22	7.08E-05	1.32E-05
Uterus	23	1.79E-05	3.33E-06
EXT EDE	24	5.71E-04	1.07E-04

EXECUTION TIME = 1.70E-01 SECONDS

Example 2: Calculation of Inhalation Dose

The radionuclide inventory for this example has been entered directly using the 2000 Series option. The inventory consists of 2. Ci of Sr-90 and Y-90. The short-lived daughters of radionuclides should be entered along with their parents unless sufficient decay time has been provided to allow the short-lived daughters to buildup to equilibrium. RSAC-6 will automatically decay and ingrow progeny during the downwind transport time. However, in this example, the transport time to the downwind receptor is insufficient to allow the Y-90 buildup into equilibrium.

The release is assumed to occur at ground level with an average wind velocity of 4.5 m/s. A mixing layer depth of 1,000 m has been entered. No credit for plume depletion has been taken. This option may only be requested when the program is requested to calculate the meteorological diffusion. However, in this example standard deviations of the plume are entered directly to demonstrate how to use the option. Building wake correction has been requested for a building 40 m wide and 10 m high. While deposition velocities have been entered, they do not have an affect on the calculation.

The release has been decay corrected for a linear release occurring over a period of 15 minutes. While decay correction has little affect on the results from this example, it can significantly affect the subsequent dose calculations when short-lived radionuclides are present.

Two downwind distances have been specified for the subsequent dose calculations. RSAC+ will not allow downwind distances of less than 10 meters to be entered when the program calculates the downwind diffusion. However, when standard deviations of the plume are entered directly by the user as in this example, any downwind distance may be selected if RSAC-6 is run directly from an ASCII input file. When this is done, the burden of certifying the validity of the meteorological diffusion is placed on the user.

In this example, doses from the inhalation pathway are requested for only selected organs. In addition, dose calculations are requested for only Sr and Y, which speeds up the calculation time. A standard high breathing rate of 3.33E-04 m^3/s is used and doses are calculated using rem units. Doses are also calculated using the default RSAC-6 lung clearance classes that have been selected to give the maximum element doses. A respirable fraction of 0.25 has been used in the example.

```
example2     RSAC-6 INPUT     04/25/01     13:12
 0        1         2         3         4         5         6         7
 12345678901234567890123456789012345678901234567890123456789012345678901234567890123456789

 * Calculation of inhalation dose
 #
 2000,0               * Entering radionuclides directly
 SR 90,2.                   * 2. Ci Sr-90
 Y 90,2.                    * 2. Ci  Y-90
 2999                 * End of direct radionuclide input
 #
 5000,0             * Requests input of meteorological data
 #
 5001,4.5,0,1000.,1.099E3,0,0    * 4.5 m/s average wind velocity
 #                                 Ground level release
 #                                 1000 m mixing layer depth
 #                                 1099. g/cubic m air density
 #                                 No plume depletion by wet deposition
 #                                 No plume depletion by dry deposition
 #
 5002,0.001,0.01,0,0.001,0.001   * Entering deposition velocities
 #                                     0.001 m/s for solids, Cs and Ru
 #                                     0.01 for halogens
 #                                     0.0 for noble gases
 #
 5101,1.E2,1.5E2                 * Requesting doses for 2 downwind distances
 #                                     100. and 150. meters
 #
 5201,0.001111,0                 * Decay correct for a linear release over
 #                                 15 minutes
 #
 5400,1,40.,10.                  * Using option for user input of plume standard
 #                                 deviations
 #                                       Requesting correction for building wake
 #                                           40 meter wide by 10 meters high
 #
 5401,15.,8.,20.,11.             * Standard deviations inserted in pairs of 2
 #                                       100 meter distance
 #                                            sigy = 15. m, sigz = 8. m
 #                                       150 meter distance
 #                                            sigy = 20. m, sigz = 11. m
 #
 5999                          * End of meteorological input
 #
 7000,0,2,1,1,2                * Requesting inhalation dose calculation
 #                                       Using program default parameters
 #
 #                                       Requesting dose printout for each
 #                                       radionuclide and organ with crosswind
 #                                       doses for each organ

 0        1         2         3         4         5         6         7
 12345678901234567890123456789012345678901234567890123456789012345678901234567890123456789
```

```
 example2     RSAC-6 INPUT     04/25/01     13:12
0        1         2         3         4         5         6         7
12345678901234567890123456789012345678901234567890123456789012345678901234567890123456789

#
#                                       Doses in rem, for selected elements
#                                       and organs
#
7001,3.33E-4,0,0,0,.25          * High breathing rate of 3.33E-4 cubic m/s
#                                       Defaulting to program calculated
#                                       decay function time which gives a
#                                       100% release of the inventory
#
#                                       Requesting a respirable fraction
#                                       of 0.25.
#
7002,1,4,5,24                   * Calculating dose for LUNGS, ULI WALL, LLI
#                                 WALL and CEDE
#
7081,38,39                      * Calculating dose for Sr and Y only
#
7999                        * End of dose calculation
#
10000                       * End of run

0        1         2         3         4         5         6         7
12345678901234567890123456789012345678901234567890123456789012345678901234567890123456789
```

```
            RADIOLOGICAL SAFETY ANALYSIS COMPUTER PROGRAM (RSAC-6)
 (RSAC-6, REV 6.1, 03/07/01)  SERIAL  800  DATE 04/25/2001  TIME 13:12 PAGE   1
 example2:  Calculation of inhalation dose

***DIRECT RADIONUCLIDE INPUT

       ANY PREVIOUS INVENTORY HAS BEEN ZEROED

    NUCLIDE          HALF LIFE       CURIES

  380900  Sr 90    2.878E+01  yr    2.000E+00
  390900   Y 90    6.410E+01  h     2.000E+00

***METEOROLOGICAL DATA

       MEAN WIND SPEED = 4.500E+00 (m/s)    STACK HEIGHT = 0.000E+00 (m)
    MIXING LAYER HEIGHT = 1.000E+03 (m)       AIR DENSITY = 1.099E+03 (g/cu m)
    WET DEPOSITION SCAVENGING COEFFICIENT = 0.000E+00 (1/S)

    NO CORRECTION IS BEING MADE FOR PLUME DEPLETION BY FALLOUT

    DRY DEPOSITION VELOCITIES (m/s)
         SOLIDS = 1.000E-03    HALOGENS = 1.000E-02   NOBLE GASES = 0.000E+00
         CESIUM = 1.000E-03   RUTHENIUM = 1.000E-03

    THERE IS 1 SET OF LEAKAGE CONSTANTS (K1,K2)
          1.111E-03       0.000E+00

    BUILDING WIDTH =  4.000E+01 (m)   BUILDING HEIGHT =  1.000E+01 (m)

                                      EFFECTIVE   EFFECTIVE
    DOWNWIND DISTANCE       STACK       SIGY        SIGZ        CHI/Q
                          HEIGHT (m)     (m)         (m)       (s/cu m)
         1.000E+02         0.000E+00  2.203E+01  9.315E+00  3.447E-04
         1.500E+02         0.000E+00  3.114E+01  1.293E+01  1.757E-04

*** INHALATION DOSE EQUIVALENT CALCULATION

       USING DOSE CONVERSION FACTORS FROM FEDERAL GUIDANCE REPORT 11

    RESPIRABLE FRACTION =  2.500E-01
    BREATHING RATE =  3.330E-04 (cu m/s)
    RELEASE TIME FOR EXPONENTIAL DECAY FUNCTION =  9.001E+02 (s)
    INTERNAL EXPOSURE TIME PERIOD  =  5.000E+01 (yr)

    PARTICLE SIZE =  1.0 MICRON AMAD
    LUNG DEPOSITION FRACTIONS: N-P = 0.300  T-B = 0.080  P = 0.250

    DEFAULT ELEMENT LUNG CLEARANCE CLASSES SELECTED TO GIVE MAXIMUM DOSE
    LUNG CLEARANCE CLASSES USED IN CALCULATIONS
      ELEMENT     CLASS        ELEMENT     CLASS

      38   Sr       Y          39    Y       Y
```

RADIOLOGICAL SAFETY ANALYSIS COMPUTER PROGRAM (RSAC-6)
(RSAC-6, REV 6.1, 03/07/01) SERIAL 800 DATE 04/25/2001 TIME 13:12 PAGE 2
example2: Calculation of inhalation dose

DOWNWIND DISTANCE = 1.000E+02 (m) PLUME TRAVEL TIME = 2.222E+01 (s)
CHI/Q = 3.447E-04 (s/cu m)

LUNGS INHALATION	ISOTOPE	NUCLIDE	CDE(rem)	WCDE (rem)
	Sr - 90	380900	6.07E-01	7.29E-02
	TOTAL Sr (ATOMIC NO 38)		6.07E-01	7.29E-02
	Y - 90	390900	1.98E-03	2.37E-04
	TOTAL Y (ATOMIC NO 39)		1.98E-03	2.37E-04
	TOTAL LUNGS INHALATION =		6.09E-01	7.31E-02

ULI WALL INHALATION	ISOTOPE	NUCLIDE	CDE(rem)	WCDE (rem)
	Sr - 90	380900	1.29E-03	7.73E-05
	TOTAL Sr (ATOMIC NO 38)		1.29E-03	7.73E-05
	Y - 90	390900	1.12E-03	6.74E-05
	TOTAL Y (ATOMIC NO 39)		1.12E-03	6.74E-05
	TOTAL ULI WALL INHALATION =		2.41E-03	1.45E-04

LLI WALL INHALATION	ISOTOPE	NUCLIDE	CDE(rem)	WCDE (rem)
	Sr - 90	380900	4.37E-03	2.62E-04
	TOTAL Sr (ATOMIC NO 38)		4.37E-03	2.62E-04
	Y - 90	390900	2.68E-03	1.61E-04
	TOTAL Y (ATOMIC NO 39)		2.68E-03	1.61E-04
	TOTAL LLI WALL INHALATION =		7.05E-03	4.23E-04

CEDE INHALATION	ISOTOPE	NUCLIDE	CEDE(rem)
	Sr - 90	380900	7.45E-02
	TOTAL Sr (ATOMIC NO 38)		7.45E-02
	Y - 90	390900	4.84E-04
	TOTAL Y (ATOMIC NO 39)		4.84E-04

```
          RADIOLOGICAL SAFETY ANALYSIS COMPUTER PROGRAM (RSAC-6)
(RSAC-6, REV 6.1, 03/07/01)  SERIAL  800  DATE 04/25/2001  TIME 13:12 PAGE   3
example2:  Calculation of inhalation dose

   DOWNWIND DISTANCE =  1.000E+02    CEDE     INHALATION DOSE EQUIVALENT

                    TOTAL CEDE     INHALATION =    7.50E-02

   DOWNWIND DISTANCE =  1.500E+02 (m)     PLUME TRAVEL TIME =  3.333E+01 (s)
                                          CHI/Q =  1.757E-04 (s/cu m)

      LUNGS    INHALATION     ISOTOPE    NUCLIDE    CDE(rem)   WCDE (rem)

                             Sr -  90     380900    3.10E-01     3.71E-02

                        TOTAL Sr (ATOMIC NO 38)    3.10E-01     3.71E-02

                             Y -  90     390900    1.01E-03     1.21E-04

                        TOTAL  Y (ATOMIC NO 39)    1.01E-03     1.21E-04

                    TOTAL LUNGS    INHALATION =    3.11E-01     3.73E-02

      ULI WALL INHALATION     ISOTOPE    NUCLIDE    CDE(rem)   WCDE (rem)

                             Sr -  90     380900    6.57E-04     3.94E-05

                        TOTAL Sr (ATOMIC NO 38)    6.57E-04     3.94E-05

                             Y -  90     390900    5.73E-04     3.44E-05

                        TOTAL  Y (ATOMIC NO 39)    5.73E-04     3.44E-05

                    TOTAL ULI WALL INHALATION =    1.23E-03     7.38E-05

      LLI WALL INHALATION     ISOTOPE    NUCLIDE    CDE(rem)   WCDE (rem)

                             Sr -  90     380900    2.23E-03     1.34E-04

                        TOTAL Sr (ATOMIC NO 38)    2.23E-03     1.34E-04

                             Y -  90     390900    1.36E-03     8.18E-05

                        TOTAL  Y (ATOMIC NO 39)    1.36E-03     8.18E-05

                    TOTAL LLI WALL INHALATION =    3.59E-03     2.16E-04
```

```
            RADIOLOGICAL SAFETY ANALYSIS COMPUTER PROGRAM (RSAC-6)
(RSAC-6, REV 6.1, 03/07/01)  SERIAL  800  DATE 04/25/2001  TIME 13:12 PAGE   4
example2:  Calculation of inhalation dose

    DOWNWIND DISTANCE =  1.500E+02    CEDE     INHALATION DOSE EQUIVALENT

       CEDE     INHALATION     ISOTOPE     NUCLIDE    CEDE(rem)

                              Sr -  90      380900     3.80E-02

                           TOTAL Sr (ATOMIC NO 38)     3.80E-02

                                Y -  90      390900     2.47E-04

                           TOTAL  Y (ATOMIC NO 39)     2.47E-04

                        TOTAL CEDE     INHALATION =     3.82E-02

&&      INHALATION COMMITTED DOSE EQUIVALENTS ORDERED BY ORGAN (rem)

                  DOWNWIND DISTANCES (m)
   ORGAN    NO.  1.00E+02  1.50E+02
 --------  ---  --------  --------
 LUNGS       1  6.09E-01  3.11E-01
 ULI WALL    4  2.41E-03  1.23E-03
 LLI WALL    5  7.05E-03  3.59E-03

&&      INHALATION COMMITTED DOSE EQUIVALENCES ORDERED  BYDOSE (rem)

                  DOWNWIND DISTANCES (m)
   ORGAN    NO.  1.00E+02  1.50E+02
 --------  ---  --------  --------
 LUNGS       1  6.09E-01  3.11E-01
 ULI WALL    4  2.41E-03  1.23E-03
 LLI WALL    5  7.05E-03  3.59E-03
```

```
            RADIOLOGICAL SAFETY ANALYSIS COMPUTER PROGRAM (RSAC-6)
(RSAC-6, REV 6.1, 03/07/01)  SERIAL  800  DATE 04/25/2001  TIME 13:12 PAGE   5
example2:  Calculation of inhalation dose

&&      INHALATION WEIGHTED COMMITTED DOSE EQUIVALENTS (rem)

                DOWNWIND DISTANCES (m)
   ORGAN    NO.  1.00E+02  1.50E+02
 --------  ---  --------  --------
 LUNGS       1   7.31E-02  3.73E-02
 ULI WALL    4   1.45E-04  7.38E-05
 LLI WALL    5   4.23E-04  2.16E-04
 CEDE       24   7.50E-02  3.82E-02

   EXECUTION TIME =  5.00E-02 SECONDS
```

Example 3: Ingestion Dose Calculation from an Acute Release

This example uses the 2000 Series option to directly input the radionuclide inventory. The inventory is then decayed for a period of 20 years. Decay of the inventory for subsequent dose calculations must be done using the 1000 Series input. The release is assumed to occur at ground level with a 4 m/s average wind velocity.

Because no additional decay of the radionuclide inventory is desired during holdup before release, a linear release over a period of 1 second has been requested. In this example, χ/Q values are entered directly. When χ/Q values of standard deviations are entered directly, no plume depletion correction can be requested. However, in contrast to Example 2, deposition velocities must be entered to determine the amount of activity deposited on the ground and plant surfaces.

Ingestion doses have been requested for all organs and only selected elements. In this example, doses are calculated using the unit of Sv. The acute release is assumed to occur over a period of 1 day followed by a 7 day harvest period. The option for user supplied ingestion parameters has been requested to demonstrate how the standard default parameters can be changed.

```
example3     RSAC-6 INPUT     04/25/01     13:10
0        1         2         3         4         5         6         7
12345678901234567890123456789012345678901234567890123456789012345678901234567890123456789

* Ingestion dose calculation from an acute release
#
2000,0               * Direct input of Pu and Am
PU238,0.72                * 0.72 Ci of Pu-238
PU239,0.18                * 0.18 Ci of Pu-239
AM241,0.045               * 0.045 Ci of Am-241
#
2999                      * End of direct radionuclide input
#
1000                 * Decaying inventory for 20 years prior to
#                      calculating doses
#
1001,1,0,0           * Retaining previously entered inventory
#
1003,6.3115E8,0,0    * Decaying 20 yr = 6.3115E+8 s
#                         Setting reactor operating power to zero
#                         Operating reactor for zero time
#                             This prevents the addition of any
#                             activity other than the Pu and Am
#                             originally entered.  Any decay of the
#                             inventory prior to calculating a downwind
#                             dose must be done in the 1000 Series.
#
1999                 * End line for the 1000 Series
#
5000                 * Input of meteorological data
#
5001,4.,0,2000.,1.099E3,0,0   * 4 m/s average wind velocity
#                               ground level release
#                               2000 m mixing layer depth
#                               1099. g/cubic m air density
#                               No plume depletion by wet deposition
#                               No plume depletion by dry deposition
#
5002,0.001,0.01,0,0.001,0.001 * Entering deposition velocities
#                                   0.001 m/s for solids, Cs and Ru
#                                   0.01 m/s for halogens
#                                   0.0 m/s for noble gases
#
5101,1.E4,5.E4       * Requesting doses for 2 downwind distances
#                          1000. and 5000. meters
#
5201,1.,0            * No decay correction of inventory is desired during
#                          release period.  This is accomplished by simulating
#                          a puff release over a period of 1 second.
#

0        1         2         3         4         5         6         7
12345678901234567890123456789012345678901234567890123456789012345678901234567890123456789
```

```
 example3     RSAC-6 INPUT     04/25/01     13:10
0        1         2         3         4         5         6         7
12345678901234567890123456789012345678901234567890123456789012345678901234567890123456789

5400,3,0,0,0          * Using option to input chi/Q values directly
#                           Building wake option cannot be used with
#                           direct chi/Q input option
#
5421,2.1E-6,3.2E-7    * Entering chi/Q values matched to the 2 downwind
#                       distances
#
5999                  * End of meteorological data input
#
7000,3,-2,2,1,1       * Requesting ingestion dose calculation with user
#                       supplied parameters on Line 7003
#                           Printout of only dose summaries
#                           Requesting doses in Sv
#                           Requesting doses for only selected elements
#                           Calculating doses for all organs
#
7001,3.33E-4,0,0,0      * Breathing rate not used - defaulting to program
#                         calculated value
#
#                         Defaulting to program values for line remainder
#
7004,1,2,1.,7.                  * Requesting a printout of ingestion
#                                 transfer parameters
#
#                                 Requesting to input ingestion parameters
#
#                                 Calculating ingestion dose for an acute
#                                 release period occurring over 1 day
#
#                                 Requesting a harvest duration time period
#                                 of 7 days following the acute release
#
7051,520.,64.,110.,310.,0.5,0.75  * Changed the fraction of stored vegetables
#                                   from the default of 0.76 to 0.5
#
#                                   Changed the fraction of fresh vegetables
#                                   from the default of 1.0 to 0.75
#
7052,0.57,0.2,1.,0.0021,60.,30.,1.  * Retaining the default values on Lines
7053,225.,60.,1.,16.,2.,20.         * 7052 through 7055
7054,0.4,0.43,90.,2.,0.28,4.9
7055,.5,.33,0.5,.33
#
7081,94,95                      * Requesting doses for Pu and Am by entering
#                                 their atomic numbers of 94 and 95

0        1         2         3         4         5         6         7
12345678901234567890123456789012345678901234567890123456789012345678901234567890123456789
```

```
 example3     RSAC-6 INPUT     04/25/01     13:10
0         1         2         3         4         5         6         7
12345678901234567890123456789012345678901234567890123456789012345678901234567890123456789

#
7999                  * End of ingestion dose calculation input
#
10000                 * End of run

0         1         2         3         4         5         6         7
12345678901234567890123456789012345678901234567890123456789012345678901234567890123456789
```

```
            RADIOLOGICAL SAFETY ANALYSIS COMPUTER PROGRAM (RSAC-6)
 (RSAC-6, REV 6.1, 03/07/01)  SERIAL  800  DATE 04/25/2001  TIME 13:10 PAGE   1
 example3:  Ingestion dose calculation from an acute release

***DIRECT RADIONUCLIDE INPUT

       ANY PREVIOUS INVENTORY HAS BEEN ZEROED

    NUCLIDE          HALF LIFE       CURIES

  942380  Pu238    8.770E+01  yr    7.200E-01
  942390  Pu239    2.411E+04  yr    1.800E-01
  952410  Am241    4.322E+02  yr    4.500E-02

***FISSION PRODUCT CALCULATION

   RADIONUCLIDE INVENTORY HAS BEEN DECAYED FOR  6.312E+08 SECONDS

   TOTAL RADIONUCLIDE REMAINING =  3.101E+10  D/s OR  8.382E-01 Ci

***METEOROLOGICAL DATA

      MEAN WIND SPEED = 4.000E+00 (m/s)    STACK HEIGHT = 0.000E+00 (m)
   MIXING LAYER HEIGHT = 2.000E+03 (m)      AIR DENSITY = 1.099E+03 (g/cu m)
   WET DEPOSITION SCAVENGING COEFFICIENT = 0.000E+00 (1/S)

   NO CORRECTION IS BEING MADE FOR PLUME DEPLETION BY FALLOUT

   DRY DEPOSITION VELOCITIES (m/s)
        SOLIDS = 1.000E-03    HALOGENS = 1.000E-02   NOBLE GASES = 0.000E+00
        CESIUM = 1.000E-03   RUTHENIUM = 1.000E-03

   THERE IS 1 SET OF LEAKAGE CONSTANTS (K1,K2)
         1.000E+00       0.000E+00

   CHI/Q VALUES INPUT DIRECTLY

         DOWNWIND DISTANCE     CHI/Q
             1.000E+04       2.100E-06
             5.000E+04       3.200E-07

***  INGESTION DOSE EQUIVALENT CALCULATION

       USING DOSE CONVERSION FACTORS FROM FEDERAL GUIDANCE REPORT 11

    RELEASE TIME FOR EXPONENTIAL DECAY FUNCTION =  1.000E+00 (s)
    INTERNAL EXPOSURE TIME PERIOD =  5.000E+01 (yr)

    INGESTION CALCULATIONS MADE USING USER SUPPLIED CONSTANTS

       INGESTION CONSTANTS:
           5.20E+02  STORED VEGETABLE USAGE FACTOR (Kg/yr)
           6.40E+01  FRESH VEGETABLE USAGE FACTOR (Kg/yr)
           1.10E+02  MEAT USAGE FACTOR (Kg/yr)
           3.10E+02  MILK USAGE FACTOR (L/yr)
           5.00E-01  FRACTION OF STORED VEGETABLES FROM GARDEN
           7.50E-01  FRACTION OF FRESH VEGETABLES FROM GARDEN
```

RADIOLOGICAL SAFETY ANALYSIS COMPUTER PROGRAM (RSAC-6)
(RSAC-6, REV 6.1, 03/07/01) SERIAL 800 DATE 04/25/2001 TIME 13:10 PAGE 2
example3: Ingestion dose calculation from an acute release

5.70E-01	RETENTION FACTOR FOR ACTIVITY ON FORAGE
2.00E-01	RETENTION FACTOR FOR ACTIVITY ON VEGETABLES
1.00E+00	RETENTION FACTOR FOR IODINES
2.10E-03	REMOVAL RATE CONSTANT FOR CROPS (1/h)
6.00E+01	VEGETABLE EXPOSURE TIME TO PLUME FOR CHRONIC RELEASE (d)
3.00E+01	FORAGE EXPOSURE TIME TO PLUME FOR CHRONIC RELEASE (d)
1.00E+00	HTO REMOVAL HALF TIME (d)
2.25E+02	EFFECTIVE SURFACE SOIL DENSITY (Kg/sq m)
6.00E+01	STORED VEGETABLE HOLDUP TIME AFTER HARVEST (d)
1.00E+00	FRESH VEGETABLE HOLDUP TIME AFTER HARVEST (d)
1.60E+01	ANIMALS DAILY FORAGE FEED (Kg/d)
2.00E+00	FEED-MILK-RECEPTOR TRANSFER TIME (d)
2.00E+01	SLAUGHTER TO CONSUMPTION TIME (d)
4.00E-01	FRACTION OF YEAR ON PASTURE
4.30E-01	PASTURE FEED FRACTION
9.00E+01	STORED FEED STORAGE TIME
2.00E+00	VEGETABLE VEGETATION YIELD (Kg/sq m)
2.80E-01	FORAGE VEGETATION YIELD (Kg/sq m)
4.90E+00	ABSOLUTE HUMIDITY (g/cu m)

ACUTE RELEASE OVER 1.000E+00 (d)
HARVEST DURATION TIME OF 7.000E+00 (d) AFTER ACUTE RELEASE
CONSUMPTION OF CROPS GROWN ON CONTAMINATED SOIL FOR 1.500E+01 (Y)

FRACTIONS OF ANNUAL VEGETABLES AND FORAGE CONTAMINATED BY ACUTE RELEASE

5.0E-01	STORED VEGETABLES
3.3E-01	FRESH VEGETABLES
5.0E-01	STORED FEED
3.3E-01	PASTURE FEED

INGESTION TRANSFER CONSTANTS

ELEMENT		BV1 FORAGE/ SOIL (dry)	BV2 VEG/SOIL (wet)	FM MILK (d/L)	FF MEAT (d/kg)	TRANS-LOCATION
H	1	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.0E+00
He	2	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.0E+00
Li	3	2.5E-02	1.7E-03	2.0E-02	1.0E-02	1.0E+00
Be	4	1.0E-02	6.4E-04	9.0E-07	1.0E-03	1.0E+00
B	5	4.0E+00	8.6E-01	1.5E-03	8.0E-04	1.0E+00
C	6	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.0E+00
N	7	3.0E+01	1.3E+01	2.5E-02	7.5E-02	1.0E+00
O	8	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.0E+00
F	9	6.0E-02	2.6E-03	1.0E-03	1.5E-01	1.0E+00
Ne	10	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.0E+00
Na	11	7.5E-02	2.4E-02	3.5E-02	5.5E-02	1.0E+00
Mg	12	1.0E+00	2.4E-01	4.0E-03	5.0E-03	1.0E+00
Al	13	4.0E-03	2.8E-04	2.0E-04	1.5E-03	1.0E+00
Si	14	3.5E-01	3.0E-02	2.0E-05	4.0E-05	1.0E+00
P	15	3.5E+00	1.5E+00	1.5E-02	5.5E-02	1.0E+00
S	16	1.5E+00	6.4E-01	1.5E-02	1.0E-01	1.0E+00
Cl	17	7.0E+01	3.0E+01	1.5E-02	8.0E-02	1.0E+00
Ar	18	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.0E+00
K	19	1.0E+00	2.4E-01	7.0E-03	2.0E-02	1.0E+00
Ca	20	3.5E+00	1.5E-01	1.0E-02	7.0E-04	1.0E+00

RADIOLOGICAL SAFETY ANALYSIS COMPUTER PROGRAM (RSAC-6)
(RSAC-6, REV 6.1, 03/07/01) SERIAL 800 DATE 04/25/2001 TIME 13:10 PAGE 3
example3: Ingestion dose calculation from an acute release

ELEMENT		BV1 FORAGE/ SOIL (dry)	BV2 VEG/SOIL (wet)	FM MILK (d/L)	FF MEAT (d/kg)	TRANS-LOCATION
Sc	21	6.0E-03	4.3E-04	5.0E-06	1.5E-02	1.0E+00
Ti	22	5.5E-03	1.3E-03	1.0E-02	3.0E-02	1.0E+00
V	23	5.5E-03	1.3E-03	2.0E-05	2.5E-03	1.0E+00
Cr	24	7.5E-03	1.9E-03	1.5E-03	5.5E-03	1.0E+00
Mn	25	2.5E-01	2.1E-02	3.5E-04	4.0E-04	1.0E+00
Fe	26	4.0E-03	4.3E-04	2.5E-04	2.0E-02	1.0E+00
Co	27	2.0E-02	3.0E-03	2.0E-03	2.0E-02	1.0E+00
Ni	28	6.0E-02	2.6E-02	1.0E-03	6.0E-03	1.0E+00
Cu	29	4.0E-01	1.1E-01	1.5E-03	1.0E-02	1.0E+00
Zn	30	1.5E+00	3.9E-01	1.0E-02	1.0E-01	1.0E+00
Ga	31	4.0E-03	1.7E-04	5.0E-05	5.0E-04	1.0E+00
Ge	32	4.0E-01	3.4E-02	7.0E-02	7.0E-01	1.0E+00
As	33	4.0E-02	2.6E-03	6.0E-05	2.0E-03	1.0E+00
Se	34	2.5E-02	1.1E-02	4.0E-03	1.5E-02	1.0E+00
Br	35	1.5E+00	6.4E-01	2.0E-02	2.5E-02	1.0E+00
Kr	36	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.0E+00
Rb	37	1.5E-01	3.0E-02	1.0E-02	1.5E-02	1.0E+00
Sr	38	2.5E+00	1.1E-01	1.5E-03	3.0E-04	1.5E-01
Y	39	1.5E-02	2.6E-03	2.0E-05	3.0E-04	1.0E+00
Zr	40	2.0E-03	2.1E-04	3.0E-05	5.5E-03	1.0E+00
Nb	41	2.0E-02	2.1E-03	2.0E-02	2.5E-01	1.0E+00
Mo	42	2.5E-01	2.6E-02	1.5E-03	6.0E-03	1.0E+00
Tc	43	9.5E+00	6.4E-01	1.0E-02	8.5E-03	1.0E+00
Ru	44	7.5E-02	8.6E-03	6.0E-07	2.0E-03	5.0E-02
Rh	45	1.5E-01	1.7E-02	1.0E-02	2.0E-03	1.0E+00
Pd	46	1.5E-01	1.7E-02	1.0E-02	4.0E-03	1.0E+00
Ag	47	4.0E-01	4.3E-02	2.0E-02	3.0E-03	1.0E+00
Cd	48	5.5E-01	6.4E-02	1.0E-03	5.5E-04	1.0E+00
In	49	4.0E-03	1.7E-04	1.0E-04	8.0E-03	1.0E+00
Sn	50	3.0E-02	2.6E-03	1.0E-03	8.0E-02	1.0E+00
Sb	51	2.0E-01	1.3E-02	1.0E-04	1.0E-03	1.0E+00
Te	52	2.5E-02	1.7E-03	2.0E-04	1.5E-02	1.0E+00
I	53	1.5E-01	2.1E-02	1.0E-02	7.0E-03	1.0E-01
Xe	54	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.0E+00
Cs	55	8.0E-02	1.3E-02	7.0E-03	2.0E-02	5.0E-01
Ba	56	1.5E-01	6.4E-03	3.5E-04	1.5E-04	1.0E+00
La	57	1.0E-02	1.7E-03	2.0E-05	3.0E-04	1.0E+00
Ce	58	1.0E-02	1.7E-03	2.0E-05	7.5E-04	3.0E-01
Pr	59	1.0E-02	1.7E-03	2.0E-05	3.0E-04	1.0E+00
Nd	60	1.0E-02	1.7E-03	2.0E-05	3.0E-04	1.0E+00
Pm	61	1.0E-02	1.7E-03	2.0E-05	5.0E-03	1.0E+00
Sm	62	1.0E-02	1.7E-03	2.0E-05	5.0E-03	1.0E+00
Eu	63	1.0E-02	1.7E-03	2.0E-05	5.0E-03	1.0E+00
Gd	64	1.0E-02	1.7E-03	2.0E-05	3.5E-03	1.0E+00
Tb	65	1.0E-02	1.7E-03	2.0E-05	4.5E-03	1.0E+00
Dy	66	1.0E-02	1.7E-03	2.0E-05	5.5E-03	1.0E+00
Ho	67	1.0E-02	1.7E-03	2.0E-05	4.5E-03	1.0E+00
Er	68	1.0E-02	1.7E-03	2.0E-05	4.0E-03	1.0E+00

RADIOLOGICAL SAFETY ANALYSIS COMPUTER PROGRAM (RSAC-6)
(RSAC-6, REV 6.1, 03/07/01) SERIAL 800 DATE 04/25/2001 TIME 13:10 PAGE 4
example3: Ingestion dose calculation from an acute release

ELEMENT	BV1 FORAGE/ SOIL (dry)	BV2 VEG/SOIL (wet)	FM MILK (d/L)	FF MEAT (d/kg)	TRANS- LOCATION
Tm 69	1.0E-02	1.7E-03	2.0E-05	4.5E-03	1.0E+00
Yb 70	1.0E-02	1.7E-03	2.0E-05	4.0E-03	1.0E+00
Lu 71	1.0E-02	1.7E-03	2.0E-05	4.5E-03	1.0E+00
Hf 72	3.5E-03	3.6E-04	5.0E-06	1.0E-03	1.0E+00
Ta 73	1.0E-02	1.1E-03	3.0E-06	6.0E-04	1.0E+00
W 74	4.5E-02	4.3E-03	3.0E-04	4.5E-02	1.0E+00
Re 75	1.5E+00	1.5E-01	1.5E-03	8.0E-03	1.0E+00
Os 76	1.5E-02	1.5E-03	5.0E-03	4.0E-01	1.0E+00
Ir 77	5.5E-02	6.4E-03	2.0E-06	1.5E-03	1.0E+00
Pt 78	9.5E-02	1.1E-02	5.0E-03	4.0E-03	1.0E+00
Au 79	4.0E-01	4.3E-02	5.5E-06	8.0E-03	1.0E+00
Hg 80	9.0E-01	8.6E-02	4.5E-04	2.5E-01	1.0E+00
Tl 81	4.0E-03	1.7E-04	2.0E-03	4.0E-02	1.0E+00
Pb 82	4.5E-02	3.9E-03	2.5E-04	3.0E-04	1.0E+00
Bi 83	3.5E-02	2.1E-03	5.0E-04	4.0E-04	1.0E+00
Po 84	2.5E-03	1.7E-04	3.5E-04	9.5E-05	1.0E+00
At 85	1.0E+00	6.4E-02	1.0E-02	1.0E-02	1.0E+00
Rn 86	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.0E+00
Fr 87	3.0E-02	3.4E-03	2.0E-02	2.5E-03	1.0E+00
Ra 88	1.5E-02	6.4E-04	4.5E-04	2.5E-04	1.0E+00
Ac 89	3.5E-03	1.5E-04	2.0E-05	2.5E-05	1.0E+00
Th 90	8.5E-04	3.6E-05	5.0E-06	6.0E-06	1.0E+00
Pa 91	2.5E-03	1.1E-04	5.0E-06	1.0E-05	1.0E+00
U 92	8.5E-03	1.7E-03	6.0E-04	2.0E-04	1.0E+00
Np 93	1.0E-01	4.3E-03	5.0E-06	5.5E-05	1.0E+00
Pu 94	4.5E-04	1.9E-05	1.0E-07	5.0E-07	1.0E-02
Am 95	5.5E-03	1.1E-04	4.0E-07	3.5E-06	3.0E-01
Cm 96	8.5E-04	6.4E-06	2.0E-05	3.5E-06	3.0E-01
Bk 97	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Cf 98	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Es 99	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Fm 100	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

DOWNWIND DISTANCE = 1.000E+04 (m) PLUME TRAVEL TIME = 2.500E+03 (s)
CHI/Q = 2.100E-06 (s/cu m)

DOWNWIND DISTANCE = 5.000E+04 (m) PLUME TRAVEL TIME = 1.250E+04 (s)
CHI/Q = 3.200E-07 (s/cu m)

RADIOLOGICAL SAFETY ANALYSIS COMPUTER PROGRAM (RSAC-6)
(RSAC-6, REV 6.1, 03/07/01) SERIAL 800 DATE 04/25/2001 TIME 13:10 PAGE 5
example3: Ingestion dose calculation from an acute release

&& INGESTION COMMITTED DOSE EQUIVALENTS ORDERED BY ORGAN (Sv)

		DOWNWIND DISTANCES (m)	
ORGAN	NO.	1.00E+04	5.00E+04
LUNGS	1	1.27E-09	1.93E-10
S WALL	2	1.34E-07	2.04E-08
SI WALL	3	3.33E-07	5.07E-08
ULI WALL	4	1.92E-06	2.93E-07
LLI WALL	5	5.88E-06	8.97E-07
TESTES	6	2.56E-05	3.90E-06
BREASTS	7	1.14E-09	1.74E-10
BONE SUR	8	1.73E-03	2.63E-04
R MARROW	9	1.39E-04	2.11E-05
THYROID	10	9.08E-10	1.38E-10
KIDNEYS	11	1.35E-09	2.05E-10
LIVER	12	3.15E-04	4.80E-05
SPLEEN	13	1.01E-09	1.54E-10
PANCREAS	14	1.39E-09	2.12E-10
MUSCLE	15	1.14E-09	1.74E-10
SKIN	16	9.66E-10	1.47E-10
BRAIN	17	1.08E-09	1.65E-10
THYMUS	18	9.16E-10	1.40E-10
BL WALL	19	1.06E-09	1.62E-10
ADRENALS	20	1.49E-09	2.27E-10
ESOPHAGU	21	9.16E-10	1.40E-10
OVARIES	22	2.56E-05	3.90E-06
UTERUS	23	1.18E-09	1.79E-10

RADIOLOGICAL SAFETY ANALYSIS COMPUTER PROGRAM (RSAC-6)
(RSAC-6, REV 6.1, 03/07/01) SERIAL 800 DATE 04/25/2001 TIME 13:10 PAGE 6
example3: Ingestion dose calculation from an acute release

&& INGESTION COMMITTED DOSE EQUIVALENCES ORDERED BYDOSE (Sv)

		DOWNWIND DISTANCES (m)	
ORGAN	NO.	1.00E+04	5.00E+04
BONE SUR	8	1.73E-03	2.63E-04
LIVER	12	3.15E-04	4.80E-05
R MARROW	9	1.39E-04	2.11E-05
TESTES	6	2.56E-05	3.90E-06
OVARIES	22	2.56E-05	3.90E-06
LLI WALL	5	5.88E-06	8.97E-07
ULI WALL	4	1.92E-06	2.93E-07
SI WALL	3	3.33E-07	5.07E-08
S WALL	2	1.34E-07	2.04E-08
ADRENALS	20	1.49E-09	2.27E-10
PANCREAS	14	1.39E-09	2.12E-10
KIDNEYS	11	1.35E-09	2.05E-10
LUNGS	1	1.27E-09	1.93E-10
UTERUS	23	1.18E-09	1.79E-10
BREASTS	7	1.14E-09	1.74E-10
MUSCLE	15	1.14E-09	1.74E-10
BRAIN	17	1.08E-09	1.65E-10
BL WALL	19	1.06E-09	1.62E-10
SPLEEN	13	1.01E-09	1.54E-10
SKIN	16	9.66E-10	1.47E-10
THYMUS	18	9.16E-10	1.40E-10
ESOPHAGU	21	9.16E-10	1.40E-10
THYROID	10	9.08E-10	1.38E-10

RADIOLOGICAL SAFETY ANALYSIS COMPUTER PROGRAM (RSAC-6)
(RSAC-6, REV 6.1, 03/07/01) SERIAL 800 DATE 04/25/2001 TIME 13:10 PAGE 7
example3: Ingestion dose calculation from an acute release

&& INGESTION WEIGHTED COMMITTED DOSE EQUIVALENTS (Sv)

		DOWNWIND DISTANCES (m)	
ORGAN	NO.	1.00E+04	5.00E+04
LUNGS	1	1.52E-10	2.32E-11
S WALL	2	8.04E-09	1.23E-09
SI WALL	3	2.00E-08	3.04E-09
ULI WALL	4	1.15E-07	1.76E-08
LLI WALL	5	3.53E-07	5.38E-08
TESTES	6	6.40E-06	9.75E-07
BREASTS	7	1.72E-10	2.61E-11
BONE SUR	8	5.18E-05	7.89E-06
R MARROW	9	1.66E-05	2.53E-06
THYROID	10	2.72E-11	4.15E-12
KIDNEYS	11	8.08E-11	1.23E-11
LIVER	12	1.89E-05	2.88E-06
SPLEEN	13	6.08E-11	9.27E-12
PANCREAS	14	8.34E-11	1.27E-11
MUSCLE	15	6.86E-11	1.05E-11
SKIN	16	9.66E-12	1.47E-12
BRAIN	17	6.48E-11	9.88E-12
THYMUS	18	5.50E-11	8.38E-12
BL WALL	19	6.38E-11	9.72E-12
ADRENALS	20	8.95E-11	1.36E-11
ESOPHAGU	21	5.50E-11	8.38E-12
OVARIES	22	6.40E-06	9.75E-07
UTERUS	23	7.05E-11	1.07E-11
CEDE	24	9.42E-05	1.44E-05

EXECUTION TIME = 2.70E-01 SECONDS

Example 4: Ground Surface Dose Calculation

An inventory of only Co-60 is entered directly using the 2000 Series option. The 1000 Series option is used to demonstrate how the inventory can be fractionated at any time. In this case, the option to fractionate the entire inventory by a factor of 0.5 has been selected.

The release is assumed to occur at ground level during a Class C meteorological condition with a 2,000-m mixing layer depth. Diffusion is made using Hilsmeier-Gifford diffusion parameters.

In this example, the air density is changed to the standard sea level value. Ground surface doses are calculated in rem for all organs and the element Co only. A building shielding factor of 1. has been used to indicate that no reduction of the dose by buildings is desired. In addition, it is assumed that doses are being calculated for a controlled area where workers are normally present only 40/168 hours a week. Thus an occupancy factor of 0.2381 has been entered.

```
example4     RSAC-6 INPUT     04/25/01     13:11
 0        1         2         3         4         5         6         7
 12345678901234567890123456789012345678901234567890123456789012345678901234567890123456789

 * Ground surface dose calculation
 #
 2000,0                * Direct input of Co-60
 #
 CO 60,75.             * Entering 75 Ci
 #
 2999                  * End of direct radionuclide input
 #
 1000                  * Using 1000 Series to fractionate inventory
 #
 1001,1,0,0                 * Retaining existing inventory
 #
 1004,0,.5                  * Fractionating the inventory by a factor of 0.5
 #
 1999                       * End of inventory fractionation
 #
 5000                  * Input of meteorological data
 #
 5001,6.,0,2000.,1.240E3,0,0     * 6 m/s average wind velocity
 #                                 ground level release
 #                                 2000. m mixing layer depth
 #                                 1240. g/cubic m air density
 #
 5002,0.001,0.01,0,0.001,0.001   * Defaulting to program standard deposition
 #                                 velocities
 #
 5101,3.5E3                      * Calculating dose for 1 downwind distance
 #
 5201,1.,0                       * Releasing as a puff
 #
 5400,2,0,0,0                    * Requesting program to calculate sigmas
 #
 5410,1,3,0                      * Hilsmeier-Gifford diffusion
 #                                    Class C
 #
 #                                    Cannot request plume rise for ground
 #                                    level release
 #
 5999                            * End of meteorological data
 #
 7000,4,-2,1,1,1         * Requesting ground surface dose calculation
 #                             Printing only summary doses
 #                             Calculating doses in rem
 #                             Requesting doses for only selected elements
 #                             Requesting doses for all organs
 #

 0        1         2         3         4         5         6         7
 12345678901234567890123456789012345678901234567890123456789012345678901234567890123456789
```

```
 example4      RSAC-6 INPUT      04/25/01     13:11
0         1         2         3         4         5         6         7
12345678901234567890123456789012345678901234567890123456789012345678901234567890123456789

7001,3.33E-4,0,1.,1.,.2381 * Defaulting to program standard values except:
#                                The building shielding factor which has been
#                                changed to a factor of 1. indicating no
#                                reduction of the dose by buildings
#
#                                Receptor is assumed to be in a controlled
#                                work area and is present only 40/168 hours
#                                per week.  An occupancy foctor of 0.2381
#                                has been entered.
#
7081,27                  * Requesting dose calculation for only cobalt
#
7999                     * End of input for dose calculation
#
10000                    * End of run

0         1         2         3         4         5         6         7
12345678901234567890123456789012345678901234567890123456789012345678901234567890123456789
```

```
            RADIOLOGICAL SAFETY ANALYSIS COMPUTER PROGRAM (RSAC-6)
 (RSAC-6, REV 6.1, 03/07/01)  SERIAL  800  DATE 04/25/2001  TIME 13:11 PAGE   1
 example4:  Ground surface dose calculation

***DIRECT RADIONUCLIDE INPUT

        ANY PREVIOUS INVENTORY HAS BEEN ZEROED

     NUCLIDE          HALF LIFE       CURIES

  270600  Co 60     5.271E+00  yr    7.500E+01

***FISSION PRODUCT CALCULATION

     FRACTION OF RADIONUCLIDE INVENTORY RELEASED =  5.000E-01

    TOTAL RADIONUCLIDE REMAINING =  1.388E+12  D/s OR  3.750E+01 Ci

***METEOROLOGICAL DATA

        MEAN WIND SPEED = 6.000E+00 (m/s)    STACK HEIGHT = 0.000E+00 (m)
    MIXING LAYER HEIGHT = 2.000E+03 (m)       AIR DENSITY = 1.240E+03 (g/cu m)
    WET DEPOSITION SCAVENGING COEFFICIENT = 0.000E+00 (1/S)

    NO CORRECTION IS BEING MADE FOR PLUME DEPLETION BY FALLOUT

    DRY DEPOSITION VELOCITIES (m/s)
         SOLIDS = 1.000E-03    HALOGENS = 1.000E-02   NOBLE GASES = 0.000E+00
         CESIUM = 1.000E-03   RUTHENIUM = 1.000E-03

    THERE IS 1 SET OF LEAKAGE CONSTANTS (K1,K2)
          1.000E+00       0.000E+00

    PASQUILL CLASS C METEOROLOGY,  H-G   SIGMA VALUES

    NO BUILDING WAKE CORRECTION MADE

    DOWNWIND DISTANCE       STACK         SIGY         SIGZ         CHI/Q
                          HEIGHT (m)       (m)          (m)        (s/cu m)
         3.500E+03         0.000E+00   3.546E+02   1.979E+02   7.560E-07

*** GROUND SURFACE DEPOSITION DOSE EQUIVALENT CALCULATION

        USING DOSE RATE CONVERSION FACTORS FROM FEDERAL GUIDANCE REPORT 12

    OCCUPANCY FACTOR =  2.381E-01
    TIME RECEPTOR IS EXPOSED TO CONTAMINATED SOIL =  1.000E+00 (yr)
    BUILDING SHIELDING FACTOR =  1.000E+00
    RELEASE TIME FOR EXPONENTIAL DECAY FUNCTION =  1.000E+00 SECONDS
```

RADIOLOGICAL SAFETY ANALYSIS COMPUTER PROGRAM (RSAC-6)
(RSAC-6, REV 6.1, 03/07/01) SERIAL 800 DATE 04/25/2001 TIME 13:11 PAGE 2
example4: Ground surface dose calculation

DOWNWIND DISTANCE = 3.500E+03 (m) PLUME TRAVEL TIME = 5.833E+02 (s)
CHI/Q = 7.560E-07 (s/cu m)

&& GROUND SURFACE DOSE EQUIVALENTS ORDERED BY ORGAN (rem)

		DOWNWIND DISTANCES (m)
ORGAN	NO.	3.50E+03
Lungs	1	1.62E-03
S Wall	2	1.56E-03
SI Wall	3	1.55E-03
ULI Wall	4	1.56E-03
LLI Wall	5	1.61E-03
Testes	6	1.75E-03
Breast	7	1.67E-03
BSurface	8	2.22E-03
R Marrow	9	1.67E-03
Thyroid	10	1.61E-03
Kidney	11	1.59E-03
Liver	12	1.57E-03
Spleen	13	1.57E-03
Pancreas	14	1.46E-03
Muscle	15	1.47E-03
Skin	16	1.97E-03
Brain	17	1.54E-03
Thymus	18	1.50E-03
U Bladd	19	1.59E-03
Adrenal	20	1.75E-03
Esophagu	21	1.42E-03
Ovaries	22	1.46E-03
Uterus	23	1.52E-03

RADIOLOGICAL SAFETY ANALYSIS COMPUTER PROGRAM (RSAC-6)
(RSAC-6, REV 6.1, 03/07/01) SERIAL 800 DATE 04/25/2001 TIME 13:11 PAGE 3
example4: Ground surface dose calculation

&& GROUND SURFACE DOSE EQUIVALENCES ORDERED BY DOSE (rem)

		DOWNWIND DISTANCES (m)
ORGAN	NO.	3.50E+03
BSurface	8	2.22E-03
Skin	16	1.97E-03
Testes	6	1.75E-03
Adrenal	20	1.75E-03
Breast	7	1.67E-03
R Marrow	9	1.67E-03
Lungs	1	1.62E-03
LLI Wall	5	1.61E-03
Thyroid	10	1.61E-03
Kidney	11	1.59E-03
U Bladd	19	1.59E-03
Liver	12	1.57E-03
Spleen	13	1.57E-03
S Wall	2	1.56E-03
ULI Wall	4	1.56E-03
SI Wall	3	1.55E-03
Brain	17	1.54E-03
Uterus	23	1.52E-03
Thymus	18	1.50E-03
Muscle	15	1.47E-03
Pancreas	14	1.46E-03
Ovaries	22	1.46E-03
Esophagu	21	1.42E-03

```
          RADIOLOGICAL SAFETY ANALYSIS COMPUTER PROGRAM (RSAC-6)
(RSAC-6, REV 6.1, 03/07/01)  SERIAL  800  DATE 04/25/2001  TIME 13:11 PAGE   4
example4:  Ground surface dose calculation

&& GROUND SURFACE  WEIGHTED DOSE EQUIVALENTS (rem)

                DOWNWIND DISTANCES (m)
   ORGAN    NO.   3.50E+03
 --------  ---   --------
 Lungs       1   1.95E-04
 S Wall      2   9.35E-05
 SI Wall     3   9.31E-05
 ULI Wall    4   9.35E-05
 LLI Wall    5   9.65E-05
 Testes      6   4.38E-04
 Breast      7   2.51E-04
 BSurface    8   6.67E-05
 R Marrow    9   2.00E-04
 Thyroid    10   4.82E-05
 Kidney     11   9.52E-05
 Liver      12   9.39E-05
 Spleen     13   9.39E-05
 Pancreas   14   8.75E-05
 Muscle     15   8.79E-05
 Skin       16   1.97E-05
 Brain      17   9.26E-05
 Thymus     18   9.01E-05
 U Bladd    19   9.52E-05
 Adrenal    20   1.05E-04
 Esophagu   21   8.49E-05
 Ovaries    22   3.65E-04
 Uterus     23   9.13E-05
 EXT EDE    24   1.68E-03

    EXECUTION TIME =  1.70E-01 SECONDS
```

Example 5: Air Immersion Dose Calculation

This example assumes the release of only Xe-133. The release is assumed to be from a 50-m stack during Class D meteorology (Markee diffusion parameters) with a 10 m/s average wind velocity. A mixing layer depth of 2,500 m has been chosen. The release is assumed to occur exponentially as a function of time with a release half-time of 2 days. Plume rise above the top of the stack was calculated for a jet plume being released from a 1.22- internal stack diameter discharging with a 20 m/s efflux speed.

Air immersion doses were calculated for all organs with the dose expressed in rem. The decay time for the exponential release function was set to 2 hours (2.88E4 seconds) to give the air immersion dose that would be received during the first 2 hours following the onset of the release. To alert the user, RSAC-6 prints a warning when less than 100% of the inventory has been released. In this case, the release was purposely adjusted to give less than a 100% release.

When using the air immersion model, be sure that the plume size is large compared to the mean free path of the gamma rays and that it has diffused to the ground level. The easiest way to confirm this is to make a calculation using the finite-plume cloud gamma model (Series 9000) to see if the EDE converges. In this case, it is a good exercise for the user to verify that the results for the two models converge only to a factor of 3, indicating that the air immersion model is not appropriate in this case and that a cloud gamma calculation using a finite plume should be used.

```
example5     RSAC-6 INPUT     04/25/01     13:11
 0        1         2         3         4         5         6         7
 12345678901234567890123456789012345678901234567890123456789012345678901234567890123456789

 * Air immersion dose calculation
 #
 2000,0                * Direct input of Xe-133 only
 #
 XE133,1.E6                  * Entering 1.6E6 Ci
 #
 2999                  * End of direct radionuclide input
 #
 5000                  * Input of meteorological data
 #
 5001,10.,50.,2500.,1.099E3,0,0  * 10 m/s average wind velocity
 #                                 50 m stack height
 #                                 2500. m mixing layer depth
 #                                 1099. g/cubic m air density
 #
 5101,1.E4,3.E4                  * 2 downwind distances entered
 #
 5201,5.687-5,5.687E-5           * Decay correcting for an exponential release
 #
 #                                      Exponential constant (K2) for the leakage
 #                                      function adjusted to give a release
 #                                      half-time of 2 days.
 #                                         K2 = 1/(2 x 8.64E+4) = 5.787E-5
 #
 #                                      Using equation from page 4-16 of manual,
 #                                      K1 = K2 for 100% release and large time T
 #
 5400,2,0,0,0                    * Requesting program to calculate sigmas
 #
 #                                      No credit can be taken for building wake
 #                                      when the release is from a stack
 #
 5410,2,4,1                      * Choosing Markee diffusion
 #                                      Class D
 #
 #                                      Requesting plume rise calculation
 #                                      for a jet plume
 #
 5411,1.22,0,20.,0               * 1.22 m internal stack diameter
 #
 #                                      Class D does not use a restoring
 #                                      acceleration - defaulting to 0
 #
 #                                      20 m/s efflux speed of gases
 #
 #                                      Entering 0 for heat emission as it

 0        1         2         3         4         5         6         7
 12345678901234567890123456789012345678901234567890123456789012345678901234567890123456789
```

```
 example5      RSAC-6 INPUT      04/25/01      13:11
0         1         2         3         4         5         6         7
12345678901234567890123456789012345678901234567890123456789012345678901234567890123456789

#                                    is not used for a jet plume.  However,
#                                    RSAC-5 requires an entry for all words
#                                    on a line.
#
5999                  * End of meteorological data input
#
7000,5,-2,1,1,1       * Requesting air immersion dose calculation which is a
#                       valid calculation because the plume is large compared
#                       to the mean free path of the photons
#
#                              Printing only summary doses
#                              Calculating doses in rem
#                              Requesting doses for only selected elements
#                              Requesting doses for all organs
#
7001,3.33E-4,7.2E3,0,0     * Breathing rate not used - defaulting to program
#                            calculated value
#
#                            Exposing the receptor for only 2 h (7.2E3 s)
#                                 This does not release all of the inventory.
#                                 The program prints a warning when less than
#                                 100% of the inventory is released to be sure
#                                 that is really what is desired.  This
#                                 would represent evacuation of the downwind
#                                 location after 2 hours or the release was
#                                 terminated after 2 hours.
#
7081,54                    * Requesting dose calculation for only xenon.  A
#                            request could have been made for all elements;
#                            however, it would only take more computer time
#                            to get the same result.
#
7999                  * End of dose calculation
#
10000                 * End of run

0         1         2         3         4         5         6         7
12345678901234567890123456789012345678901234567890123456789012345678901234567890123456789
```

```
          RADIOLOGICAL SAFETY ANALYSIS COMPUTER PROGRAM (RSAC-6)
(RSAC-6, REV 6.1, 03/07/01)  SERIAL  800  DATE 04/25/2001  TIME 13:11 PAGE   1
example5:  Air immersion dose calculation

***DIRECT RADIONUCLIDE INPUT

       ANY PREVIOUS INVENTORY HAS BEEN ZEROED

    NUCLIDE          HALF LIFE       CURIES

 541330  Xe133    5.243E+00  d     1.000E+06

***METEOROLOGICAL DATA

      MEAN WIND SPEED = 1.000E+01 (m/s)    STACK HEIGHT = 5.000E+01 (m)
   MIXING LAYER HEIGHT = 2.500E+03 (m)      AIR DENSITY = 1.099E+03 (g/cu m)
   WET DEPOSITION SCAVENGING COEFFICIENT = 0.000E+00 (1/S)

   NO CORRECTION IS BEING MADE FOR PLUME DEPLETION BY FALLOUT

   DRY DEPOSITION VELOCITIES (m/s)
        SOLIDS = 0.000E+00    HALOGENS = 0.000E+00   NOBLE GASES = 0.000E+00
        CESIUM = 0.000E+00   RUTHENIUM = 0.000E+00

   THERE IS 1 SET OF LEAKAGE CONSTANTS (K1,K2)
        5.687E-05       5.687E-05

   PASQUILL CLASS D METEOROLOGY, MARKEE SIGMA VALUES

   PLUME RISE CALCULATED USING JET CONDITIONS
              STACK DIAMETER = 1.220E+00 (m)
           EFFLUENT VELOCITY = 2.000E+01 (m/s)
       RESTORING ACCELERATION = 0.000E+00 (1/sq s)

                      EFFECTIVE
   DOWNWIND DISTANCE    STACK        SIGY         SIGZ        CHI/Q
                      HEIGHT (m)      (m)          (m)       (s/cu m)
        1.000E+04      5.732E+01  3.841E+02    2.998E+02   2.714E-07
        3.000E+04      5.732E+01  8.322E+02    7.506E+02   5.081E-08

*** AIR IMMERSION DOSE EQUIVALENT CALCULATION

       USING DOSE RATE CONVERSION FACTORS FROM FEDERAL GUIDANCE REPORT 12

   RELEASE TIME FOR EXPONENTIAL DECAY FUNCTION =  7.200E+03 SECONDS
 WARNING, EXPONENTIAL LEAKAGE CONSTANTS AND EXPONENTIAL DECAY TIME ARE NOT
         MATCHED,   3.36E+01 PERCENT OF INVENTORY RELEASED

   DOWNWIND DISTANCE =  1.000E+04 (m)     PLUME TRAVEL TIME =  1.000E+03 (s)
                                          CHI/Q =  2.714E-07 (s/cu m)
```

RADIOLOGICAL SAFETY ANALYSIS COMPUTER PROGRAM (RSAC-6)
(RSAC-6, REV 6.1, 03/07/01) SERIAL 800 DATE 04/25/2001 TIME 13:11 PAGE 2
example5: Air immersion dose calculation

DOWNWIND DISTANCE = 3.000E+04 (m) PLUME TRAVEL TIME = 3.000E+03 (s)
CHI/Q = 5.081E-08 (s/cu m)

&& AIR IMMERSION DOSE EQUIVALENTS ORDERED BY ORGAN (rem)

		DOWNWIND DISTANCES (m)	
ORGAN	NO.	1.00E+04	3.00E+04
Lungs	1	4.83E-04	9.02E-05
S Wall	2	4.03E-04	7.51E-05
SI Wall	3	3.10E-04	5.79E-05
ULI Wall	4	3.39E-04	6.33E-05
LLI Wall	5	3.14E-04	5.85E-05
Testes	6	5.89E-04	1.10E-04
Breast	7	7.17E-04	1.34E-04
BSurface	8	1.88E-03	3.50E-04
R Marrow	9	3.92E-04	7.31E-05
Thyroid	10	5.53E-04	1.03E-04
Kidney	11	4.35E-04	8.13E-05
Liver	12	4.10E-04	7.65E-05
Spleen	13	4.06E-04	7.58E-05
Pancreas	14	3.38E-04	6.31E-05
Muscle	15	2.96E-04	5.53E-05
Skin	16	1.82E-03	3.39E-04
Brain	17	4.54E-04	8.47E-05
Thymus	18	4.65E-04	8.67E-05
U Bladd	19	3.81E-04	7.10E-05
Adrenal	20	5.09E-04	9.49E-05
Esophagu	21	2.93E-04	5.48E-05
Ovaries	22	2.83E-04	5.29E-05
Uterus	23	2.98E-04	5.55E-05

RADIOLOGICAL SAFETY ANALYSIS COMPUTER PROGRAM (RSAC-6)
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example5: Air immersion dose calculation

&& AIR IMMERSION DOSE EQUIVALENCES ORDERED BY DOSE (rem)

		DOWNWIND DISTANCES (m)	
ORGAN	NO.	1.00E+04	3.00E+04
BSurface	8	1.88E-03	3.50E-04
Skin	16	1.82E-03	3.39E-04
Breast	7	7.17E-04	1.34E-04
Testes	6	5.89E-04	1.10E-04
Thyroid	10	5.53E-04	1.03E-04
Adrenal	20	5.09E-04	9.49E-05
Lungs	1	4.83E-04	9.02E-05
Thymus	18	4.65E-04	8.67E-05
Brain	17	4.54E-04	8.47E-05
Kidney	11	4.35E-04	8.13E-05
Liver	12	4.10E-04	7.65E-05
Spleen	13	4.06E-04	7.58E-05
S Wall	2	4.03E-04	7.51E-05
R Marrow	9	3.92E-04	7.31E-05
U Bladd	19	3.81E-04	7.10E-05
ULI Wall	4	3.39E-04	6.33E-05
Pancreas	14	3.38E-04	6.31E-05
LLI Wall	5	3.14E-04	5.85E-05
SI Wall	3	3.10E-04	5.79E-05
Uterus	23	2.98E-04	5.55E-05
Muscle	15	2.96E-04	5.53E-05
Esophagu	21	2.93E-04	5.48E-05
Ovaries	22	2.83E-04	5.29E-05

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            RADIOLOGICAL SAFETY ANALYSIS COMPUTER PROGRAM (RSAC-6)
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example5:  Air immersion dose calculation

&&   AIR IMMERSION WEIGHTED DOSE EQUIVALENTS (rem)

                DOWNWIND DISTANCES (m)
   ORGAN    NO.  1.00E+04  3.00E+04
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 Lungs       1   5.80E-05  1.08E-05
 S Wall      2   2.42E-05  4.51E-06
 SI Wall     3   1.86E-05  3.48E-06
 ULI Wall    4   2.04E-05  3.80E-06
 LLI Wall    5   1.88E-05  3.51E-06
 Testes      6   1.47E-04  2.75E-05
 Breast      7   1.08E-04  2.01E-05
 BSurface    8   5.63E-05  1.05E-05
 R Marrow    9   4.70E-05  8.77E-06
 Thyroid    10   1.66E-05  3.09E-06
 Kidney     11   2.61E-05  4.88E-06
 Liver      12   2.46E-05  4.59E-06
 Spleen     13   2.44E-05  4.55E-06
 Pancreas   14   2.03E-05  3.79E-06
 Muscle     15   1.78E-05  3.32E-06
 Skin       16   1.82E-05  3.39E-06
 Brain      17   2.72E-05  5.08E-06
 Thymus     18   2.79E-05  5.20E-06
 U Bladd    19   2.28E-05  4.26E-06
 Adrenal    20   3.05E-05  5.70E-06
 Esophagu   21   1.76E-05  3.29E-06
 Ovaries    22   7.08E-05  1.32E-05
 Uterus     23   1.79E-05  3.33E-06
 EXT EDE    24   5.71E-04  1.07E-04

   EXECUTION TIME =  1.10E-01 SECONDS
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