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SOFTWARE RELEASE NOTICE

2/1/01

1. SRN Number: PA-SRN ~~232~~ 236	
2. Project Title: TSPA & Technical Integration Code	Project No. 20-01402-762
3. SRN Title: TPA Version 4.1e	
4. Originator/Requestor: Bruce Mabrito	Date: 01/31/01

5. Summary of Actions

- ☐ Release of new software
- ■ Release of modified software:
  - ■ Enhancements made
  - ■ Corrections made
- ☐ Change of access software
- ☑ Software Retirement GW 2/12/2003

6. Persons Authorized Access

Name	Read Only/Read-Write	Addition/Change/Delete
Sitakanta Mohanty	RW	
Ron Janetzke	RW	
David Esh (NRC)	RW	
Tim McCartin (NRC)	RW	
James Firth (NRC)	RW	

7. Element Manager Approval: Sitakanta Mohanty for G. Wittmeyer Date: 1/31/01

8. Remarks:

An 8mm tape containing FORTRAN source code for the TPA Version 4.1e code, and 2 data CDs containing binary executable files for the PC/Windows NT platform were sent to NRC.

CNWRA Form TOP-6 (05/98)

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SOFTWARE SUMMARY FORM

01. Summary Date: 01/31/01	02. Summary prepared by (Name and phone): Sitakanta Mohanty (210) 522-5185	03. Summary Action: Modified
04. Software Date: 01/31/01	05. Short Title: TPA Version 4.1e	
06. Software Title: TPA - System Performance Assessment Computer Code, Version 4.1e		07. Internal Software ID: None

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

11. Submitting Organization and Address:	12. Technical Contact(s) and Phone:
CNWRA/SwRI 6220 Culebra Road San Antonio, TX 78228	Sitakanta Mohanty (210) 522-5185

13. Software Application: The TPA Code consists of the following modules: UZFLOW, NFENV, EBSREL, UZFT, SZFT, DCAGW, FAULTO, SEISMO, VOLCANO, ASHPLUMO, ASHRMVO, DCAGS, LHS, EXEC.

14. Computer Platform:	15. Computer Operating System:	16. Programming Language(s):	17. Number of Source Program Statements:
SUN Workstation PC	UNIX Windows NT	SUN FORTRAN 5.0 Lahey LF90 V4.5	Approx. 41000 lines w/o stand alone codes
18. Computer Memory Requirements: 105 Mb	19. Tape Drives: None	20. Disk Units: N/A	21. Graphics: N/A

22. Other Operational Requirements:

Uses system environment variables: TPA_TEST and TPA_DATA.

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

25.

Software Developer: Ron Janetzke Date: 1-31-01

CNWRA Form TOP-4-1 (05/98)

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CENTER FOR NUCLEAR WASTE REGULATORY ANALYSES
DESIGN VERIFICATION REPORT FOR CNWRA SOFTWARE

DEVELOPED SOFTWARE[1]

Software Title/Name: TPA

Version: 4.1.e

Demonstration workstation: Sun Sparc 10

Operating System: Solaris 5.5.1

Developer: R. Janetzke

---

1. Software Requirements Description: TOP-018, Section 5.3

Software Requirements Description (SRD) and any changes thereto reviewed in accordance with QAP-002 requirements?

Yes: ☐ No: ☐ N/A: ☒

SRD Version: 4.0

SRD Approval Date: 11/30/99

Notes: Release consists of bug fixes & operational enhancements.

2. Software Development Plan (SDP): TOP-018, Section 5.4

a) The Element Manager has approved the SDP and any changes?

Yes: ☒ No: ☐ N/A: ☐

b) The SDP addresses applicable section of TOP-018, Appendix B, Software Development Plan Template?

Yes: ☒ No: ☐ N/A: ☐

SDP Version: 4.0

SDP Approval Date: 12/15/00

Notes: To be updated for 5.0 release.

[1] See TOP-018, Table 1 for criteria.

DESIGN VERIFICATION REPORT FOR CNWRA SOFTWARE DEVELOPED SOFTWARE

3. Design and Development: TOP-018, Section 5.5.1, 5.5.2

a) Is development and module/subroutine-level testing documented either in scientific notebooks and/or in Software Change Reports (SCR)?

Yes: ☒ No: ☐ N/A: ☐

Scientific Notebook(s): _____

SCR Number(s): ~~20~~ 19 PA-SCR-328, 329, 330, 331, 332, 333

Notes: Good documentation of testing.

b) Is development and module/subroutine-level testing sufficiently documented so that an informed reviewer can follow the testing procedures and logic?

Yes: ☒ No: ☐ N/A: ☐

Notes: See SCR's above.

c) Is development in accordance with the conventions described in the SDP/SCR, i.e. coding convention?

Yes: ☒ No: ☐ N/A: ☐

Notes:

4. Internal Documentation: TOP-018, Section 5.5.3

Software internally documented to allow a user to understand the function(s) being performed and to follow the flow of execution of individual routines?

Yes: ☒ No: ☐ N/A: ☐

Module(s) Reviewed: dcagw.f
exec.f

Notes:

5. Output: TOP-018, Section 5.5.4

Software designed so that individual runs are uniquely identified by Date, Time, Name of software and version?

Yes: ☒ No: ☐ N/A: ☐

Date and time of run: Jan 31, 2001 11:48:48

Name and version: TPA Version 4.1e

Notes: See attached

DESIGN VERIFICATION REPORT FOR CNWRA SOFTWARE DEVELOPED SOFTWARE

6. Code Reviews: TOP-018, Section 5.5.5

Are code reviews (if implemented) documented in a scientific notebook or in another format that allows others to understand the code review process and results?

Yes: ☐ No: ☐ N/A: ☒

Scientific Notebook: No code reviews for this release.

Notes: Acquired code that is not to be modified is accepted as is. No code reviews required.

7. Medium and Header Documentation: TOP-018, Section 5.5.6

a) Program title block of main program contains required information?

Yes: ☒ No: ☐ N/A: ☐

Program Title: TPA 4.1e

Customer Name: NSNRC

Customer Office/Division: Div. of Waste mgmt.

Customer Contact(s): Tim McCartin

Customer Phone Number: 301-415-6681

Associated Documentation: 4.0 User's manual

Disclaimer Notice: Included.

Notes:

b) Source code module header contains required information provides Program Name, Client Name, Contract Reference, Revision Number, and Revision History*? 4.1

Yes: ☒ No: ☐ N/A: ☐

Module Reviewed: dcagw.f

Module Reviewed: reader.f

Module Reviewed: Sampler.f

Notes: * Added during design verification for Three (3) affected modules.

DESIGN VERIFICATION REPORT FOR CNWRA SOFTWARE DEVELOPED SOFTWARE

7. Medium and Header Documentation, continued: TOP-018, Section 5.5.6

c) The physical labeling of software medium (tapes, disks, etc.) contain required information?

Yes: ☒ No: ☐ N/A: ☐

Program Name: TPA 4.1e

Module/Name/Title: tar -crf /dev/rmt/0

Module Revision: tpa 41e

File Type (ASCII, OBJ, EXE): tar

Recording Date: 1/31/01

Operating System of Supporting Hardware: Sun / solaris

Notes: List of modules on print out enclosed with tape.

8. User's Manual: TOP-018, Section 5.5.5

a) Is there a Users' Manual for the software?

Yes: ☒ No: ☐ N/A: ☐

User's Manual Version and Date: 4.0, April 2000

Notes:

b) Are there basic instructions for the use of the software?

Yes: ☒ No: ☐ N/A: ☐

Location of Instruction: Section 21

Notes: Addressed b/k installation & execution.

9. Acceptance Testing: TOP-018, Section 5.6

a) Does the acceptance testing demonstrate whether or not requirements in the SRD and/or SCR have been fulfilled?

Yes: ☒ No: ☐ N/A: ☐

Location of Test Results: See scrs in question #3

Notes:

DESIGN VERIFICATION REPORT FOR CNWRA SOFTWARE DEVELOPED SOFTWARE

9. Acceptance Testing, continued: TOP-018, Section 5.6

b) Has acceptance testing been conducted for each intended computer platform and operating system?

Yes: ☒ No: ☐ 02/32/01 N/A: ☐

Platform(s): Sun ~~NT~~ Intel PC

Operating System(s): Solaris NT

Location of Test Results: See SCRs listed ~~page~~ #3.

Notes: Base case run on each platform. See attached.

c) Has installation testing been conducted for each intended computer platform and operating system?

Yes: ☒ No: ☐ N/A: ☐

Platform(s): Sun ~ Vulcan, NT-Alby

Operating System(s): Solaris NT

Location of Test Results: See attached

Notes: Inspected results & compared between Sun & NT systems.

10. Configuration Control: TOP-018, Section 5.7

a) Is the Software Summary Form completed and signed?

Yes: ☒ No: ☐ N/A: ☐

Software Summary Form Approval Date: Jan 31, 01

Notes:

b) Is a software technical description prepared, documenting the essential mathematical and numerical basis?

Yes: ☒ No: ☐ N/A: ☐

Location Technical Description: User's Manual Ver 4.0

Notes: Sections 4-18

c) 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: tape

Notes:

DESIGN VERIFICATION REPORT FOR CNWRA SOFTWARE DEVELOPED SOFTWARE

11. Configuration Control, continued: TOP-018, Section 5.7

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

Yes: ☒ No: ☐ N/A: ☐

Location of Script/Make Files: on tape

Notes: Files listed on tpa41e.lst

12. Software Release: TOP-018, Section 5.9

Upon acceptance of the software as verified above, has a Software Release Notice, Form TOP-6 been issued?

Yes: ☒ No: ☐ N/A: ☐

Version number on software (1.0 for 1st issue): 4.1e

Version number on SRN: 4.1e

Notes:

13. Software Validation: TOP-018, Section 5.10

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

Yes: ☐ No: ☐ N/A: ☒

Version/Date of SVTP: _____

Date reviewed and approved via QAP-002: _____

Notes: No SVTP to date. Due for version 5.0

b) 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/Date of SVTR: _____

Date reviewed and approved via QAP-002: _____

Notes: No SVTR to date Due for version 5.0

Additional Remarks:

1-31-01
CNWRA Software Developer/Date

1/31/01
CNWRA Software Custodian/Date

1/31/2001

```
=====================================================================
          exec: Welcome to TPA Version 4.1e
        Job started: Wed Jan 31 11:18:48 2001
=====================================================================
 REPOSITORY DESIGN INFORMATION
 Subarea   Area       Waste   Number of WP
    #     [m^2]       [MTU]
    1    723591.3    11058.1        1133
    2    784763.0    11546.1        1183
    3    390372.0     5563.2         570
    4    207581.3     3445.3         353
    5    378972.8     5553.4         569
    6    424872.5     6236.6         639
    7    163938.3     2381.4         244
    8    393468.9     6588.0         675
    9    660785.5     9311.0         954
   10    589497.1     8325.3         853

 Total Area [acre]          =     1165.7629779961
 Total Buried Waste [MTU]   =     70008.480000000
 Repository AML [MTU/acre]  =     60.053785650616

 Specified Global Parameters:

                Compliance Period =  10000.0 (yr)
           Maximum Simulation Time = 100000.0 (yr)
            Number Of Realizations =      1
                Number Of Subareas =     10
                Volcanism scenario =      0 (yes=1, no=0)
                 Faulting scenario =      0 (yes=1, no=0)
                  Seismic scenario =      1 (yes=1, no=0)
       Distance to Receptor Group =     20.0 (km)


 **>>> CAUTION: CHECKING OF NUCLIDES AND CHAINS IS DISABLED <<<**
 **>>> You may not be using the standard chains specified   <<<**
 **>>> in the invent module.                                <<<**
 **>>> (see "CheckNuclidesAndChains(yes=1,no=0)" in tpa.inp)<<<**

 The specified path for data  = $TPA_DATA/
 The specified path for codes = $TPA_TEST/

 **To modify global parameters or the path, stop code execution using control-C**
-----------------------------------------------------------------------
    subarea   1 of  10          realization    1 of    1
-----------------------------------------------------------------------
 exec: calling uzflow
 exec: calling nfenv
 exec: calling ebsfail
      ebsfail: time of WP failure =    60928.4  yr
 exec: calling seismo
 exec: failed WPs from INITIAL   event =      2 at time =      0.0 yr
 exec: failed WPs from CORROSION event =   1131 at time =  60928.4 yr
  *** failed WPs: all WPs failed (  1133) ***
 exec: calling ebsrel
                 Highest release rates from Sub Area  1
             Tc99    1.7174E-02 [Ci/yr/SA] at  7.798E+04 yr
             Cs135   4.0632E-03 [Ci/yr/SA] at  7.798E+04 yr
             Pu239   1.6162E-03 [Ci/yr/SA] at  7.798E+04 yr
```

```
              Ni59     2.7706E-04 [Ci/yr/SA] at  7.798E+04 yr
              I129     2.7511E-04 [Ci/yr/SA] at  7.798E+04 yr
              Np237    2.6937E-04 [Ci/yr/SA] at  1.000E+05 yr
 exec: calling uzft
                       Highest release rates from UZ
              Tc99     1.6904E-02 [Ci/yr/SA] at  7.798E+04 yr
              I129     2.7100E-04 [Ci/yr/SA] at  7.798E+04 yr
              Np237    2.6723E-04 [Ci/yr/SA] at  1.000E+05 yr
              Se79     1.8559E-04 [Ci/yr/SA] at  7.798E+04 yr
              Cl36     1.4904E-04 [Ci/yr/SA] at  7.798E+04 yr
              Nb94     1.6053E-05 [Ci/yr/SA] at  7.798E+04 yr
 exec: calling szft
                       Highest release rates from SZ
              Tc99     1.6222E-02 [Ci/yr/SA] at  7.798E+04 yr
              I129     2.6061E-04 [Ci/yr/SA] at  7.798E+04 yr
              Cl36     1.4312E-04 [Ci/yr/SA] at  7.798E+04 yr
              U234     3.0292E-06 [Ci/yr/SA] at  1.000E+05 yr
              Np237    2.8293E-06 [Ci/yr/SA] at  6.093E+04 yr
              U238     9.0880E-07 [Ci/yr/SA] at  1.000E+05 yr
-----------------------------------------------------------------------
     subarea   2 of  10           realization    1 of    1
-----------------------------------------------------------------------
 exec: calling uzflow
 exec: calling nfenv
 exec: calling ebsfail
      ebsfail: time of WP failure =    60928.4  yr
 exec: failed WPs from INITIAL   event =      2 at time =      0.0 yr
 exec: failed WPs from CORROSION event =   1181 at time =  60928.4 yr
  *** failed WPs: all WPs failed (  1183) ***
  *** ejected WPs:   0
 exec: calling ebsrel
                  Highest release rates from Sub Area  2
              Tc99     1.1571E-03 [Ci/yr/SA] at  7.798E+04 yr
              Pu239    8.4316E-04 [Ci/yr/SA] at  7.798E+04 yr
              Cs135    2.6513E-04 [Ci/yr/SA] at  7.798E+04 yr
              Am243    3.7100E-05 [Ci/yr/SA] at  1.505E+04 yr
              Ni59     2.2193E-05 [Ci/yr/SA] at  7.798E+04 yr
              C14      2.1744E-05 [Ci/yr/SA] at  1.505E+04 yr
 exec: calling uzft
       *** NEFTRAN is skipped for this UZ path since no layers have significant grou
nd water
travel time. ***
                       Highest release rates from UZ
              Tc99     1.1571E-03 [Ci/yr/SA] at  7.798E+04 yr
              Pu239    8.4316E-04 [Ci/yr/SA] at  7.798E+04 yr
              Cs135    2.6513E-04 [Ci/yr/SA] at  7.798E+04 yr
              Am243    3.7100E-05 [Ci/yr/SA] at  1.505E+04 yr
              Ni59     2.2193E-05 [Ci/yr/SA] at  7.798E+04 yr
              Np237    1.9285E-05 [Ci/yr/SA] at  7.798E+04 yr
 exec: calling szft
                       Highest release rates from SZ
              Tc99     1.1116E-03 [Ci/yr/SA] at  7.798E+04 yr
              I129     1.7268E-05 [Ci/yr/SA] at  7.798E+04 yr
              Cl36     9.5116E-06 [Ci/yr/SA] at  7.798E+04 yr
              Ni59     3.2545E-06 [Ci/yr/SA] at  1.000E+05 yr
              Np237    2.7980E-06 [Ci/yr/SA] at  6.093E+04 yr
              U234     2.6138E-06 [Ci/yr/SA] at  1.000E+05 yr
-----------------------------------------------------------------------
     subarea   3 of  10           realization    1 of    1
```

```
-----------------------------------------------------------------------
 exec: calling uzflow
 exec: calling nfenv
 exec: calling ebsfail
      ebsfail: time of WP failure =    60928.4  yr
 exec: failed WPs from INITIAL   event =      1 at time =      0.0 yr
 exec: failed WPs from CORROSION event =    569 at time =  60928.4 yr
  *** failed WPs: all WPs failed (  570) ***
 exec: calling ebsrel
                  Highest release rates from Sub Area  3
              Tc99    1.6142E-03 [Ci/yr/SA] at  7.798E+04 yr
              Pu239   8.1999E-04 [Ci/yr/SA] at  7.798E+04 yr
              Cs135   3.7275E-04 [Ci/yr/SA] at  7.798E+04 yr
              Ni59    2.9609E-05 [Ci/yr/SA] at  7.798E+04 yr
              Np237   2.5738E-05 [Ci/yr/SA] at  7.798E+04 yr
              I129    2.5224E-05 [Ci/yr/SA] at  7.798E+04 yr
 exec: calling uzft
                      Highest release rates from UZ
              Tc99    1.5831E-03 [Ci/yr/SA] at  7.798E+04 yr
              Np237   2.5667E-05 [Ci/yr/SA] at  1.000E+05 yr
              I129    2.4762E-05 [Ci/yr/SA] at  7.798E+04 yr
              Se79    1.6711E-05 [Ci/yr/SA] at  7.798E+04 yr
              Cl36    1.3653E-05 [Ci/yr/SA] at  7.798E+04 yr
              U234    2.0203E-06 [Ci/yr/SA] at  7.798E+04 yr
 exec: calling szft
                      Highest release rates from SZ
              Tc99    1.5194E-03 [Ci/yr/SA] at  7.798E+04 yr
              I129    2.3816E-05 [Ci/yr/SA] at  7.798E+04 yr
              Cl36    1.3112E-05 [Ci/yr/SA] at  7.798E+04 yr
              U234    1.4891E-06 [Ci/yr/SA] at  1.000E+05 yr
              U238    4.4369E-07 [Ci/yr/SA] at  1.000E+05 yr
              Th230   1.0252E-07 [Ci/yr/SA] at  1.000E+05 yr
-----------------------------------------------------------------------
     subarea   4 of  10           realization    1 of    1
-----------------------------------------------------------------------
 exec: calling uzflow
 exec: calling nfenv
 exec: calling ebsfail
      ebsfail: time of WP failure =    60928.4  yr
 exec: failed WPs from INITIAL   event =      1 at time =      0.0 yr
 exec: failed WPs from CORROSION event =    352 at time =  60928.4 yr
  *** failed WPs: all WPs failed (  353) ***
 exec: calling ebsrel
                  Highest release rates from Sub Area  4
              Tc99    1.2188E-03 [Ci/yr/SA] at  7.798E+04 yr
              Pu239   3.5007E-04 [Ci/yr/SA] at  7.798E+04 yr
              Cs135   2.8317E-04 [Ci/yr/SA] at  7.798E+04 yr
              Ni59    2.1620E-05 [Ci/yr/SA] at  7.798E+04 yr
              Np237   1.9321E-05 [Ci/yr/SA] at  1.000E+05 yr
              I129    1.9163E-05 [Ci/yr/SA] at  7.798E+04 yr
 exec: calling uzft
                      Highest release rates from UZ
              Tc99    1.1922E-03 [Ci/yr/SA] at  7.798E+04 yr
              Np237   1.9257E-05 [Ci/yr/SA] at  1.000E+05 yr
              I129    1.8766E-05 [Ci/yr/SA] at  7.798E+04 yr
              Se79    1.2521E-05 [Ci/yr/SA] at  7.798E+04 yr
              Cl36    1.0344E-05 [Ci/yr/SA] at  7.798E+04 yr
              Nb94    1.2521E-06 [Ci/yr/SA] at  7.798E+04 yr
 exec: calling szft
```

```
                    Highest release rates from SZ
            Tc99    1.1452E-03 [Ci/yr/SA] at  7.798E+04 yr
            I129    1.8062E-05 [Ci/yr/SA] at  7.798E+04 yr
            Cl36    9.9416E-06 [Ci/yr/SA] at  7.798E+04 yr
            U234    6.2742E-07 [Ci/yr/SA] at  1.000E+05 yr
            U238    1.8606E-07 [Ci/yr/SA] at  1.000E+05 yr
            Np237   1.1533E-07 [Ci/yr/SA] at  6.093E+04 yr
-----------------------------------------------------------------------
    subarea   5 of  10          realization    1 of    1
-----------------------------------------------------------------------
 exec: calling uzflow
 exec: calling nfenv
 exec: calling ebsfail
     ebsfail: time of WP failure =    60928.4  yr
 exec: failed WPs from INITIAL   event =      1 at time =      0.0 yr
 exec: failed WPs from CORROSION event =    568 at time =  60928.4 yr
  *** failed WPs: all WPs failed (  569) ***
 exec: calling ebsrel
                Highest release rates from Sub Area  5
            Tc99    3.9216E-03 [Ci/yr/SA] at  7.798E+04 yr
            Cs135   9.1776E-04 [Ci/yr/SA] at  7.798E+04 yr
            Pu239   7.4487E-04 [Ci/yr/SA] at  7.798E+04 yr
            Ni59    6.6702E-05 [Ci/yr/SA] at  7.798E+04 yr
            I129    6.2116E-05 [Ci/yr/SA] at  7.798E+04 yr
            Np237   6.1502E-05 [Ci/yr/SA] at  1.000E+05 yr
 exec: calling uzft
                    Highest release rates from UZ
            Tc99    3.7974E-03 [Ci/yr/SA] at  7.798E+04 yr
            Np237   6.0949E-05 [Ci/yr/SA] at  1.000E+05 yr
            I129    6.0244E-05 [Ci/yr/SA] at  7.798E+04 yr
            Se79    3.8347E-05 [Ci/yr/SA] at  7.798E+04 yr
            Cl36    3.3185E-05 [Ci/yr/SA] at  7.798E+04 yr
            Nb94    3.7982E-06 [Ci/yr/SA] at  7.798E+04 yr
 exec: calling szft
                    Highest release rates from SZ
            Tc99    3.6470E-03 [Ci/yr/SA] at  7.798E+04 yr
            I129    5.7977E-05 [Ci/yr/SA] at  7.798E+04 yr
            Cl36    3.1890E-05 [Ci/yr/SA] at  7.798E+04 yr
            U234    1.3612E-06 [Ci/yr/SA] at  1.000E+05 yr
            Np237   9.3291E-07 [Ci/yr/SA] at  7.798E+04 yr
            U238    4.0874E-07 [Ci/yr/SA] at  1.000E+05 yr
-----------------------------------------------------------------------
    subarea   6 of  10          realization    1 of    1
-----------------------------------------------------------------------
 exec: calling uzflow
 exec: calling nfenv
 exec: calling ebsfail
     ebsfail: time of WP failure =    60928.4  yr
 exec: failed WPs from INITIAL   event =      1 at time =      0.0 yr
 exec: failed WPs from CORROSION event =    638 at time =  60928.4 yr
  *** failed WPs: all WPs failed (  639) ***
 exec: calling ebsrel
                Highest release rates from Sub Area  6
            Tc99    8.4773E-03 [Ci/yr/SA] at  7.798E+04 yr
            Cs135   2.0232E-03 [Ci/yr/SA] at  7.798E+04 yr
            Pu239   6.2272E-04 [Ci/yr/SA] at  7.798E+04 yr
            I129    1.3701E-04 [Ci/yr/SA] at  7.798E+04 yr
            Ni59    1.2977E-04 [Ci/yr/SA] at  7.798E+04 yr
            Np237   1.2966E-04 [Ci/yr/SA] at  1.000E+05 yr
```

```
 exec: calling uzft
                        Highest release rates from UZ
              Tc99     8.0919E-03 [Ci/yr/SA] at  7.798E+04 yr
              I129     1.3109E-04 [Ci/yr/SA] at  7.798E+04 yr
              Np237    1.2611E-04 [Ci/yr/SA] at  1.000E+05 yr
              Se79     7.6036E-05 [Ci/yr/SA] at  7.798E+04 yr
              Cl36     7.1953E-05 [Ci/yr/SA] at  7.798E+04 yr
              Nb94     7.1638E-06 [Ci/yr/SA] at  7.798E+04 yr
 exec: calling szft
                        Highest release rates from SZ
              Tc99     7.7726E-03 [Ci/yr/SA] at  7.798E+04 yr
              I129     1.2617E-04 [Ci/yr/SA] at  7.798E+04 yr
              Cl36     6.9156E-05 [Ci/yr/SA] at  7.798E+04 yr
              U234     1.1184E-06 [Ci/yr/SA] at  1.000E+05 yr
              Np237    4.1909E-07 [Ci/yr/SA] at  7.798E+04 yr
              U238     3.3968E-07 [Ci/yr/SA] at  1.000E+05 yr
-----------------------------------------------------------------------
     subarea   7 of  10           realization    1 of    1
-----------------------------------------------------------------------
 exec: calling uzflow
 exec: calling nfenv
 exec: calling ebsfail
      ebsfail: time of WP failure =    60928.4  yr
 exec: failed WPs from CORROSION event =    244 at time =  60928.4 yr
  *** failed WPs: all WPs failed (  244) ***
 exec: calling ebsrel
                   Highest release rates from Sub Area  7
              Tc99     3.6523E-03 [Ci/yr/SA] at  7.798E+04 yr
              Cs135    8.7821E-04 [Ci/yr/SA] at  7.798E+04 yr
              Pu239    2.2305E-04 [Ci/yr/SA] at  7.798E+04 yr
              I129     5.9480E-05 [Ci/yr/SA] at  7.798E+04 yr
              Np237    5.4616E-05 [Ci/yr/SA] at  1.000E+05 yr
              Ni59     5.3349E-05 [Ci/yr/SA] at  7.798E+04 yr
 exec: calling uzft
                        Highest release rates from UZ
              Tc99     3.4588E-03 [Ci/yr/SA] at  7.798E+04 yr
              I129     5.6479E-05 [Ci/yr/SA] at  7.798E+04 yr
              Np237    5.2517E-05 [Ci/yr/SA] at  1.000E+05 yr
              Cl36     3.0970E-05 [Ci/yr/SA] at  7.798E+04 yr
              Se79     3.0184E-05 [Ci/yr/SA] at  7.798E+04 yr
              Nb94     2.9005E-06 [Ci/yr/SA] at  7.798E+04 yr
 exec: calling szft
                        Highest release rates from SZ
              Tc99     3.3227E-03 [Ci/yr/SA] at  7.798E+04 yr
              I129     5.4368E-05 [Ci/yr/SA] at  7.798E+04 yr
              Cl36     2.9770E-05 [Ci/yr/SA] at  7.798E+04 yr
              U234     4.0151E-07 [Ci/yr/SA] at  1.000E+05 yr
              U238     1.2119E-07 [Ci/yr/SA] at  1.000E+05 yr
              Th230    3.1843E-08 [Ci/yr/SA] at  1.000E+05 yr
-----------------------------------------------------------------------
     subarea   8 of  10           realization    1 of    1
-----------------------------------------------------------------------
 exec: calling uzflow
 exec: calling nfenv
 exec: calling ebsfail
      ebsfail: time of WP failure =    60928.4  yr
 exec: failed WPs from INITIAL   event =      1 at time =      0.0 yr
 exec: failed WPs from CORROSION event =    674 at time =  60928.4 yr
  *** failed WPs: all WPs failed (  675) ***
```

```
 exec: calling ebsrel
                 Highest release rates from Sub Area  8
              Tc99    5.5818E-03 [Ci/yr/SA] at  7.798E+04 yr
              Cs135   1.3049E-03 [Ci/yr/SA] at  7.798E+04 yr
              Pu239   8.8555E-04 [Ci/yr/SA] at  7.798E+04 yr
              Ni59    9.6166E-05 [Ci/yr/SA] at  7.798E+04 yr
              Np237   8.9042E-05 [Ci/yr/SA] at  1.000E+05 yr
              I129    8.8322E-05 [Ci/yr/SA] at  7.798E+04 yr
 exec: calling uzft
       *** NEFTRAN is skipped for this UZ path since no layers have significant grou
nd water
travel time. ***
                      Highest release rates from UZ
              Tc99    5.5818E-03 [Ci/yr/SA] at  7.798E+04 yr
              Cs135   1.3049E-03 [Ci/yr/SA] at  7.798E+04 yr
              Pu239   8.8555E-04 [Ci/yr/SA] at  7.798E+04 yr
              Ni59    9.6166E-05 [Ci/yr/SA] at  7.798E+04 yr
              Np237   8.9042E-05 [Ci/yr/SA] at  1.000E+05 yr
              I129    8.8322E-05 [Ci/yr/SA] at  7.798E+04 yr
 exec: calling szft
                      Highest release rates from SZ
              Tc99    5.3598E-03 [Ci/yr/SA] at  7.798E+04 yr
              I129    8.4984E-05 [Ci/yr/SA] at  7.798E+04 yr
              Cl36    4.6760E-05 [Ci/yr/SA] at  7.798E+04 yr
              Ni59    1.3281E-05 [Ci/yr/SA] at  1.000E+05 yr
              U234    1.6618E-06 [Ci/yr/SA] at  1.000E+05 yr
              Np237   1.6232E-06 [Ci/yr/SA] at  6.093E+04 yr
-----------------------------------------------------------------------
     subarea   9 of  10           realization    1 of    1
-----------------------------------------------------------------------
 exec: calling uzflow
 exec: calling nfenv
 exec: calling ebsfail
      ebsfail: time of WP failure =    60928.4  yr
 exec: failed WPs from INITIAL   event =      2 at time =      0.0 yr
 exec: failed WPs from CORROSION event =    952 at time =  60928.4 yr
  *** failed WPs: all WPs failed (  954) ***
 exec: calling ebsrel
                 Highest release rates from Sub Area  9
              Tc99    7.1764E-03 [Ci/yr/SA] at  7.798E+04 yr
              Cs135   1.6812E-03 [Ci/yr/SA] at  7.798E+04 yr
              Pu239   1.1440E-03 [Ci/yr/SA] at  7.798E+04 yr
              Ni59    1.2180E-04 [Ci/yr/SA] at  7.798E+04 yr
              I129    1.1379E-04 [Ci/yr/SA] at  7.798E+04 yr
              Np237   1.1333E-04 [Ci/yr/SA] at  1.000E+05 yr
 exec: calling uzft
       *** NEFTRAN is skipped for this UZ path since no layers have significant grou
nd water
travel time. ***
                      Highest release rates from UZ
              Tc99    7.1764E-03 [Ci/yr/SA] at  7.798E+04 yr
              Cs135   1.6812E-03 [Ci/yr/SA] at  7.798E+04 yr
              Pu239   1.1440E-03 [Ci/yr/SA] at  7.798E+04 yr
              Ni59    1.2180E-04 [Ci/yr/SA] at  7.798E+04 yr
              I129    1.1379E-04 [Ci/yr/SA] at  7.798E+04 yr
              Np237   1.1333E-04 [Ci/yr/SA] at  1.000E+05 yr
 exec: calling szft
                      Highest release rates from SZ
              Tc99    6.8022E-03 [Ci/yr/SA] at  7.798E+04 yr
```

```
              I129    1.0814E-04 [Ci/yr/SA] at  7.798E+04 yr
              Cl36    5.9492E-05 [Ci/yr/SA] at  7.798E+04 yr
              Ni59    1.7432E-05 [Ci/yr/SA] at  1.000E+05 yr
              U234    2.4169E-06 [Ci/yr/SA] at  1.000E+05 yr
              Np237   1.5576E-06 [Ci/yr/SA] at  1.000E+05 yr
-----------------------------------------------------------------------
     subarea  10 of  10           realization    1 of    1
-----------------------------------------------------------------------
 exec: calling uzflow
 exec: calling nfenv
 exec: calling ebsfail
      ebsfail: time of WP failure =    60928.4  yr
 exec: failed WPs from INITIAL   event =      1 at time =      0.0 yr
 exec: failed WPs from CORROSION event =    852 at time =  60928.4 yr
  *** failed WPs: all WPs failed (  853) ***
 exec: calling ebsrel
                 Highest release rates from Sub Area  10
              Tc99    2.5384E-03 [Ci/yr/SA] at  7.798E+04 yr
              Pu239   9.8815E-04 [Ci/yr/SA] at  7.798E+04 yr
              Cs135   5.8831E-04 [Ci/yr/SA] at  7.798E+04 yr
              Ni59    4.5578E-05 [Ci/yr/SA] at  7.798E+04 yr
              Np237   4.0137E-05 [Ci/yr/SA] at  1.000E+05 yr
              I129    3.9811E-05 [Ci/yr/SA] at  7.798E+04 yr
 exec: calling uzft
       *** NEFTRAN is skipped for this UZ path since no layers have significant grou
nd water
travel time. ***
                      Highest release rates from UZ
              Tc99    2.5384E-03 [Ci/yr/SA] at  7.798E+04 yr
              Pu239   9.8815E-04 [Ci/yr/SA] at  7.798E+04 yr
              Cs135   5.8831E-04 [Ci/yr/SA] at  7.798E+04 yr
              Ni59    4.5578E-05 [Ci/yr/SA] at  7.798E+04 yr
              Np237   4.0137E-05 [Ci/yr/SA] at  1.000E+05 yr
              I129    3.9811E-05 [Ci/yr/SA] at  7.798E+04 yr
 exec: calling szft
                      Highest release rates from SZ
              Tc99    2.4074E-03 [Ci/yr/SA] at  7.798E+04 yr
              I129    3.7858E-05 [Ci/yr/SA] at  7.798E+04 yr
              Cl36    2.0849E-05 [Ci/yr/SA] at  7.798E+04 yr
              Ni59    6.5268E-06 [Ci/yr/SA] at  1.000E+05 yr
              U234    2.0692E-06 [Ci/yr/SA] at  1.000E+05 yr
              U238    6.2243E-07 [Ci/yr/SA] at  1.000E+05 yr
 exec: calling dcagw
                      Highest annual dose GW pathway
              I129    1.6834E-02 [mrem/yr]  at  7.798E+04 yr
              Tc99    5.8850E-03 [mrem/yr]  at  7.798E+04 yr
              Np237   2.8102E-03 [mrem/yr]  at  6.093E+04 yr
              U234    3.9202E-04 [mrem/yr]  at  1.000E+05 yr
              Cl36    1.2377E-04 [mrem/yr]  at  7.798E+04 yr
              U238    1.0969E-04 [mrem/yr]  at  1.000E+05 yr
            At end of TPI, annual dose GW pathway
              I129    1.3727E-03 [mrem/yr]
              Tc99    1.1734E-03 [mrem/yr]
              Np237   1.1261E-03 [mrem/yr]
              U234    3.9202E-04 [mrem/yr]
              U238    1.0969E-04 [mrem/yr]
              Th230   7.6750E-05 [mrem/yr]
                 sum  4.2668E-03 [mrem/yr]
 exec: end realizations
```

```
exec: Peak Mean Dose is 2.41080E-05 rem/yr at  77979.0 yr.

exec:  Run Successfully Completed
```

```
tpa41e/
tpa41e/CLEANUP
tpa41e/array.f
tpa41e/ashplumo.f
tpa41e/ashrmovo.f
tpa41e/condxyzt.f
tpa41e/dcags.f
tpa41e/dcagw.f
tpa41e/ebsfail.f
tpa41e/ebsrel.f
tpa41e/exec.f
tpa41e/execa.i
tpa41e/execb.i
tpa41e/execc.i
tpa41e/faulto.f
tpa41e/fileunit.f
tpa41e/findelev.f
tpa41e/invent.f
tpa41e/iareader.f
tpa41e/ia.i
tpa41e/ia1.i
tpa41e/Makefile
tpa41e/max500yr.i
tpa41e/maxchain.i
tpa41e/maxnnucl.i
tpa41e/maxnsuba.i
tpa41e/maxntime.i
tpa41e/mv.f
tpa41e/nfenv.f
tpa41e/reflux2.i
tpa41e/nintv.i
tpa41e/notice.i
tpa41e/numrecip.f
tpa41e/path.i
tpa41e/peakfind.f
tpa41e/ran.f
tpa41e/reader.f
tpa41e/reader.i
tpa41e/reader1.i
tpa41e/reader2.i
tpa41e/reader3.i
tpa41e/reader4.i
tpa41e/driftsa.i
tpa41e/sampler.f
tpa41e/seismo.f
tpa41e/stop.i
tpa41e/subarea.f
tpa41e/szft.f
tpa41e/szft.i
tpa41e/tpa.inp
tpa41e/tpa_.out
tpa41e/uzflow.f
tpa41e/uzft.f
tpa41e/volcano.f
tpa41e/fu1.i
tpa41e/fu2.i
tpa41e/inventa.i
tpa41e/inventb.i
tpa41e/inventc.i
```

```
tpa41e/inventd.i
tpa41e/invente.i
tpa41e/inventf.i
tpa41e/inventg.i
tpa41e/inventh.i
tpa41e/inventi.i
tpa41e/inventj.i
tpa41e/inventk.i
tpa41e/inventl.i
tpa41e/inventm.i
tpa41e/inventn.i
tpa41e/invento.i
tpa41e/inventp.i
tpa41e/mva.i
tpa41e/mvb.i
tpa41e/mvc.i
tpa41e/mvd.i
tpa41e/mve.i
tpa41e/mvf.i
tpa41e/sampler0.i
tpa41e/sampler1.i
tpa41e/sampler2.i
tpa41e/sampler3.i
tpa41e/sampler4.i
tpa41e/samplera.i
tpa41e/samplerb.i
tpa41e/samplerc.i
tpa41e/samplerd.i
tpa41e/samplere.i
tpa41e/samplerf.i
tpa41e/samplerg.i
tpa41e/samplerh.i
tpa41e/sampleri.i
tpa41e/samplerj.i
tpa41e/samplerk.i
tpa41e/samplerl.i
tpa41e/samplerm.i
tpa41e/samplern.i
tpa41e/samplero.i
tpa41e/samplerp.i
tpa41e/samplerq.i
tpa41e/samplerr.i
tpa41e/samplers.i
tpa41e/samplert.i
tpa41e/sampleru.i
tpa41e/samplerv.i
tpa41e/samplerw.i
tpa41e/samplerx.i
tpa41e/samplery.i
tpa41e/samplerz.i
tpa41e/subareaa.i
tpa41e/subareab.i
tpa41e/subareac.i
tpa41e/subaread.i
tpa41e/subareae.i
tpa41e/subareaf.i
tpa41e/subareag.i
tpa41e/uz_climi.i
tpa41e/uz_climr.i
```

```
tpa41e/uz_climz.i
tpa41e/uz_flowi.i
tpa41e/uz_flowr.i
tpa41e/uz_flowz.i
tpa41e/uz_parms.i
tpa41e/zportunx.f
tpa41e/codes/
tpa41e/codes/Makefile
tpa41e/codes/README
tpa41e/codes/SIZES.INC
tpa41e/codes/SIZES2.INC
tpa41e/codes/ashplume.f
tpa41e/codes/failt.f
tpa41e/codes/nefmks.f
tpa41e/codes/releaset.f
tpa41e/codes/snllhs.f
tpa41e/codes/ebsfilt.f
tpa41e/codes/gentpa/
tpa41e/codes/gentpa/Mkenv.fig
tpa41e/codes/gentpa/Mkenvin.fig
tpa41e/codes/gentpa/AFPPAR.CMN
tpa41e/codes/gentpa/AIRPAR.CMN
tpa41e/codes/gentpa/ANMPAR.CMN
tpa41e/codes/gentpa/AQUPAR.CMN
tpa41e/codes/gentpa/CONC.CMN
tpa41e/codes/gentpa/DAYPC.CMN
tpa41e/codes/gentpa/DECAY.CMN
tpa41e/codes/gentpa/DFPAR.CMN
tpa41e/codes/gentpa/DOSALL.CMN
tpa41e/codes/gentpa/ENVPAR.CMN
tpa41e/codes/gentpa/EXPALL.CMN
tpa41e/codes/gentpa/EXTPAR.CMN
tpa41e/codes/gentpa/FILES.CMN
tpa41e/codes/gentpa/FODPAR.CMN
tpa41e/codes/gentpa/INVIN.CMN
tpa41e/codes/gentpa/LABELS.CMN
tpa41e/codes/gentpa/MTBPAR.CMN
tpa41e/codes/gentpa/Make.bat
tpa41e/codes/gentpa/OPT.CMN
tpa41e/codes/gentpa/ORGMAS.CMN
tpa41e/codes/gentpa/ORGPAR.CMN
tpa41e/codes/gentpa/RAD.CMN
tpa41e/codes/gentpa/RMD.CMN
tpa41e/codes/gentpa/RADIN.CMN
tpa41e/codes/gentpa/RMD2.CMN
tpa41e/codes/gentpa/SOLPAR.CMN
tpa41e/codes/gentpa/SWPAR.CMN
tpa41e/codes/gentpa/TIMES.CMN
tpa41e/codes/gentpa/TITL.CMN
tpa41e/codes/gentpa/accmod.f
tpa41e/codes/gentpa/acute1.f
tpa41e/codes/gentpa/acutea.f
tpa41e/codes/gentpa/acutec.f
tpa41e/codes/gentpa/aircal.f
tpa41e/codes/gentpa/anmcal.f
tpa41e/codes/gentpa/aqucal.f
tpa41e/codes/gentpa/biocal.f
tpa41e/codes/gentpa/blockd.f
tpa41e/codes/gentpa/bsort.f
```

```
tpa41e/codes/itym/src/estimator.f
tpa41e/codes/itym/src/init_itym.f
tpa41e/codes/itym/src/itym.f
tpa41e/codes/itym/src/itym.i
tpa41e/codes/itym/src/itymutils.f
tpa41e/codes/itym/src/path.i
tpa41e/codes/itym/src/preuzf.i
tpa41e/codes/itym/src/ran.f
tpa41e/codes/itym/src/strtokfunc.f
tpa41e/codes/itym/src/uncertain.f
tpa41e/codes/itym/src/uncertain.i
tpa41e/codes/itym/src/unctab.i
tpa41e/codes/itym/src/zportunx.f
tpa41e/data/
tpa41e/data/multiflo.dat
tpa41e/data/strmtube.dat
tpa41e/data/climato1.dat
tpa41e/data/climato2.dat
tpa41e/data/dilution.dat
tpa41e/data/ebsfail.def
tpa41e/data/ebsrel.def
tpa41e/data/repdes.dat
tpa41e/data/ia.dat
tpa41e/data/itym.dat
tpa41e/data/soildem.dat
tpa41e/data/elevdem.dat
tpa41e/data/bunitdem.dat
tpa41e/data/maswtbl.dat
tpa41e/data/sunitdem.dat
tpa41e/data/winddem.dat
tpa41e/data/gs_cb_ad.dat
tpa41e/data/gs_cb_ci.dat
tpa41e/data/gs_pb_ad.dat
tpa41e/data/gs_pb_ci.dat
tpa41e/data/tefkti.inp
tpa41e/data/tpanames.dbs
tpa41e/data/ebsfilt.def
tpa41e/data/drythick.dat
tpa41e/data/nuclides.dat
tpa41e/data/burnup.dat
tpa41e/data/wpflow.def
tpa41e/data/FILENAME.DAT
tpa41e/data/gbioac1.dat
tpa41e/data/gdefault.def
tpa41e/data/gdosinc2.dat
tpa41e/data/gftrans.def
tpa41e/data/ggamen.dat
tpa41e/data/ggenii.def
tpa41e/data/ggrdf.dat
tpa41e/data/gnewdf.dat
tpa41e/data/grmdlib.dat
tpa41e/data/maidtbl.dat
tpa41e/data/organdf.dat
tpa41e/ccdf/
tpa41e/ccdf/tccdf.f
tpa41e/ccdf/tccdf.i
tpa41e/ccdf/tccdf.inp
tpa41e/ccdf/Makefile
```

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Software:
TPA Version 4.1e
Code
Folder
Software
Drawers

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February 1, 2001
Contract No. NRC–02–97–009
Account No. 20.01402.762

U.S. Nuclear Regulatory Commission
ATTN: Mr. James Firth
Office of Nuclear Material Safety and Safeguards
Division of Waste Management
Performance Assessment and High-Level Waste Integration Branch
Mail Stop 7C–18
Washington, DC 20555

Subject: Transmittal of the TPA Version 4.1e Code (AI 20.01402.762.101)

Dear Mr. Firth:

The purpose of this letter is to transmit the Total-system Performance Assessment Version 4.1e code. Attached herewith is an 8mm tape containing FORTRAN source code for the SUN workstation and the Intel-based PC running NT4.0 operating system, and three CDs containing the binary executable files for the PC platform. This version of the code contains approximately 77,000 lines of code and will execute the delivered *tpa.inp* file (base case with one realization and 10 subareas) in 9 minutes on a SUN SparcStation 20.

This version of the code has the following modifications:

(i) The input parameters for thermal reflux in the *tpa.inp* input file have been updated to reflect new values for the EDA-II repository design.

(ii) The TPA radionuclide inventory data file was updated with a new value for Se79 to reflect the latest published values.

(iii) The occupancy factor for volcanism in the *tpa.inp* input file was adjusted to be consistent with the groundwater exposure scenario.

(iv) The ChlorideMultFactor parameter in the *tpa.inp* input file was adjusted to ensure that the chloride concentration does not exceed the saturation limit.

(v) The thickness of CHnv stratigraphic unit for subarea 9 was set to zero to avoid NEFTRAN array overruns.

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(vi) The TPA parameter sampling scheme was modified to permit the generation of the sampled parameter file *lhs.out* using the LHS module for both the Monte Carlo mode and the LHS sampling mode that are selected in the *tpa.inp* input file. This file is available for inspection by the analyst at the beginning of the TPA run.

(vii) The TPA code was modified to produce a new output file called *pkmndose.out*. This file contains the dose value for each realization for the time at which the peak of the mean dose for all realizations occurred.

(viii) The TPA code was modified to produce a new output file called *tpameans.out*. This file contains the mean values of the parameters in the *tpa.inp* file. Adjusting parameter ranges in the *tpa.inp* file will cause changes in the *tpameans.out* file. This was done to aid the analyst in preparing a TPA mean value input file. This output file can be used as a valid *tpa.inp* input file without any changes, except for the file name, if desired.

(ix) A bug fix for the calculation of stream tube width at 10km was incorporated. This change does not affect the dose, within the limits of significance for the output values, for either the 10km case or the 20km case.

If you have any questions on the installation and execution of the TPA code, please call Mr. Ron Janetzke at (210) 522-3318. If you have questions on the additions and modifications that have been made to the TPA code please contact Dr. Sitakanta Mohanty at (210) 522-5185.

Sincerely yours,

Gordon Wittmeyer

Gordon W. Wittmeyer, Ph.D.
Manager, Performance Assessment

GWW/cw
Enclosure

cc:	J. Linehan	D. Esh	W. Patrick	P. LaPlante
	D. DeMarco	R. Codell	**CNWRA Directors**	M. Smith
	B. Meehan	C. Lui	CNWRA Element Managers	O. Pensado
	J. Greeves	C. McKenney	T. Nagy (SwRI Contracts)	S. Mayer
	J. Holonich	M. Rahimi	P. Maldonaldo	R. Benke
	B. Reamer		R Janetzke	
	S. Wastler		S. Mohanty	
	T. McCartin		J. Weldy	

SOFTWARE CHANGE REPORT

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SOFTWARE CHANGE REPORT (SCR)

SCR No. (*Software Developer Assigns*): PA-SCR-328	**Software Title and Version:** TPA 4.1	**/Project No:** 20-1402-762

Affected Software Module(s), Description of Problem(s):

dcagw.f

1) EPA ground water arrays are dimensioned improperly. 2) The stream tube width is incorrect for the 10km case.

Change Requested by: T. McCartin Date:10-6-00	**Change Authorized by** (*Software Developer*): R. Janetzke Date: 10-9-00

Description of Change(s) or Problem Resolution (*If changes not implemented, please justify*):

The arrays should be dimensioned consistent with the maxntime.i file.
The distance to the receptor group needs to be initialized correctly so that it can be used to determine the proper stream tube widths from the strmtube.dat file.

Implemented by: R. Janetzke	**Date:** 10-18-00

Description of Acceptance Tests:

See attached Hard copy and floppy dskette.

Tested by: R. Benke	**Date:** 1/31/01 1/31/2001

CNWRA Form TOP-5 (01/99)

Acceptance Testing of Software Change Report No. PA-SCR-328

Tester:	R. Benke
Date:	January 31, 2001
Software, Version:	TPA 4.1
Affected Module:	*dcagw.f*

Documentation Attached

The file, *dcagw.f*, was obtained from */vulcan/home/janetzke/tpa41e* and saved onto the attached diskette as */tpa41e/dcagw.f*. An attached printout of *dcagw.f* displays the first 8 of 57 pages. The file, *strmtube.dat*, was obtained from */solapps/cnwra/A_tpa4.1e/data*, and a 2-page printout is also included. The *dcagw.f* file without the fix from version 4.1 was obtained from */vulcan/home/janetzke/tpa41* and a print statement for the total tube width was added for testing purposes (see full printout). Printouts of the screen outputs from running the TPA code with and without the fix are attached (*NoFix10kmTubeOut.wpd; NoFix20kmTubeOut.wpd*; *10km_fixedoutput.doc*; *20km_fixedoutput.doc*) and saved within the directories */SCR328_Test/AfterFix* and */SCR328_Test/BeforeFix*, respectively, under subdirectories for receptor group distances of 10 and 20 km.

Change 1

The EPA ground water arrays are dimensioned improperly. The arrays should be dimensioned consistent with the *maxntime.i* file.

Test 1 => PASSED

The test verified that new code was added in three locations, highlighted in pink with a blue check mark on pages 2, 3, and 4 of the attachment, where the dimensioning was changed from *ntim* to *maxntime*.

Change 2

The stream tube width is incorrect for the 10 km case. The distance to the receptor group needs to be initialized correctly so that it can be used to determine the proper stream tube widths from the *strmtube.dat* file.

Test 2 => PASSED

The test identified that a new line of code was added (highlighted in green with a blue check mark on page 7 of the *dcagw.f* attachment) to initialize the distance to the receptor group. The code was tested with and without this fix. A print statement for the total tube width was also added into *dcagw.f* (see full printout), and the code was run with and without the fix for receptor group distances of 10 and 20 km. The printouts of the screen output for the 10-km and 20-km distances <u>without</u> the fix (*NoFix10kmTubeOut.wpd* and *NoFix20kmTubeOut.wpd*, respectively) yielded a total tube widths of 5500 m, which are inconsistent with the data in *strmtube.dat*. The printout of the screen output for the 10-km distance <u>with</u> the fix (*10km_fixedoutput.doc*) yielded a total tube width of 1890 m, which is consistent with the 10-km data in the attached *strmtube.dat* printout. The printout of the screen output for the 20-km distance <u>with</u> the fix (*20km_fixedoutput.doc*) yielded a total tube width of 1230 m, which is consistent with the 20-km data in the attached *strmtube.dat* printout.

Signature Roland R. Benke Date 01/31/2001

fixed (dcagw.f) page 1-8 of 57 26/119

```
c Program Name:          TPA - Total-System Performance Assessment Code
c File Name:             dcagw.f
c File Date:             10/19/00
c Release Version:       4.1
c
c Client Name:           USNRC
c                        U. S. Nuclear Regulatory Commission
c                        NRC Office of Nuclear Material Safety and Safeguards
c                        Division of Waste Management
c Contract Number:       NRC 02-97-009
c
c NRC Contact            Tim McCartin (301) 415-6681
c
c CNWRA Contact:         Sitakanta Mohanty (210) 522-5185
c                        Center for Nuclear Waste Regulatory Analyses
c                        San Antonio, Texas 78238-5166
c                        smohanty@swri.edu
c
c Documentation:         Predecisional "Total-System Performance Assessment
c                        (TPA) Version 4.0 Code: Module Description and
c                        User's Guide", Center for Nuclear Waste Regulatory
c                        Analyses
c NUREG-Series Designator: N/A
cccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccc
c
c = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = =
c
c                          D I S C L A I M E R
c
c = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = =
c
c     "This computer code/material was prepared as an account of work
c performed by the Center for Nuclear Waste Regulatory Analyses (CNWRA)
c for the Division of Waste Management of the Nuclear Regulatory
c Commission (NRC), an independent agency of the United States
c Government.  Neither the developer(s) of the code nor any of their
c sponsors make any warranty, expressed or implied, or assume any legal
c liability or responsibility for the accuracy, completeness, or
c usefulness of any information, apparatus, product or process
c disclosed, or represent that its use would not infringe on privately-
c owned rights."
c
c     "In no event unless required by applicable law will the sponsors
c or those who have written or modified this code, be liable for
c damages, including any lost profits, lost monies, or other special,
c incidental or consequential damages arising out of the use or
c inability to use the program (including but not limited to loss of
c data or data being rendered inaccurate or losses sustained by third
c parties or a failure of the program to operate with other programs),
c even if you have been advised of the possibility of such damages or
c for any claim by any other party."
c
c = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = =
c
c by S. Mohanty, R. Janetzke, R. Rice
c    M. Jarzemba (initial version)
c
```

```
c mas - M. Smith, M. Muller - 2/10/00 (subroutine gentodcf for TPA4.0beta)
c mas - M. Smith - 2/29/00 added age-specific inhalation rate parameter (rir)
c mas - M. Smith - 2/29/00 added append file for gw_cb.ad.dat and gw_pb_ad.dat
c mas - M. Smith - 2/29/00 added new header info for gw_ dcf files
c==============================================================================
cc rwj 2-12-00  Add realization number.
cc     subroutine dcagw( mxntime, mxnnucl,
       subroutine dcagw( irl, mxntime, mxnnucl,
     &                   ntim, tim, nnucl, names,
     &                   aveqm3peryrallsafromuz,
     &                   dMAP,dMAT,ciperyrallsafromsz,
     &                   remperyrpernuclgw,
     &                   dwdcf, dilutionvolume, fractionmasscaptured )
c==============================================================================
c calculates dose through groundwater pathway by extraction at well.
c calculates saturated zone flow from below repository to compliance
c point which may be located 5,25, 30, 35 km from repository
c
c dilution volume determination by using:
c the maximum of (1) pumping rate, (2) flow (streamtube flow x mixing thickness)
c and (3) average flow rate out of the repository
c if CP is less than 20 km, then use qm3peryrallsafromsz to calculate
c concentration of nuclides in GW.
c if CP is greater than 20 km, then use well pumping rate to calculate
c concentration of nuclides in GW, assuming all nuclides extracted
c from system by pumping
c
c mxntime = input, integer, size to dimension arrays
c mxnnucl = input, integer, size to dimension arrays
c ntim = input, integer, maximum number of times used to dimension arrays
c tim(ntim)  = input, double precision, array of times
c nnucl = input, integer, maximum number of nuclides used to dimension arrays
c names(nnucl) = input, character*6, names of nuclides to be tracked
c aveqm3peryrallsafromuz =  input, double precision, average groundwater
c                flow rate [m^3/yr] from all subareas from the unsaturated zone
c dMAP(ntim) = input, double precision, annual precipitaion rate [in/yr]
c dMAT(ntim) = input, double precision, temperature [F]
c ciperyrallsafromsz(mxntime,mxnnucl) = input, double precision, nuclide
c                    release rate [Ci/yr] from all subareas from the
c                    saturated zone at the compliance point
c remperyrpernuclgw[mxntime,nnucl] = output, double precision, array of
c              annual EDE (effective dose equivalent) per nuclide
c dwdcf(maxntime,mxnnucl) = output, double precision, array of drinking water
c              dose conversion factors from the *.in files
c dilutionvolume = output, double precision, dilution volume used to
c              determine dose (m3/yr)
c fractionmasscaptured = ouput, double precision, fraction of mass in the
c                        plume captured by the well pumping at 5 km
c                        (for 20km this fraction is 1.0)
c
      implicit double precision (a-h,o-z)
      include 'path.i'
      include 'szft.i'
cc rwj 10-18-00
      include 'maxntime.i'

      dimension tim(ntim)
```

```
      character*6 names(nnucl)
      dimension ciperyrallsafromsz(mxntime,mxnnucl)
      dimension remperyrpernuclgw(mxntime, mxnnucl)
      dimension dcfde(43),dcfinh(43),dcfinga(43),dcfingp(43),dcfdw(43)
cc    mam 02/01/00 Add def.
      dimension dcfmlk(43)

      dimension dwdcf(mxntime,43)

      parameter ( maxtubes = 50 )
      dimension szflowrate(maxtubes)
      parameter ( maxaqthickness = 5 )
      parameter ( maxpumprates = 8 )
      integer nearlegs(maxlayers)
      dimension tablepumpratescw(maxpumprates)
      dimension tablepumpratesct(maxpumprates)
      dimension tableaqthicknesscw(maxaqthickness)
      dimension tableaqthicknessct(maxaqthickness)
      dimension outputarray(maxpumprates)
      dimension ainputarray(maxpumprates)
      dimension dummyarray(maxpumprates)
      dimension amaplistarray(maxaqthickness)

      dimension dMAP(ntim), dMAT(ntim)

cc rwj 10-18-00
cc    jrw 7/27/00 added for groundwater protection
cc    dimension aconc(ntim), rconc(ntim), uconc(ntim)
cc    dimension aconcsum(ntim), rconcsum(ntim), uconcsum(ntim)
cc    dimension rnconc(ntim, 43)
      dimension aconc(maxntime), rconc(maxntime), uconc(maxntime)
      dimension aconcsum(maxntime),rconcsum(maxntime),uconcsum(maxntime)
      dimension rnconc(maxntime, 43)

      character*80 aline

      character*60 name
      character*10 char
      character*80 command

      integer dilflg
      integer plumflg
cc rwj 9-15-00
cc SCR 324
      integer pluv

      common / dcagw1 / ikey
      common / dcagw2 / dcf(43)
      common / dcagw3 / idist
      common / dcagw4 / dist
      common / dcagw5 / ipump5
      common / dcagw6 / ipump20
      common / dcagw8 / iamix20
      common / dcagw9 / icutoffpt
      common / dcagw10 / ireadtubefile
      common / dcagw11 / ireaddilutionfile
      common / dcagw12 / iaqthickness5km
```

```
      common / dcagw13 / anearfielddist, farfielddist
      common / dcagw14 / sumflow
      common / dcagw15 / totaltubewidth
      common / dcagw16 / tablepumpratescwct(maxpumprates)
      common / dcagw17 / tableaqthicknesscwct(maxaqthickness)
      common / dcagw18 / tablecapthick(maxpumprates,maxaqthickness)
      common / dcagw19 / tablecapwidth(maxpumprates,maxaqthickness)
      common / dcagw20 / tablepumpratessl(maxpumprates)
      common / dcagw21 / tablescreenlength(maxpumprates)
      common / dcagw22 / numberpumpratescwct
      common / dcagw23 / numberaqthicknesscwct
      common / dcagw24 / numberpumpratessl

cc rwr 9/6/00 modified for groundwater protection calculations
      integer gwpc
      character*6 nucname(43)
      common / dcagw25 / gwpc
      common / dcagw26 / ipumpgwp
      common / dcagw27 / ifrplumegwp
      common / dcagw28 / durationcp,numberreal
      common / dcagw29 / dosefactor(43,8)
cc rwj 10-18-00
cc    dimension epadose(ntim,43,8)
cc    dimension epadoseave(ntim,8)
cc    dimension epadosesum(ntim,8)
cc    dimension epadosetotal(ntim)
cc    dimension epadosetotalsum(ntim)
      dimension epadose(maxntime,43,8)
      dimension epadoseave(maxntime,8)
      dimension epadosesum(maxntime,8)
      dimension epadosetotal(maxntime)
      dimension epadosetotalsum(maxntime)

      dimension epapktim(12,2)
      dimension epasf(5)

      include 'inventp.i'
      include 'execc.i'

      external maplist
      external clearchar
      external valuesp
      integer zportsh
      external zportsh

cc rwj 8-23-00
cc     Remove old importance analysis method.
cc    external aiafilter

      save i1

      if( (nnucl .le. 0) .or. (nnucl .gt. 43) ) then
        print *, ' ***>>> Error in DCAGW <<<*** '
        print *, ' (nnucl .le. 0)  .or. (nnucl .gt. 43)'
        print *, ' nnucl = ', nnucl
        STOP
      endif
```

```
      if( ntim .gt. mxntime ) then
        print *, ' ***>>> Error in DCAGW <<<*** '
        print *, ' ntim .gt. mxntime '
        print *, ' mxntime = ', mxntime
        print *, ' ntim    = ', ntim
        STOP
      endif
      if( ntim .le. 0 ) then
        print *, ' ***>>> Error in DCAGW <<<*** '
        print *, ' ntim .le. 0 '
        print *, ' ntim = ', ntim
        STOP
      endif

      if (ikey .ne. 39231) then
cc to avoid warning message, make trivial use of tim()
        ajunk = tim(1)

        call clearchar( 60, name )
        name = 'DistanceToReceptorGroup[km][should_be_10_or_20]'
        idist = ispquery( name )

        call clearchar( 60, name )
        name = 'WellPumpingRateAtReceptorGroup10km[gal/day]'
        ipump5 = ispquery( name )

        call clearchar( 60, name )
        name = 'WellPumpingRateAtReceptorGroup20km[gal/day]'
        ipump20 = ispquery( name )

        call clearchar( 60, name )
        name = 'PlumeThickness5km[m]'
        iplume5 = ispquery( name )

        call clearchar( 60, name )
        name = 'MixingZoneThickness20km[m]'
        iamix20 = ispquery( name )

        call clearchar( 60, name )
        name = 'DistanceCutoffForDoseConversionDualityInDCAGS[km]'
        icutoffpt = ispquery( name )

        call clearchar( 60, name )
        name = 'PlumeCaptureModel'
        iplumflg = ispquery( name )
        plumflg  = ivaluesp(iplumflg)

        call clearchar( 60, name )
        name = 'DilutionModel'
        idilflg = ispquery( name )
        dilflg  = ivaluesp(idilflg)

        call clearchar( 60, name )
        name = 'UserDefinedPlumeCaptureFraction'
        iuserplumefraction = ispquery( name )

        call clearchar( 60, name )
```

```
        name = 'UserDefinedDilutionVolume[gal/day]'
        iuserdilutionvolume= ispquery( name )

        i1=igetunitnumber('dcagw   ')

        ireadtubefile = igetunitnumber('dcagw   ')

        call clearchar( 60, name )
        name = 'AquiferThickness5km[m]'
        iaqthickness5km = ispquery( name )

        ireaddilutionfile = igetunitnumber('dcagw   ')

cc jrw 7/21/00 modified to incorporate groundwater protection calculation

        call clearchar( 60, name )
        name = 'GroundwaterProtectionCalc(yes=1,no=0)'
        igwpc = ispquery( name )
        gwpc  = ivaluesp(igwpc)

        call clearchar( 60, name )
        name = 'WellPumpingRateGroundwaterProtection[gal/day]'
        ipumpgwp = ispquery( name )

        call clearchar( 60, name )
        name = 'FractionPlumeCaptureGroundwaterProtection'
        ifrplumegwp = ispquery( name )

cc jrw 1/31/00 modified for user input switch to pluvial DCF values
cc jrw 1/31/00 modified for pluvial pump rates at 20 km

        call clearchar( 60, name )
        name = 'PluvialWellPumpingRateAtReceptorGroup20km[gal/day]'
        ipluvpump20 = ispquery( name )

        call clearchar( 60, name )
        name = 'PluvialSwitchTime[yr]'
        ipluvswitch = ispquery( name )

        iline=1
        open (unit=ireadtubefile,file='strmtube.dat',status='old')
  100   continue
        read (ireadtubefile, '(a80)', end=889, err=903) aline
        iline = iline+1
        if (aline(1:2) .eq. 'TI' .or.
    &       aline(1:2) .eq. 'ti' .or.
    &       aline(1:2) .eq. '**' )   go to 100
        read (aline,*) numberoftubes
  150   continue
        read (ireadtubefile, '(a80)', end=889, err=903) aline
        iline = iline+1
        if (aline(1:2) .eq. '**') go to 150
        read (aline,*) numberflowrates
        if (numberflowrates .GT. maxtubes) then
           print *, ' ***>>> Error in DCAGW <<<*** '
           print *, ' (numberflowrates .GT. maxtubes)'
           print *, ' numberflowrates = ', numberflowrates
```

```
          print *, ' maxtubes = ', maxtubes
          STOP
        endif

       do itube = 1, numberoftubes
         read (ireadtubefile, *, end=889, err=903) szflowrate(itube)
         iline = iline+1
       enddo

  175  continue
       read (ireadtubefile, '(a80)') aline
       iline = iline+1
       if (aline(1:2) .eq. '**') go to 175
       read (aline,*) anearfielddist, farfielddist

       sumflow = 0.0d0
       do isum = 1, numberflowrates
         sumflow = sumflow + szflowrate(isum)
       enddo

       totaltubewidth = 0.0d0

       do itube = 1, numberoftubes

  177    continue
         read (ireadtubefile, '(a80)') aline
         iline = iline+1
         if (aline(1:2) .eq. '**') go to 177
cc rwj 2-5-00 New file format.
         read (aline, *, end=889, err=903) itubeid
         read (ireadtubefile,'(a80)', end=889, err=903) aline
         iline = iline+1

         read (aline, *, end=889, err=903) nearlegs(itube)
         read (ireadtubefile,'(a80)', end=889, err=903) aline
         iline = iline+1
cc
         do ileg = 1,nearlegs(itube)
           read (ireadtubefile, *, end = 889, err=903) ajunk
           iline = iline+1
         enddo
       enddo

cc rwj 10-18-00
       dist  = valuesp( idist )
cc rwj 2-5-00 New file format.
       do itube = 1, numberoftubes
  178    continue
         read (ireadtubefile, '(a80)') aline
         iline = iline+1
         if (aline(1:2) .eq. '**') go to 178
cc use only the last width to determine totaltubewidth
         read (aline, *, end=889, err=903) nearlegs(itube)
         read (ireadtubefile, '(a80)') aline
         iline = iline+1
         do ileg = 1,nearlegs(itube)
           read (ireadtubefile, *, end = 889, err=903)
```

distance initial Bed

```
     &      aifdist, awidth
            iline = iline+1
            if (aifdist .le. dist) width = awidth
          enddo
          totaltubewidth = totaltubewidth + width
        enddo

        print *, ' total tube width [m] = ',totaltubewidth
        close ( ireadtubefile )

        call clearchar(80,command)
        command = 'cp ' // dpath // 'data/dilution.dat .'
        istatus=zportsh(command)
        if(istatus .ne. 0) then
           print *, ' ***>>> Error in DCAGW <<<*** '
           print *, ' Failure copying dilution.dat'
           print *, ' command = ', command
           print *, ' Status = ', istatus
           STOP
        endif

        iline=1
        open (unit=ireaddilutionfile,file='dilution.dat',status='old')
179     continue
        read (ireaddilutionfile, '(a80)', end=905, err=908) aline
        iline = iline+1
        if (aline(1:2) .eq. 'TI' .or.
     &      aline(1:2) .eq. 'ti' .or.
     &      aline(1:2) .eq. '**' )   go to 179

        read (aline, *, end=905, err=908) numberpumpratescwct

        if (numberpumpratescwct .lt. 2) then
          print *, ' ***>>> Error in DCAGW <<<*** '
          print *, ' check number of pump rates in dilution.dat'
          print *, ' for capture widths and thicknesses'
          print *, ' (numberpumprates .lt. 2)'
          print *, ' numberpumprates = ',numberpumpratescwct
           STOP
        endif

        if (numberpumpratescwct .gt. maxpumprates) then
          print *, ' ***>>> Error in DCAGW <<<*** '
          print *, ' check number of pump rates in dilution.dat'
          print *, ' for capture widths and thicknesses'
          print *, ' (numberpumprates .gt. maxpumprates)'
          print *, ' numberpumprates = ',numberpumpratescwct
          print *, ' maxpumprates = ',maxpumprates
           STOP
        endif

181     continue
        read (ireaddilutionfile, '(a80)', end=905, err=908) aline
        iline = iline+1
        if (aline(1:2) .eq. '**' ) go to 181

        read (aline, *, end=905, err=908) numberaqthicknesscwct
```

20km - fixed output date

WITH PXO

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```
=====================================================================
          exec: Welcome to TPA Version 4.1e
        Job started: Tue Jan 30 09:04:32 2001
=====================================================================
 REPOSITORY DESIGN INFORMATION
 Subarea   Area       Waste   Number of WP
    #      [m^2]      [MTU]
    1    723591.3    11058.1        1133
    2    784763.0    11546.1        1183
    3    390372.0     5563.2         570
    4    207581.3     3445.3         353
    5    378972.8     5553.4         569
    6    424872.5     6236.6         639
    7    163938.3     2381.4         244
    8    393468.9     6588.0         675
    9    660785.5     9311.0         954
   10    589497.1     8325.3         853

 Total Area [acre]          =     1165.7629779961
 Total Buried Waste [MTU]   =     70008.480000000
 Repository AML [MTU/acre]  =     60.053785650616

 Specified Global Parameters:

                Compliance Period =  10000.0 (yr)
          Maximum Simulation Time = 100000.0 (yr)
           Number Of Realizations =      1
               Number Of Subareas =     10
               Volcanism scenario =      0 (yes=1, no=0)
                Faulting scenario =      0 (yes=1, no=0)
                 Seismic scenario =      1 (yes=1, no=0)
      Distance to Receptor Group =     20.0 (km)


 **>>> CAUTION: CHECKING OF NUCLIDES AND CHAINS IS DISABLED <<<**
 **>>> You may not be using the standard chains specified   <<<**
 **>>> in the invent module.                                <<<**
 **>>> (see "CheckNuclidesAndChains(yes=1,no=0)" in tpa.inp)<<<**

 The specified path for data  = $TPA_DATA/
 The specified path for codes = $TPA_TEST/

 **To modify global parameters or the path, stop code execution using control-C**
 Note: IEEE floating-point exception traps enabled:
    overflow;  division by zero;  invalid operation;
 See the Numerical Computation Guide, ieee_handler(3M)
---------------------------------------------------------------------
     subarea   1 of  10           realization    1 of    1
---------------------------------------------------------------------
 exec: calling uzflow
 exec: calling nfenv
 exec: calling ebsfail
      ebsfail: time of WP failure =    60928.4  yr
 exec: calling seismo
 exec: failed WPs from INITIAL   event =      2 at time =      0.0 yr
 exec: failed WPs from CORROSION event =   1131 at time =  60928.4 yr
  *** failed WPs: all WPs failed (  1133) ***
 exec: calling ebsrel
                 Highest release rates from Sub Area  1
              Tc99    1.7174E-02 [Ci/yr/SA] at  7.798E+04 yr
              Cs135   4.0632E-03 [Ci/yr/SA] at  7.798E+04 yr
              Pu239   1.6162E-03 [Ci/yr/SA] at  7.798E+04 yr
              Ni59    2.7706E-04 [Ci/yr/SA] at  7.798E+04 yr
              I129    2.7511E-04 [Ci/yr/SA] at  7.798E+04 yr
              Np237   2.6937E-04 [Ci/yr/SA] at  1.000E+05 yr
 exec: calling uzft
                      Highest release rates from UZ
              Tc99    1.6904E-02 [Ci/yr/SA] at  7.798E+04 yr
              I129    2.7100E-04 [Ci/yr/SA] at  7.798E+04 yr
              Np237   2.6723E-04 [Ci/yr/SA] at  1.000E+05 yr
              Se79    1.8559E-04 [Ci/yr/SA] at  7.798E+04 yr
              Cl36    1.4904E-04 [Ci/yr/SA] at  7.798E+04 yr
              Nb94    1.6053E-05 [Ci/yr/SA] at  7.798E+04 yr
 exec: calling szft
 Note: IEEE floating-point exception flags raised:
    Inexact;  Underflow;
 See the Numerical Computation Guide, ieee_flags(3M)
                      Highest release rates from SZ
              Tc99    1.6222E-02 [Ci/yr/SA] at  7.798E+04 yr
              I129    2.6061E-04 [Ci/yr/SA] at  7.798E+04 yr
              Cl36    1.4312E-04 [Ci/yr/SA] at  7.798E+04 yr
```

```
            U234    3.0292E-06 [Ci/yr/SA] at  1.000E+05 yr
            Np237   2.8293E-06 [Ci/yr/SA] at  6.093E+04 yr
            U238    9.0880E-07 [Ci/yr/SA] at  1.000E+05 yr
-----------------------------------------------------------------------
    subarea   2 of  10          realization    1 of    1
-----------------------------------------------------------------------
 exec: calling uzflow
 exec: calling nfenv
 exec: calling ebsfail
      ebsfail: time of WP failure =    60928.4  yr
 exec: failed WPs from INITIAL   event =      2 at time =      0.0 yr
 exec: failed WPs from CORROSION event =   1181 at time =  60928.4 yr
  *** failed WPs: all WPs failed (  1183) ***
  *** ejected WPs:   0
 exec: calling ebsrel
                 Highest release rates from Sub Area  2
            Tc99    1.1571E-03 [Ci/yr/SA] at  7.798E+04 yr
            Pu239   8.4316E-04 [Ci/yr/SA] at  7.798E+04 yr
            Cs135   2.6513E-04 [Ci/yr/SA] at  7.798E+04 yr
            Am243   3.7100E-05 [Ci/yr/SA] at  1.505E+04 yr
            Ni59    2.2193E-05 [Ci/yr/SA] at  7.798E+04 yr
            C14     2.1744E-05 [Ci/yr/SA] at  1.505E+04 yr
 exec: calling uzft
       *** NEFTRAN is skipped for this UZ path since no layers have significant ground water travel time. ***
                     Highest release rates from UZ
            Tc99    1.1571E-03 [Ci/yr/SA] at  7.798E+04 yr
            Pu239   8.4316E-04 [Ci/yr/SA] at  7.798E+04 yr
            Cs135   2.6513E-04 [Ci/yr/SA] at  7.798E+04 yr
            Am243   3.7100E-05 [Ci/yr/SA] at  1.505E+04 yr
            Ni59    2.2193E-05 [Ci/yr/SA] at  7.798E+04 yr
            Np237   1.9285E-05 [Ci/yr/SA] at  7.798E+04 yr
 exec: calling szft
 Note: IEEE floating-point exception flags raised:
    Inexact;  Underflow;
 See the Numerical Computation Guide, ieee_flags(3M)
                     Highest release rates from SZ
            Tc99    1.1116E-03 [Ci/yr/SA] at  7.798E+04 yr
            I129    1.7268E-05 [Ci/yr/SA] at  7.798E+04 yr
            Cl36    9.5116E-06 [Ci/yr/SA] at  7.798E+04 yr
            Ni59    3.2545E-06 [Ci/yr/SA] at  1.000E+05 yr
            Np237   2.7980E-06 [Ci/yr/SA] at  6.093E+04 yr
            U234    2.6138E-06 [Ci/yr/SA] at  1.000E+05 yr
-----------------------------------------------------------------------
    subarea   3 of  10          realization    1 of    1
-----------------------------------------------------------------------
 exec: calling uzflow
 exec: calling nfenv
 exec: calling ebsfail
      ebsfail: time of WP failure =    60928.4  yr
 exec: failed WPs from INITIAL   event =      1 at time =      0.0 yr
 exec: failed WPs from CORROSION event =    569 at time =  60928.4 yr
  *** failed WPs: all WPs failed (  570) ***
 exec: calling ebsrel
                 Highest release rates from Sub Area  3
            Tc99    1.6142E-03 [Ci/yr/SA] at  7.798E+04 yr
            Pu239   8.1999E-04 [Ci/yr/SA] at  7.798E+04 yr
            Cs135   3.7275E-04 [Ci/yr/SA] at  7.798E+04 yr
            Ni59    2.9609E-05 [Ci/yr/SA] at  7.798E+04 yr
            Np237   2.5738E-05 [Ci/yr/SA] at  7.798E+04 yr
            I129    2.5224E-05 [Ci/yr/SA] at  7.798E+04 yr
 exec: calling uzft
                     Highest release rates from UZ
            Tc99    1.5831E-03 [Ci/yr/SA] at  7.798E+04 yr
            Np237   2.5667E-05 [Ci/yr/SA] at  1.000E+05 yr
            I129    2.4762E-05 [Ci/yr/SA] at  7.798E+04 yr
            Se79    1.6711E-05 [Ci/yr/SA] at  7.798E+04 yr
            Cl36    1.3653E-05 [Ci/yr/SA] at  7.798E+04 yr
            U234    2.0203E-06 [Ci/yr/SA] at  7.798E+04 yr
 exec: calling szft
 Note: IEEE floating-point exception flags raised:
    Inexact;  Underflow;
 See the Numerical Computation Guide, ieee_flags(3M)
                     Highest release rates from SZ
            Tc99    1.5194E-03 [Ci/yr/SA] at  7.798E+04 yr
            I129    2.3816E-05 [Ci/yr/SA] at  7.798E+04 yr
            Cl36    1.3112E-05 [Ci/yr/SA] at  7.798E+04 yr
            U234    1.4891E-06 [Ci/yr/SA] at  1.000E+05 yr
            U238    4.4369E-07 [Ci/yr/SA] at  1.000E+05 yr
            Th230   1.0252E-07 [Ci/yr/SA] at  1.000E+05 yr
-----------------------------------------------------------------------
    subarea   4 of  10          realization    1 of    1
```

```
-----------------------------------------------------------------------
exec: calling uzflow
exec: calling nfenv
exec: calling ebsfail
     ebsfail: time of WP failure =    60928.4  yr
exec: failed WPs from INITIAL   event =      1 at time =      0.0 yr
exec: failed WPs from CORROSION event =    352 at time =  60928.4 yr
 *** failed WPs: all WPs failed (  353) ***
exec: calling ebsrel
                Highest release rates from Sub Area  4
             Tc99    1.2188E-03 [Ci/yr/SA] at  7.798E+04 yr
             Pu239   3.5007E-04 [Ci/yr/SA] at  7.798E+04 yr
             Cs135   2.8317E-04 [Ci/yr/SA] at  7.798E+04 yr
             Ni59    2.1620E-05 [Ci/yr/SA] at  7.798E+04 yr
             Np237   1.9321E-05 [Ci/yr/SA] at  1.000E+05 yr
             I129    1.9163E-05 [Ci/yr/SA] at  7.798E+04 yr
exec: calling uzft
                     Highest release rates from UZ
             Tc99    1.1922E-03 [Ci/yr/SA] at  7.798E+04 yr
             Np237   1.9257E-05 [Ci/yr/SA] at  1.000E+05 yr
             I129    1.8766E-05 [Ci/yr/SA] at  7.798E+04 yr
             Se79    1.2521E-05 [Ci/yr/SA] at  7.798E+04 yr
             Cl36    1.0344E-05 [Ci/yr/SA] at  7.798E+04 yr
             Nb94    1.2521E-06 [Ci/yr/SA] at  7.798E+04 yr
exec: calling szft
Note: IEEE floating-point exception flags raised:
   Inexact;  Underflow;
See the Numerical Computation Guide, ieee_flags(3M)
                     Highest release rates from SZ
             Tc99    1.1452E-03 [Ci/yr/SA] at  7.798E+04 yr
             I129    1.8062E-05 [Ci/yr/SA] at  7.798E+04 yr
             Cl36    9.9416E-06 [Ci/yr/SA] at  7.798E+04 yr
             U234    6.2742E-07 [Ci/yr/SA] at  1.000E+05 yr
             U238    1.8606E-07 [Ci/yr/SA] at  1.000E+05 yr
             Np237   1.1533E-07 [Ci/yr/SA] at  6.093E+04 yr
-----------------------------------------------------------------------
    subarea   5 of  10          realization    1 of    1
-----------------------------------------------------------------------
exec: calling uzflow
exec: calling nfenv
exec: calling ebsfail
     ebsfail: time of WP failure =    60928.4  yr
exec: failed WPs from INITIAL   event =      1 at time =      0.0 yr
exec: failed WPs from CORROSION event =    568 at time =  60928.4 yr
 *** failed WPs: all WPs failed (  569) ***
exec: calling ebsrel
                Highest release rates from Sub Area  5
             Tc99    3.9216E-03 [Ci/yr/SA] at  7.798E+04 yr
             Cs135   9.1776E-04 [Ci/yr/SA] at  7.798E+04 yr
             Pu239   7.4487E-04 [Ci/yr/SA] at  7.798E+04 yr
             Ni59    6.6702E-05 [Ci/yr/SA] at  7.798E+04 yr
             I129    6.2116E-05 [Ci/yr/SA] at  7.798E+04 yr
             Np237   6.1502E-05 [Ci/yr/SA] at  1.000E+05 yr
exec: calling uzft
                     Highest release rates from UZ
             Tc99    3.7974E-03 [Ci/yr/SA] at  7.798E+04 yr
             Np237   6.0949E-05 [Ci/yr/SA] at  1.000E+05 yr
             I129    6.0244E-05 [Ci/yr/SA] at  7.798E+04 yr
             Se79    3.8347E-05 [Ci/yr/SA] at  7.798E+04 yr
             Cl36    3.3185E-05 [Ci/yr/SA] at  7.798E+04 yr
             Nb94    3.7982E-06 [Ci/yr/SA] at  7.798E+04 yr
exec: calling szft
Note: IEEE floating-point exception flags raised:
   Inexact;  Underflow;
See the Numerical Computation Guide, ieee_flags(3M)
                     Highest release rates from SZ
             Tc99    3.6470E-03 [Ci/yr/SA] at  7.798E+04 yr
             I129    5.7977E-05 [Ci/yr/SA] at  7.798E+04 yr
             Cl36    3.1890E-05 [Ci/yr/SA] at  7.798E+04 yr
             U234    1.3612E-06 [Ci/yr/SA] at  1.000E+05 yr
             Np237   9.3291E-07 [Ci/yr/SA] at  7.798E+04 yr
             U238    4.0874E-07 [Ci/yr/SA] at  1.000E+05 yr
-----------------------------------------------------------------------
    subarea   6 of  10          realization    1 of    1
-----------------------------------------------------------------------
exec: calling uzflow
exec: calling nfenv
exec: calling ebsfail
     ebsfail: time of WP failure =    60928.4  yr
exec: failed WPs from INITIAL   event =      1 at time =      0.0 yr
exec: failed WPs from CORROSION event =    638 at time =  60928.4 yr
```

```
 *** failed WPs: all WPs failed (  639) ***
exec: calling ebsrel
                Highest release rates from Sub Area  6
            Tc99     8.4773E-03 [Ci/yr/SA] at  7.798E+04 yr
            Cs135    2.0232E-03 [Ci/yr/SA] at  7.798E+04 yr
            Pu239    6.2272E-04 [Ci/yr/SA] at  7.798E+04 yr
            I129     1.3701E-04 [Ci/yr/SA] at  7.798E+04 yr
            Ni59     1.2977E-04 [Ci/yr/SA] at  7.798E+04 yr
            Np237    1.2966E-04 [Ci/yr/SA] at  1.000E+05 yr
exec: calling uzft
                     Highest release rates from UZ
            Tc99     8.0919E-03 [Ci/yr/SA] at  7.798E+04 yr
            I129     1.3109E-04 [Ci/yr/SA] at  7.798E+04 yr
            Np237    1.2611E-04 [Ci/yr/SA] at  1.000E+05 yr
            Se79     7.6036E-05 [Ci/yr/SA] at  7.798E+04 yr
            Cl36     7.1953E-05 [Ci/yr/SA] at  7.798E+04 yr
            Nb94     7.1638E-06 [Ci/yr/SA] at  7.798E+04 yr
exec: calling szft
Note: IEEE floating-point exception flags raised:
   Inexact;  Underflow;
See the Numerical Computation Guide, ieee_flags(3M)
                     Highest release rates from SZ
            Tc99     7.7726E-03 [Ci/yr/SA] at  7.798E+04 yr
            I129     1.2617E-04 [Ci/yr/SA] at  7.798E+04 yr
            Cl36     6.9156E-05 [Ci/yr/SA] at  7.798E+04 yr
            U234     1.1184E-06 [Ci/yr/SA] at  1.000E+05 yr
            Np237    4.1909E-07 [Ci/yr/SA] at  7.798E+04 yr
            U238     3.3968E-07 [Ci/yr/SA] at  1.000E+05 yr
-----------------------------------------------------------------------
    subarea   7 of  10          realization    1 of    1
-----------------------------------------------------------------------
exec: calling uzflow
exec: calling nfenv
exec: calling ebsfail
     ebsfail: time of WP failure =    60928.4  yr
exec: failed WPs from CORROSION event =    244 at time =  60928.4 yr
 *** failed WPs: all WPs failed (  244) ***
exec: calling ebsrel
                Highest release rates from Sub Area  7
            Tc99     3.6523E-03 [Ci/yr/SA] at  7.798E+04 yr
            Cs135    8.7821E-04 [Ci/yr/SA] at  7.798E+04 yr
            Pu239    2.2305E-04 [Ci/yr/SA] at  7.798E+04 yr
            I129     5.9480E-05 [Ci/yr/SA] at  7.798E+04 yr
            Np237    5.4616E-05 [Ci/yr/SA] at  1.000E+05 yr
            Ni59     5.3349E-05 [Ci/yr/SA] at  7.798E+04 yr
exec: calling uzft
                     Highest release rates from UZ
            Tc99     3.4588E-03 [Ci/yr/SA] at  7.798E+04 yr
            I129     5.6479E-05 [Ci/yr/SA] at  7.798E+04 yr
            Np237    5.2517E-05 [Ci/yr/SA] at  1.000E+05 yr
            Cl36     3.0970E-05 [Ci/yr/SA] at  7.798E+04 yr
            Se79     3.0184E-05 [Ci/yr/SA] at  7.798E+04 yr
            Nb94     2.9005E-06 [Ci/yr/SA] at  7.798E+04 yr
exec: calling szft
Note: IEEE floating-point exception flags raised:
   Inexact;  Underflow;
See the Numerical Computation Guide, ieee_flags(3M)
                     Highest release rates from SZ
            Tc99     3.3227E-03 [Ci/yr/SA] at  7.798E+04 yr
            I129     5.4368E-05 [Ci/yr/SA] at  7.798E+04 yr
            Cl36     2.9770E-05 [Ci/yr/SA] at  7.798E+04 yr
            U234     4.0151E-07 [Ci/yr/SA] at  1.000E+05 yr
            U238     1.2119E-07 [Ci/yr/SA] at  1.000E+05 yr
            Th230    3.1843E-08 [Ci/yr/SA] at  1.000E+05 yr
-----------------------------------------------------------------------
    subarea   8 of  10          realization    1 of    1
-----------------------------------------------------------------------
exec: calling uzflow
exec: calling nfenv
exec: calling ebsfail
     ebsfail: time of WP failure =    60928.4  yr
exec: failed WPs from INITIAL   event =      1 at time =      0.0 yr
exec: failed WPs from CORROSION event =    674 at time =  60928.4 yr
 *** failed WPs: all WPs failed (  675) ***
exec: calling ebsrel
                Highest release rates from Sub Area  8
            Tc99     5.5818E-03 [Ci/yr/SA] at  7.798E+04 yr
            Cs135    1.3049E-03 [Ci/yr/SA] at  7.798E+04 yr
            Pu239    8.8555E-04 [Ci/yr/SA] at  7.798E+04 yr
            Ni59     9.6166E-05 [Ci/yr/SA] at  7.798E+04 yr
            Np237    8.9042E-05 [Ci/yr/SA] at  1.000E+05 yr
```

```
            I129    8.8322E-05 [Ci/yr/SA] at  7.798E+04 yr
exec: calling uzft
      *** NEFTRAN is skipped for this UZ path since no layers have significant ground water travel time. ***
                    Highest release rates from UZ
            Tc99    5.5818E-03 [Ci/yr/SA] at  7.798E+04 yr
            Cs135   1.3049E-03 [Ci/yr/SA] at  7.798E+04 yr
            Pu239   8.8555E-04 [Ci/yr/SA] at  7.798E+04 yr
            Ni59    9.6166E-05 [Ci/yr/SA] at  7.798E+04 yr
            Np237   8.9042E-05 [Ci/yr/SA] at  1.000E+05 yr
            I129    8.8322E-05 [Ci/yr/SA] at  7.798E+04 yr
exec: calling szft
Note: IEEE floating-point exception flags raised:
   Inexact;  Underflow;
See the Numerical Computation Guide, ieee_flags(3M)
                    Highest release rates from SZ
            Tc99    5.3598E-03 [Ci/yr/SA] at  7.798E+04 yr
            I129    8.4984E-05 [Ci/yr/SA] at  7.798E+04 yr
            Cl36    4.6760E-05 [Ci/yr/SA] at  7.798E+04 yr
            Ni59    1.3281E-05 [Ci/yr/SA] at  1.000E+05 yr
            U234    1.6618E-06 [Ci/yr/SA] at  1.000E+05 yr
            Np237   1.6232E-06 [Ci/yr/SA] at  6.093E+04 yr
-----------------------------------------------------------------------
    subarea   9 of  10          realization    1 of    1
-----------------------------------------------------------------------
exec: calling uzflow
exec: calling nfenv
exec: calling ebsfail
     ebsfail: time of WP failure =    60928.4  yr
exec: failed WPs from INITIAL   event =      2 at time =      0.0 yr
exec: failed WPs from CORROSION event =    952 at time =  60928.4 yr
 *** failed WPs: all WPs failed (  954) ***
exec: calling ebsrel
                Highest release rates from Sub Area  9
            Tc99    7.1764E-03 [Ci/yr/SA] at  7.798E+04 yr
            Cs135   1.6812E-03 [Ci/yr/SA] at  7.798E+04 yr
            Pu239   1.1440E-03 [Ci/yr/SA] at  7.798E+04 yr
            Ni59    1.2180E-04 [Ci/yr/SA] at  7.798E+04 yr
            I129    1.1379E-04 [Ci/yr/SA] at  7.798E+04 yr
            Np237   1.1333E-04 [Ci/yr/SA] at  1.000E+05 yr
exec: calling uzft
      *** NEFTRAN is skipped for this UZ path since no layers have significant ground water travel time. ***
                    Highest release rates from UZ
            Tc99    7.1764E-03 [Ci/yr/SA] at  7.798E+04 yr
            Cs135   1.6812E-03 [Ci/yr/SA] at  7.798E+04 yr
            Pu239   1.1440E-03 [Ci/yr/SA] at  7.798E+04 yr
            Ni59    1.2180E-04 [Ci/yr/SA] at  7.798E+04 yr
            I129    1.1379E-04 [Ci/yr/SA] at  7.798E+04 yr
            Np237   1.1333E-04 [Ci/yr/SA] at  1.000E+05 yr
exec: calling szft
Note: IEEE floating-point exception flags raised:
   Inexact;  Underflow;
See the Numerical Computation Guide, ieee_flags(3M)
                    Highest release rates from SZ
            Tc99    6.8022E-03 [Ci/yr/SA] at  7.798E+04 yr
            I129    1.0814E-04 [Ci/yr/SA] at  7.798E+04 yr
            Cl36    5.9492E-05 [Ci/yr/SA] at  7.798E+04 yr
            Ni59    1.7432E-05 [Ci/yr/SA] at  1.000E+05 yr
            U234    2.4169E-06 [Ci/yr/SA] at  1.000E+05 yr
            Np237   1.5576E-06 [Ci/yr/SA] at  1.000E+05 yr
-----------------------------------------------------------------------
    subarea  10 of  10          realization    1 of    1
-----------------------------------------------------------------------
exec: calling uzflow
exec: calling nfenv
exec: calling ebsfail
     ebsfail: time of WP failure =    60928.4  yr
exec: failed WPs from INITIAL   event =      1 at time =      0.0 yr
exec: failed WPs from CORROSION event =    852 at time =  60928.4 yr
 *** failed WPs: all WPs failed (  853) ***
exec: calling ebsrel
                Highest release rates from Sub Area  10
            Tc99    2.5384E-03 [Ci/yr/SA] at  7.798E+04 yr
            Pu239   9.8815E-04 [Ci/yr/SA] at  7.798E+04 yr
            Cs135   5.8831E-04 [Ci/yr/SA] at  7.798E+04 yr
            Ni59    4.5578E-05 [Ci/yr/SA] at  7.798E+04 yr
            Np237   4.0137E-05 [Ci/yr/SA] at  1.000E+05 yr
            I129    3.9811E-05 [Ci/yr/SA] at  7.798E+04 yr
exec: calling uzft
      *** NEFTRAN is skipped for this UZ path since no layers have significant ground water travel time. ***
                    Highest release rates from UZ
            Tc99    2.5384E-03 [Ci/yr/SA] at  7.798E+04 yr
```

```
            Pu239   9.8815E-04 [Ci/yr/SA] at  7.798E+04 yr
            Cs135   5.8831E-04 [Ci/yr/SA] at  7.798E+04 yr
            Ni59    4.5578E-05 [Ci/yr/SA] at  7.798E+04 yr
            Np237   4.0137E-05 [Ci/yr/SA] at  1.000E+05 yr
            I129    3.9811E-05 [Ci/yr/SA] at  7.798E+04 yr
exec: calling szft
Note: IEEE floating-point exception flags raised:
   Inexact;  Underflow;
See the Numerical Computation Guide, ieee_flags(3M)
                    Highest release rates from SZ
            Tc99    2.4074E-03 [Ci/yr/SA] at  7.798E+04 yr
            I129    3.7858E-05 [Ci/yr/SA] at  7.798E+04 yr
            Cl36    2.0849E-05 [Ci/yr/SA] at  7.798E+04 yr
            Ni59    6.5268E-06 [Ci/yr/SA] at  1.000E+05 yr
            U234    2.0692E-06 [Ci/yr/SA] at  1.000E+05 yr
            U238    6.2243E-07 [Ci/yr/SA] at  1.000E+05 yr
exec: calling dcagw
 total tube width [m] =     1230.0000000000
Computing time differences using the 2 digit year from subroutine date is not safe after year 2000.
Computing time differences using the 2 digit year from subroutine date is not safe after year 2000.
Computing time differences using the 2 digit year from subroutine date is not safe after year 2000.
Computing time differences using the 2 digit year from subroutine date is not safe after year 2000.
                    Highest annual dose GW pathway
            I129    1.6834E-02 [mrem/yr]  at  7.798E+04 yr
            Tc99    5.8850E-03 [mrem/yr]  at  7.798E+04 yr
            Np237   2.8102E-03 [mrem/yr]  at  6.093E+04 yr
            U234    3.9202E-04 [mrem/yr]  at  1.000E+05 yr
            Cl36    1.2377E-04 [mrem/yr]  at  7.798E+04 yr
            U238    1.0969E-04 [mrem/yr]  at  1.000E+05 yr
          At end of TPI, annual dose GW pathway
            I129    1.3727E-03 [mrem/yr]
            Tc99    1.1734E-03 [mrem/yr]
            Np237   1.1261E-03 [mrem/yr]
            U234    3.9202E-04 [mrem/yr]
            U238    1.0969E-04 [mrem/yr]
            Th230   7.6750E-05 [mrem/yr]
               sum  4.2668E-03 [mrem/yr]
exec: end realizations

exec: Peak Mean Dose is 2.41080E-05 rem/yr at  77979.0 yr.

exec:  Run Successfully Completed
```

10 km_fixed.output.60

WITH FIX

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```
=====================================================================
          exec: Welcome to TPA Version 4.1e
        Job started: Tue Jan 30 10:26:52 2001
=====================================================================
 REPOSITORY DESIGN INFORMATION
 Subarea   Area       Waste   Number of WP
    #      [m^2]      [MTU]
    1    723591.3    11058.1        1133
    2    784763.0    11546.1        1183
    3    390372.0     5563.2         570
    4    207581.3     3445.3         353
    5    378972.8     5553.4         569
    6    424872.5     6236.6         639
    7    163938.3     2381.4         244
    8    393468.9     6588.0         675
    9    660785.5     9311.0         954
   10    589497.1     8325.3         853

 Total Area [acre]          =     1165.7629779961
 Total Buried Waste [MTU]   =     70008.480000000
 Repository AML [MTU/acre]  =     60.053785650616

 Specified Global Parameters:

                Compliance Period =  10000.0 (yr)
           Maximum Simulation Time = 100000.0 (yr)
            Number Of Realizations =      1
                Number Of Subareas =     10
                Volcanism scenario =      0 (yes=1, no=0)
                 Faulting scenario =      0 (yes=1, no=0)
                  Seismic scenario =      1 (yes=1, no=0)
        Distance to Receptor Group =     10.0 (km)


 **>>> CAUTION: CHECKING OF NUCLIDES AND CHAINS IS DISABLED <<<**
 **>>> You may not be using the standard chains specified   <<<**
 **>>> in the invent module.                                <<<**
 **>>> (see "CheckNuclidesAndChains(yes=1,no=0)" in tpa.inp)<<<**

 The specified path for data  = $TPA_DATA/
 The specified path for codes = $TPA_TEST/

 **To modify global parameters or the path, stop code execution using control-C**
 Note: IEEE floating-point exception traps enabled:
    overflow;  division by zero;  invalid operation;
 See the Numerical Computation Guide, ieee_handler(3M)
---------------------------------------------------------------------
     subarea   1 of  10           realization    1 of    1
---------------------------------------------------------------------
 exec: calling uzflow
 exec: calling nfenv
 exec: calling ebsfail
      ebsfail: time of WP failure =    60928.4  yr
 exec: calling seismo
 exec: failed WPs from INITIAL   event =      2 at time =      0.0 yr
 exec: failed WPs from CORROSION event =   1131 at time =  60928.4 yr
  *** failed WPs: all WPs failed (  1133) ***
 exec: calling ebsrel
                 Highest release rates from Sub Area  1
              Tc99    1.7174E-02 [Ci/yr/SA] at  7.798E+04 yr
              Cs135   4.0632E-03 [Ci/yr/SA] at  7.798E+04 yr
              Pu239   1.6162E-03 [Ci/yr/SA] at  7.798E+04 yr
              Ni59    2.7706E-04 [Ci/yr/SA] at  7.798E+04 yr
              I129    2.7511E-04 [Ci/yr/SA] at  7.798E+04 yr
              Np237   2.6937E-04 [Ci/yr/SA] at  1.000E+05 yr
 exec: calling uzft
                      Highest release rates from UZ
              Tc99    1.6904E-02 [Ci/yr/SA] at  7.798E+04 yr
              I129    2.7100E-04 [Ci/yr/SA] at  7.798E+04 yr
              Np237   2.6723E-04 [Ci/yr/SA] at  1.000E+05 yr
              Se79    1.8559E-04 [Ci/yr/SA] at  7.798E+04 yr
              Cl36    1.4904E-04 [Ci/yr/SA] at  7.798E+04 yr
              Nb94    1.6053E-05 [Ci/yr/SA] at  7.798E+04 yr
 exec: calling szft
                      Highest release rates from SZ
              Tc99    1.6551E-02 [Ci/yr/SA] at  7.798E+04 yr
              I129    2.6559E-04 [Ci/yr/SA] at  7.798E+04 yr
              Np237   2.6279E-04 [Ci/yr/SA] at  1.000E+05 yr
              Cl36    1.4597E-04 [Ci/yr/SA] at  7.798E+04 yr
              Se79    1.3098E-04 [Ci/yr/SA] at  7.798E+04 yr
              U234    3.1808E-06 [Ci/yr/SA] at  7.798E+04 yr
```

```
-----------------------------------------------------------------------
    subarea   2 of  10          realization    1 of    1
-----------------------------------------------------------------------
 exec: calling uzflow
 exec: calling nfenv
 exec: calling ebsfail
      ebsfail: time of WP failure =    60928.4  yr
 exec: failed WPs from INITIAL   event =      2 at time =      0.0 yr
 exec: failed WPs from CORROSION event =   1181 at time =  60928.4 yr
  *** failed WPs: all WPs failed (  1183) ***
  *** ejected WPs:   0
 exec: calling ebsrel
                 Highest release rates from Sub Area  2
              Tc99    1.1571E-03 [Ci/yr/SA] at  7.798E+04 yr
              Pu239   8.4316E-04 [Ci/yr/SA] at  7.798E+04 yr
              Cs135   2.6513E-04 [Ci/yr/SA] at  7.798E+04 yr
              Am243   3.7100E-05 [Ci/yr/SA] at  1.505E+04 yr
              Ni59    2.2193E-05 [Ci/yr/SA] at  7.798E+04 yr
              C14     2.1744E-05 [Ci/yr/SA] at  1.505E+04 yr
 exec: calling uzft
       *** NEFTRAN is skipped for this UZ path since no layers have significant ground water travel time. ***
                      Highest release rates from UZ
              Tc99    1.1571E-03 [Ci/yr/SA] at  7.798E+04 yr
              Pu239   8.4316E-04 [Ci/yr/SA] at  7.798E+04 yr
              Cs135   2.6513E-04 [Ci/yr/SA] at  7.798E+04 yr
              Am243   3.7100E-05 [Ci/yr/SA] at  1.505E+04 yr
              Ni59    2.2193E-05 [Ci/yr/SA] at  7.798E+04 yr
              Np237   1.9285E-05 [Ci/yr/SA] at  7.798E+04 yr
 exec: calling szft
                      Highest release rates from SZ
              Tc99    1.1348E-03 [Ci/yr/SA] at  7.798E+04 yr
              Pu239   8.3142E-05 [Ci/yr/SA] at  1.000E+05 yr
              Np237   1.8809E-05 [Ci/yr/SA] at  1.000E+05 yr
              I129    1.7608E-05 [Ci/yr/SA] at  7.798E+04 yr
              Cl36    9.7070E-06 [Ci/yr/SA] at  7.798E+04 yr
              Se79    9.5235E-06 [Ci/yr/SA] at  7.798E+04 yr
-----------------------------------------------------------------------
    subarea   3 of  10          realization    1 of    1
-----------------------------------------------------------------------
 exec: calling uzflow
 exec: calling nfenv
 exec: calling ebsfail
      ebsfail: time of WP failure =    60928.4  yr
 exec: failed WPs from INITIAL   event =      1 at time =      0.0 yr
 exec: failed WPs from CORROSION event =    569 at time =  60928.4 yr
  *** failed WPs: all WPs failed (  570) ***
 exec: calling ebsrel
                 Highest release rates from Sub Area  3
              Tc99    1.6142E-03 [Ci/yr/SA] at  7.798E+04 yr
              Pu239   8.1999E-04 [Ci/yr/SA] at  7.798E+04 yr
              Cs135   3.7275E-04 [Ci/yr/SA] at  7.798E+04 yr
              Ni59    2.9609E-05 [Ci/yr/SA] at  7.798E+04 yr
              Np237   2.5738E-05 [Ci/yr/SA] at  7.798E+04 yr
              I129    2.5224E-05 [Ci/yr/SA] at  7.798E+04 yr
 exec: calling uzft
                      Highest release rates from UZ
              Tc99    1.5831E-03 [Ci/yr/SA] at  7.798E+04 yr
              Np237   2.5667E-05 [Ci/yr/SA] at  1.000E+05 yr
              I129    2.4762E-05 [Ci/yr/SA] at  7.798E+04 yr
              Se79    1.6711E-05 [Ci/yr/SA] at  7.798E+04 yr
              Cl36    1.3653E-05 [Ci/yr/SA] at  7.798E+04 yr
              U234    2.0203E-06 [Ci/yr/SA] at  7.798E+04 yr
 exec: calling szft
                      Highest release rates from SZ
              Tc99    1.5511E-03 [Ci/yr/SA] at  7.798E+04 yr
              Np237   2.5401E-05 [Ci/yr/SA] at  1.000E+05 yr
              I129    2.4284E-05 [Ci/yr/SA] at  7.798E+04 yr
              Cl36    1.3380E-05 [Ci/yr/SA] at  7.798E+04 yr
              Se79    1.1931E-05 [Ci/yr/SA] at  7.798E+04 yr
              U234    1.6040E-06 [Ci/yr/SA] at  7.798E+04 yr
-----------------------------------------------------------------------
    subarea   4 of  10          realization    1 of    1
-----------------------------------------------------------------------
 exec: calling uzflow
 exec: calling nfenv
 exec: calling ebsfail
      ebsfail: time of WP failure =    60928.4  yr
 exec: failed WPs from INITIAL   event =      1 at time =      0.0 yr
 exec: failed WPs from CORROSION event =    352 at time =  60928.4 yr
  *** failed WPs: all WPs failed (  353) ***
 exec: calling ebsrel
```

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```
                Highest release rates from Sub Area  4
            Tc99     1.2188E-03 [Ci/yr/SA] at  7.798E+04 yr
            Pu239    3.5007E-04 [Ci/yr/SA] at  7.798E+04 yr
            Cs135    2.8317E-04 [Ci/yr/SA] at  7.798E+04 yr
            Ni59     2.1620E-05 [Ci/yr/SA] at  7.798E+04 yr
            Np237    1.9321E-05 [Ci/yr/SA] at  1.000E+05 yr
            I129     1.9163E-05 [Ci/yr/SA] at  7.798E+04 yr
 exec: calling uzft
                     Highest release rates from UZ
            Tc99     1.1922E-03 [Ci/yr/SA] at  7.798E+04 yr
            Np237    1.9257E-05 [Ci/yr/SA] at  1.000E+05 yr
            I129     1.8766E-05 [Ci/yr/SA] at  7.798E+04 yr
            Se79     1.2521E-05 [Ci/yr/SA] at  7.798E+04 yr
            Cl36     1.0344E-05 [Ci/yr/SA] at  7.798E+04 yr
            Nb94     1.2521E-06 [Ci/yr/SA] at  7.798E+04 yr
 exec: calling szft
                     Highest release rates from SZ
            Tc99     1.1692E-03 [Ci/yr/SA] at  7.798E+04 yr
            Np237    1.9005E-05 [Ci/yr/SA] at  1.000E+05 yr
            I129     1.8419E-05 [Ci/yr/SA] at  7.798E+04 yr
            Cl36     1.0146E-05 [Ci/yr/SA] at  7.798E+04 yr
            Se79     9.0733E-06 [Ci/yr/SA] at  7.798E+04 yr
            U234     6.8454E-07 [Ci/yr/SA] at  7.798E+04 yr
-----------------------------------------------------------------------
    subarea   5 of  10          realization    1 of    1
-----------------------------------------------------------------------
 exec: calling uzflow
 exec: calling nfenv
 exec: calling ebsfail
     ebsfail: time of WP failure =    60928.4  yr
 exec: failed WPs from INITIAL   event =      1 at time =      0.0 yr
 exec: failed WPs from CORROSION event =    568 at time =  60928.4 yr
  *** failed WPs: all WPs failed (  569) ***
 exec: calling ebsrel
                Highest release rates from Sub Area  5
            Tc99     3.9216E-03 [Ci/yr/SA] at  7.798E+04 yr
            Cs135    9.1776E-04 [Ci/yr/SA] at  7.798E+04 yr
            Pu239    7.4487E-04 [Ci/yr/SA] at  7.798E+04 yr
            Ni59     6.6702E-05 [Ci/yr/SA] at  7.798E+04 yr
            I129     6.2116E-05 [Ci/yr/SA] at  7.798E+04 yr
            Np237    6.1502E-05 [Ci/yr/SA] at  1.000E+05 yr
 exec: calling uzft
                     Highest release rates from UZ
            Tc99     3.7974E-03 [Ci/yr/SA] at  7.798E+04 yr
            Np237    6.0949E-05 [Ci/yr/SA] at  1.000E+05 yr
            I129     6.0244E-05 [Ci/yr/SA] at  7.798E+04 yr
            Se79     3.8347E-05 [Ci/yr/SA] at  7.798E+04 yr
            Cl36     3.3185E-05 [Ci/yr/SA] at  7.798E+04 yr
            Nb94     3.7982E-06 [Ci/yr/SA] at  7.798E+04 yr
 exec: calling szft
                     Highest release rates from SZ
            Tc99     3.7533E-03 [Ci/yr/SA] at  7.798E+04 yr
            Np237    6.0266E-05 [Ci/yr/SA] at  1.000E+05 yr
            I129     5.9577E-05 [Ci/yr/SA] at  7.798E+04 yr
            Cl36     3.2805E-05 [Ci/yr/SA] at  7.798E+04 yr
            Se79     3.1859E-05 [Ci/yr/SA] at  7.798E+04 yr
            U234     1.5242E-06 [Ci/yr/SA] at  7.798E+04 yr
-----------------------------------------------------------------------
    subarea   6 of  10          realization    1 of    1
-----------------------------------------------------------------------
 exec: calling uzflow
 exec: calling nfenv
 exec: calling ebsfail
     ebsfail: time of WP failure =    60928.4  yr
 exec: failed WPs from INITIAL   event =      1 at time =      0.0 yr
 exec: failed WPs from CORROSION event =    638 at time =  60928.4 yr
  *** failed WPs: all WPs failed (  639) ***
 exec: calling ebsrel
                Highest release rates from Sub Area  6
            Tc99     8.4773E-03 [Ci/yr/SA] at  7.798E+04 yr
            Cs135    2.0232E-03 [Ci/yr/SA] at  7.798E+04 yr
            Pu239    6.2272E-04 [Ci/yr/SA] at  7.798E+04 yr
            I129     1.3701E-04 [Ci/yr/SA] at  7.798E+04 yr
            Ni59     1.2977E-04 [Ci/yr/SA] at  7.798E+04 yr
            Np237    1.2966E-04 [Ci/yr/SA] at  1.000E+05 yr
 exec: calling uzft
                     Highest release rates from UZ
            Tc99     8.0919E-03 [Ci/yr/SA] at  7.798E+04 yr
            I129     1.3109E-04 [Ci/yr/SA] at  7.798E+04 yr
            Np237    1.2611E-04 [Ci/yr/SA] at  1.000E+05 yr
            Se79     7.6036E-05 [Ci/yr/SA] at  7.798E+04 yr
```

```
            Cl36     7.1953E-05 [Ci/yr/SA] at  7.798E+04 yr
            Nb94     7.1638E-06 [Ci/yr/SA] at  7.798E+04 yr
 exec: calling szft
                     Highest release rates from SZ
            Tc99     7.9998E-03 [Ci/yr/SA] at  7.798E+04 yr
            I129     1.2966E-04 [Ci/yr/SA] at  7.798E+04 yr
            Np237    1.2388E-04 [Ci/yr/SA] at  1.000E+05 yr
            Cl36     7.1145E-05 [Ci/yr/SA] at  7.798E+04 yr
            Se79     6.3410E-05 [Ci/yr/SA] at  7.798E+04 yr
            U234     1.1853E-06 [Ci/yr/SA] at  7.798E+04 yr
-----------------------------------------------------------------------
     subarea   7 of  10          realization    1 of    1
-----------------------------------------------------------------------
 exec: calling uzflow
 exec: calling nfenv
 exec: calling ebsfail
      ebsfail: time of WP failure =    60928.4  yr
 exec: failed WPs from CORROSION event =    244 at time =  60928.4 yr
  *** failed WPs: all WPs failed (  244) ***
 exec: calling ebsrel
                 Highest release rates from Sub Area  7
            Tc99     3.6523E-03 [Ci/yr/SA] at  7.798E+04 yr
            Cs135    8.7821E-04 [Ci/yr/SA] at  7.798E+04 yr
            Pu239    2.2305E-04 [Ci/yr/SA] at  7.798E+04 yr
            I129     5.9480E-05 [Ci/yr/SA] at  7.798E+04 yr
            Np237    5.4616E-05 [Ci/yr/SA] at  1.000E+05 yr
            Ni59     5.3349E-05 [Ci/yr/SA] at  7.798E+04 yr
 exec: calling uzft
                     Highest release rates from UZ
            Tc99     3.4588E-03 [Ci/yr/SA] at  7.798E+04 yr
            I129     5.6479E-05 [Ci/yr/SA] at  7.798E+04 yr
            Np237    5.2517E-05 [Ci/yr/SA] at  1.000E+05 yr
            Cl36     3.0970E-05 [Ci/yr/SA] at  7.798E+04 yr
            Se79     3.0184E-05 [Ci/yr/SA] at  7.798E+04 yr
            Nb94     2.9005E-06 [Ci/yr/SA] at  7.798E+04 yr
 exec: calling szft
                     Highest release rates from SZ
            Tc99     3.4197E-03 [Ci/yr/SA] at  7.798E+04 yr
            I129     5.5870E-05 [Ci/yr/SA] at  7.798E+04 yr
            Np237    5.1449E-05 [Ci/yr/SA] at  1.000E+05 yr
            Cl36     3.0625E-05 [Ci/yr/SA] at  7.798E+04 yr
            Se79     2.5211E-05 [Ci/yr/SA] at  7.798E+04 yr
            U234     4.0053E-07 [Ci/yr/SA] at  7.798E+04 yr
-----------------------------------------------------------------------
     subarea   8 of  10          realization    1 of    1
-----------------------------------------------------------------------
 exec: calling uzflow
 exec: calling nfenv
 exec: calling ebsfail
      ebsfail: time of WP failure =    60928.4  yr
 exec: failed WPs from INITIAL   event =      1 at time =      0.0 yr
 exec: failed WPs from CORROSION event =    674 at time =  60928.4 yr
  *** failed WPs: all WPs failed (  675) ***
 exec: calling ebsrel
                 Highest release rates from Sub Area  8
            Tc99     5.5818E-03 [Ci/yr/SA] at  7.798E+04 yr
            Cs135    1.3049E-03 [Ci/yr/SA] at  7.798E+04 yr
            Pu239    8.8555E-04 [Ci/yr/SA] at  7.798E+04 yr
            Ni59     9.6166E-05 [Ci/yr/SA] at  7.798E+04 yr
            Np237    8.9042E-05 [Ci/yr/SA] at  1.000E+05 yr
            I129     8.8322E-05 [Ci/yr/SA] at  7.798E+04 yr
 exec: calling uzft
       *** NEFTRAN is skipped for this UZ path since no layers have significant ground water travel time. ***
                     Highest release rates from UZ
            Tc99     5.5818E-03 [Ci/yr/SA] at  7.798E+04 yr
            Cs135    1.3049E-03 [Ci/yr/SA] at  7.798E+04 yr
            Pu239    8.8555E-04 [Ci/yr/SA] at  7.798E+04 yr
            Ni59     9.6166E-05 [Ci/yr/SA] at  7.798E+04 yr
            Np237    8.9042E-05 [Ci/yr/SA] at  1.000E+05 yr
            I129     8.8322E-05 [Ci/yr/SA] at  7.798E+04 yr
 exec: calling szft
                     Highest release rates from SZ
            Tc99     5.4721E-03 [Ci/yr/SA] at  7.798E+04 yr
            Np237    8.8519E-05 [Ci/yr/SA] at  1.000E+05 yr
            I129     8.6665E-05 [Ci/yr/SA] at  7.798E+04 yr
            Pu239    8.2515E-05 [Ci/yr/SA] at  1.000E+05 yr
            Cl36     4.7724E-05 [Ci/yr/SA] at  7.798E+04 yr
            Se79     4.6613E-05 [Ci/yr/SA] at  7.798E+04 yr
-----------------------------------------------------------------------
     subarea   9 of  10          realization    1 of    1
-----------------------------------------------------------------------
```

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```
 exec: calling uzflow
 exec: calling nfenv
 exec: calling ebsfail
      ebsfail: time of WP failure =    60928.4  yr
 exec: failed WPs from INITIAL   event =      2 at time =      0.0 yr
 exec: failed WPs from CORROSION event =    952 at time =  60928.4 yr
  *** failed WPs: all WPs failed (  954) ***
 exec: calling ebsrel
                 Highest release rates from Sub Area  9
              Tc99    7.1764E-03 [Ci/yr/SA] at  7.798E+04 yr
              Cs135   1.6812E-03 [Ci/yr/SA] at  7.798E+04 yr
              Pu239   1.1440E-03 [Ci/yr/SA] at  7.798E+04 yr
              Ni59    1.2180E-04 [Ci/yr/SA] at  7.798E+04 yr
              I129    1.1379E-04 [Ci/yr/SA] at  7.798E+04 yr
              Np237   1.1333E-04 [Ci/yr/SA] at  1.000E+05 yr
 exec: calling uzft
       *** NEFTRAN is skipped for this UZ path since no layers have significant ground water travel time. ***
                      Highest release rates from UZ
              Tc99    7.1764E-03 [Ci/yr/SA] at  7.798E+04 yr
              Cs135   1.6812E-03 [Ci/yr/SA] at  7.798E+04 yr
              Pu239   1.1440E-03 [Ci/yr/SA] at  7.798E+04 yr
              Ni59    1.2180E-04 [Ci/yr/SA] at  7.798E+04 yr
              I129    1.1379E-04 [Ci/yr/SA] at  7.798E+04 yr
              Np237   1.1333E-04 [Ci/yr/SA] at  1.000E+05 yr
 exec: calling szft
                      Highest release rates from SZ
              Tc99    7.0539E-03 [Ci/yr/SA] at  7.798E+04 yr
              Pu239   1.2024E-04 [Ci/yr/SA] at  1.000E+05 yr
              Np237   1.1271E-04 [Ci/yr/SA] at  1.000E+05 yr
              I129    1.1193E-04 [Ci/yr/SA] at  7.798E+04 yr
              Se79    6.2832E-05 [Ci/yr/SA] at  7.798E+04 yr
              Cl36    6.1661E-05 [Ci/yr/SA] at  7.798E+04 yr
-----------------------------------------------------------------------
     subarea  10 of  10           realization    1 of    1
-----------------------------------------------------------------------
 exec: calling uzflow
 exec: calling nfenv
 exec: calling ebsfail
      ebsfail: time of WP failure =    60928.4  yr
 exec: failed WPs from INITIAL   event =      1 at time =      0.0 yr
 exec: failed WPs from CORROSION event =    852 at time =  60928.4 yr
  *** failed WPs: all WPs failed (  853) ***
 exec: calling ebsrel
                 Highest release rates from Sub Area  10
              Tc99    2.5384E-03 [Ci/yr/SA] at  7.798E+04 yr
              Pu239   9.8815E-04 [Ci/yr/SA] at  7.798E+04 yr
              Cs135   5.8831E-04 [Ci/yr/SA] at  7.798E+04 yr
              Ni59    4.5578E-05 [Ci/yr/SA] at  7.798E+04 yr
              Np237   4.0137E-05 [Ci/yr/SA] at  1.000E+05 yr
              I129    3.9811E-05 [Ci/yr/SA] at  7.798E+04 yr
 exec: calling uzft
       *** NEFTRAN is skipped for this UZ path since no layers have significant ground water travel time. ***
                      Highest release rates from UZ
              Tc99    2.5384E-03 [Ci/yr/SA] at  7.798E+04 yr
              Pu239   9.8815E-04 [Ci/yr/SA] at  7.798E+04 yr
              Cs135   5.8831E-04 [Ci/yr/SA] at  7.798E+04 yr
              Ni59    4.5578E-05 [Ci/yr/SA] at  7.798E+04 yr
              Np237   4.0137E-05 [Ci/yr/SA] at  1.000E+05 yr
              I129    3.9811E-05 [Ci/yr/SA] at  7.798E+04 yr
 exec: calling szft
                      Highest release rates from SZ
              Tc99    2.4959E-03 [Ci/yr/SA] at  7.798E+04 yr
              Pu239   1.0452E-04 [Ci/yr/SA] at  1.000E+05 yr
              Np237   4.0081E-05 [Ci/yr/SA] at  1.000E+05 yr
              I129    3.9176E-05 [Ci/yr/SA] at  7.798E+04 yr
              Se79    2.2147E-05 [Ci/yr/SA] at  7.798E+04 yr
              Cl36    2.1604E-05 [Ci/yr/SA] at  7.798E+04 yr
 exec: calling dcagw
  total tube width [m] =     1890.0000000000
Computing time differences using the 2 digit year from subroutine date is not safe after year 2000.
Computing time differences using the 2 digit year from subroutine date is not safe after year 2000.
Computing time differences using the 2 digit year from subroutine date is not safe after year 2000.
Computing time differences using the 2 digit year from subroutine date is not safe after year 2000.
                      Highest annual dose GW pathway
              Np237   1.1662E+01 [mrem/yr]  at  1.000E+05 yr
              Pu239   4.5154E+00 [mrem/yr]  at  1.000E+05 yr
              I129    7.2875E-01 [mrem/yr]  at  7.798E+04 yr
              Tc99    2.4271E-01 [mrem/yr]  at  7.798E+04 yr
              Pb210   1.7905E-01 [mrem/yr]  at  1.000E+05 yr
              Ra226   4.3243E-02 [mrem/yr]  at  1.000E+05 yr
            At end of TPI, annual dose GW pathway
```

```
            Np237   1.1662E+01 [mrem/yr]
            Pu239   4.5154E+00 [mrem/yr]
            Pb210   1.7905E-01 [mrem/yr]
            I129    4.5735E-02 [mrem/yr]
            Tc99    4.3643E-02 [mrem/yr]
            Ra226   4.3243E-02 [mrem/yr]
               sum  1.6526E+01 [mrem/yr]
exec: end realizations

exec: Peak Mean Dose is 1.65260E-02 rem/yr at 100000.0 yr.

exec:  Run Successfully Completed
```

full printout of dcagw.f for TPA 4.1

WITHOUT FIX

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```
c Program Name:         TPA - Total-System Performance Assessment Code
c File Name:            dcagw.f
c File Date:            09/26/00
c Release Version:      4.1
c
c Client Name:          USNRC
c                       U. S. Nuclear Regulatory Commission
c                       NRC Office of Nuclear Material Safety and Safeguards
c                       Division of Waste Management
c Contract Number:      NRC 02-97-009
c
c NRC Contact           Tim McCartin (301) 415-6681
c
c CNWRA Contact:        Sitakanta Mohanty (210) 522-5185
c                       Center for Nuclear Waste Regulatory Analyses
c                       San Antonio, Texas 78238-5166
c                       smohanty@swri.edu
c
c Documentation:        Predecisional "Total-System Performance Assessment
c                       (TPA) Version 4.0 Code: Module Description and
c                       User's Guide", Center for Nuclear Waste Regulatory
c                       Analyses
c NUREG-Series Designator: N/A
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c
c = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = =
c
c                       D I S C L A I M E R
c
c = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = =
c
c     "This computer code/material was prepared as an account of work
c performed by the Center for Nuclear Waste Regulatory Analyses (CNWRA)
c for the Division of Waste Management of the Nuclear Regulatory
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c or those who have written or modified this code, be liable for
c damages, including any lost profits, lost monies, or other special,
c incidental or consequential damages arising out of the use or
c inability to use the program (including but not limited to loss of
c data or data being rendered inaccurate or losses sustained by third
c parties or a failure of the program to operate with other programs),
c even if you have been advised of the possibility of such damages or
c for any claim by any other party."
c
c = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = =
c
c by S. Mohanty, R. Janetzke, R. Rice
c    M. Jarzemba (initial version)
c
c mas - M. Smith, M. Muller - 2/10/00 (subroutine gentodcf for TPA4.0beta)
c mas - M. Smith - 2/29/00 added age-specific inhalation rate parameter (rir)
c mas - M. Smith - 2/29/00 added append file for gw_cb.ad.dat and gw_pb_ad.dat
c mas - M. Smith - 2/29/00 added new header info for gw_ dcf files
c==========================================================================
cc rwj 2-12-00  Add realization number.
cc     subroutine dcagw( mxntime, mxnnucl,
       subroutine dcagw( irl, mxntime, mxnnucl,
     &                   ntim, tim, nnucl, names,
     &                   aveqm3peryrallsafromuz,
     &                   dMAP,dMAT,ciperyrallsafromsz,
     &                   remperyrpernuclgw,
     &                   dwdcf, dilutionvolume, fractionmasscaptured )
c==========================================================================
c calculates dose through groundwater pathway by extraction at well.
c calculates saturated zone flow from below repository to compliance
c point which may be located 5,25, 30, 35 km from repository
c
c dilution volume determination by using:
c the maximum of (1) pumping rate, (2) flow (streamtube flow x mixing thickness)
c and (3) average flow rate out of the repository
c if CP is less than 20 km, then use qm3peryrallsafromsz to calculate
c concentration of nuclides in GW.
c if CP is greater than 20 km, then use well pumping rate to calculate
```

← OLD VERSION without stream tube fix

```
c concentration of nuclides in GW, assuming all nuclides extracted
c from system by pumping
c
c mxntime = input, integer, size to dimension arrays
c mxnnucl = input, integer, size to dimension arrays
c ntim = input, integer, maximum number of times used to dimension arrays
c tim(ntim)  = input, double precision, array of times
c nnucl = input, integer, maximum number of nuclides used to dimension arrays
c names(nnucl) = input, character*6, names of nuclides to be tracked
c aveqm3peryrallsafromuz =  input, double precision, average groundwater
c               flow rate [m^3/yr] from all subareas from the unsaturated zone
c dMAP(ntim) = input, double precision, annual precipitaion rate [in/yr]
c dMAT(ntim) = input, double precision, temperature [F]
c ciperyrallsafromsz(mxntime,mxnnucl) = input, double precision, nuclide
c                   release rate [Ci/yr] from all subareas from the
c                   saturated zone at the compliance point
c remperyrpernuclgw[mxntime,nnucl] = output, double precision, array of
c             annual EDE (effective dose equivalent) per nuclide
c dwdcf(maxntime,mxnnucl) = output, double precision, array of drinking water
c             dose conversion factors from the *.in files
c dilutionvolume = output, double precision, dilution volume used to
c             determine dose (m3/yr)
c fractionmasscaptured = ouput, double precision, fraction of mass in the
c                        plume captured by the well pumping at 5 km
c                        (for 20km this fraction is 1.0)
c
      implicit double precision (a-h,o-z)
      include 'path.i'
      include 'szft.i'

      dimension tim(ntim)
      character*6 names(nnucl)
      dimension ciperyrallsafromsz(mxntime,mxnnucl)
      dimension remperyrpernuclgw(mxntime, mxnnucl)
      dimension dcfde(43),dcfinh(43),dcfinga(43),dcfingp(43),dcfdw(43)
cc    mam 02/01/00 Add def.
      dimension dcfmlk(43)

      dimension dwdcf(mxntime,43)

      parameter ( maxtubes = 50 )
      dimension szflowrate(maxtubes)
      parameter ( maxaqthickness = 5 )
      parameter ( maxpumprates = 8 )
      integer nearlegs(maxlayers)
      dimension tablepumpratescw(maxpumprates)
      dimension tablepumpratesct(maxpumprates)
      dimension tableaqthicknesscw(maxaqthickness)
      dimension tableaqthicknessct(maxaqthickness)
      dimension outputarray(maxpumprates)
      dimension ainputarray(maxpumprates)
      dimension dummyarray(maxpumprates)
      dimension amaplistarray(maxaqthickness)

      dimension dMAP(ntim), dMAT(ntim)

cc    jrw 7/27/00 added for groundwater protection
      dimension aconc(ntim), rconc(ntim), uconc(ntim)
      dimension aconcsum(ntim), rconcsum(ntim), uconcsum(ntim)
      dimension rnconc(ntim, 43)
      character*80 aline

      character*60 name
      character*10 char
      character*80 command

      integer dilflg
      integer plumflg
cc rwj 9-15-00
cc SCR 324
      integer pluv

      common / dcagw1 / ikey
      common / dcagw2 / dcf(43)
      common / dcagw3 / idist
      common / dcagw4 / dist
      common / dcagw5 / ipump5
      common / dcagw6 / ipump20
      common / dcagw8 / iamix20
      common / dcagw9 / icutoffpt
      common / dcagw10 / ireadtubefile
```

```
      common / dcagw11 / ireaddilutionfile
      common / dcagw12 / iaqthickness5km
      common / dcagw13 / anearfielddist, farfielddist
      common / dcagw14 / sumflow
      common / dcagw15 / totaltubewidth
      common / dcagw16 / tablepumpratescwct(maxpumprates)
      common / dcagw17 / tableaqthicknesscwct(maxaqthickness)
      common / dcagw18 / tablecapthick(maxpumprates,maxaqthickness)
      common / dcagw19 / tablecapwidth(maxpumprates,maxaqthickness)
      common / dcagw20 / tablepumpratessl(maxpumprates)
      common / dcagw21 / tablescreenlength(maxpumprates)
      common / dcagw22 / numberpumpratescwct
      common / dcagw23 / numberaqthicknesscwct
      common / dcagw24 / numberpumpratessl

cc rwr 9/6/00 modified for groundwater protection calculations
      integer gwpc
      character*6 nucname(43)
      common / dcagw25 / gwpc
      common / dcagw26 / ipumpgwp
      common / dcagw27 / ifrplumegwp
      common / dcagw28 / durationcp,numberreal
      common / dcagw29 / dosefactor(43,8)
      dimension epadose(ntim,43,8)
      dimension epadoseave(ntim,8)
      dimension epadosesum(ntim,8)
      dimension epadosetotal(ntim)
      dimension epadosetotalsum(ntim)
      dimension epapktim(12,2)
      dimension epasf(5)
      include 'inventp.i'
      include 'execc.i'

      external maplist
      external clearchar
      external valuesp
      integer zportsh
      external zportsh

cc rwj 8-23-00
cc     Remove old importance analysis method.
cc    external aiafilter

      save i1

      if( (nnucl .le. 0) .or. (nnucl .gt. 43) ) then
        print *, ' ***>>> Error in DCAGW <<<*** '
        print *, ' (nnucl .le. 0)  .or. (nnucl .gt. 43)'
        print *, ' nnucl = ', nnucl
        STOP
      endif
      if( ntim .gt. mxntime ) then
        print *, ' ***>>> Error in DCAGW <<<*** '
        print *, ' ntim .gt. mxntime '
        print *, ' mxntime = ', mxntime
        print *, ' ntim    = ', ntim
        STOP
      endif
      if( ntim .le. 0 ) then
        print *, ' ***>>> Error in DCAGW <<<*** '
        print *, ' ntim .le. 0 '
        print *, ' ntim = ', ntim
        STOP
      endif

      if (ikey .ne. 39231) then
cc to avoid warning message, make trivial use of tim()
        ajunk = tim(1)

        call clearchar( 60, name )
        name = 'DistanceToReceptorGroup[km][should_be_10_or_20]'
        idist = ispquery( name )

        call clearchar( 60, name )
        name = 'WellPumpingRateAtReceptorGroup10km[gal/day]'
        ipump5 = ispquery( name )

        call clearchar( 60, name )
        name = 'WellPumpingRateAtReceptorGroup20km[gal/day]'
        ipump20 = ispquery( name )
```

```
      call clearchar( 60, name )
      name = 'PlumeThickness5km[m]'
      iplume5 = ispquery( name )

      call clearchar( 60, name )
      name = 'MixingZoneThickness20km[m]'
      iamix20 = ispquery( name )

      call clearchar( 60, name )
      name = 'DistanceCutoffForDoseConversionDualityInDCAGS[km]'
      icutoffpt = ispquery( name )

      call clearchar( 60, name )
      name = 'PlumeCaptureModel'
      iplumflg = ispquery( name )
      plumflg  = ivaluesp(iplumflg)

      call clearchar( 60, name )
      name = 'DilutionModel'
      idilflg = ispquery( name )
      dilflg  = ivaluesp(idilflg)

      call clearchar( 60, name )
      name = 'UserDefinedPlumeCaptureFraction'
      iuserplumefraction = ispquery( name )

      call clearchar( 60, name )
      name = 'UserDefinedDilutionVolume[gal/day]'
      iuserdilutionvolume= ispquery( name )

      i1=igetunitnumber('dcagw   ')

      ireadtubefile = igetunitnumber('dcagw   ')

      call clearchar( 60, name )
      name = 'AquiferThickness5km[m]'
      iaqthickness5km = ispquery( name )

      ireaddilutionfile = igetunitnumber('dcagw   ')

cc jrw 7/21/00 modified to incorporate groundwater protection calculation

      call clearchar( 60, name )
      name = 'GroundwaterProtectionCalc(yes=1,no=0)'
      igwpc = ispquery( name )
      gwpc  = ivaluesp(igwpc)

      call clearchar( 60, name )
      name = 'WellPumpingRateGroundwaterProtection[gal/day]'
      ipumpgwp = ispquery( name )

      call clearchar( 60, name )
      name = 'FractionPlumeCaptureGroundwaterProtection'
      ifrplumegwp = ispquery( name )

cc jrw 1/31/00 modified for user input switch to pluvial DCF values
cc jrw 1/31/00 modified for pluvial pump rates at 20 km

      call clearchar( 60, name )
      name = 'PluvialWellPumpingRateAtReceptorGroup20km[gal/day]'
      ipluvpump20 = ispquery( name )

      call clearchar( 60, name )
      name = 'PluvialSwitchTime[yr]'
      ipluvswitch = ispquery( name )

      iline=1
      open (unit=ireadtubefile,file='strmtube.dat',status='old')
  100 continue
      read (ireadtubefile, '(a80)', end=889, err=903) aline
      iline = iline+1
      if (aline(1:2) .eq. 'TI' .or.
     &     aline(1:2) .eq. 'ti' .or.
     &     aline(1:2) .eq. '**' )   go to 100
      read (aline,*) numberoftubes
  150 continue
      read (ireadtubefile, '(a80)', end=889, err=903) aline
      iline = iline+1
      if (aline(1:2) .eq. '**') go to 150
      read (aline,*) numberflowrates
      if (numberflowrates .GT. maxtubes) then
```

```
          print *, ' ***>>> Error in DCAGW <<<*** '
          print *, ' (numberflowrates .GT. maxtubes)'
          print *, ' numberflowrates = ', numberflowrates
          print *, ' maxtubes = ', maxtubes
          STOP
        endif

      do itube = 1, numberoftubes
        read (ireadtubefile, *, end=889, err=903) szflowrate(itube)
        iline = iline+1
      enddo

  175 continue
      read (ireadtubefile, '(a80)') aline
      iline = iline+1
      if (aline(1:2) .eq. '**') go to 175
      read (aline,*) anearfielddist, farfielddist

      sumflow = 0.0d0
      do isum = 1, numberflowrates
        sumflow = sumflow + szflowrate(isum)
      enddo

      totaltubewidth = 0.0d0

      do itube = 1, numberoftubes

  177   continue
        read (ireadtubefile, '(a80)') aline
        iline = iline+1
        if (aline(1:2) .eq. '**') go to 177
cc rwj 2-5-00 New file format.
        read (aline, *, end=889, err=903) itubeid
        read (ireadtubefile,'(a80)', end=889, err=903) aline
        iline = iline+1

        read (aline, *, end=889, err=903) nearlegs(itube)
        read (ireadtubefile,'(a80)', end=889, err=903) aline
        iline = iline+1
cc
        do ileg = 1,nearlegs(itube)
          read (ireadtubefile, *, end = 889, err=903) ajunk
          iline = iline+1
        enddo
      enddo

cc rwj 2-5-00 New file format.
      do itube = 1, numberoftubes
  178   continue
        read (ireadtubefile, '(a80)') aline
        iline = iline+1
        if (aline(1:2) .eq. '**') go to 178
cc use only the last width to determine totaltubewidth
        read (aline, *, end=889, err=903) nearlegs(itube)
        read (ireadtubefile, '(a80)') aline
        iline = iline+1
        do ileg = 1,nearlegs(itube)
          read (ireadtubefile, *, end = 889, err=903)
     &    aifdist, awidth
          iline = iline+1
          if (aifdist .le. dist) width = awidth
        enddo
        totaltubewidth = totaltubewidth + width
      enddo

      print *,' total tube width [m] = ', totaltubewidth
      close ( ireadtubefile )

      call clearchar(80,command)
      command = 'cp ' // dpath // 'data/dilution.dat .'
      istatus=zportsh(command)
      if(istatus .ne. 0) then
         print *, ' ***>>> Error in DCAGW <<<*** '
         print *, ' Failure copying dilution.dat'
         print *, ' command = ', command
         print *, ' Status = ', istatus
         STOP
      endif

      iline=1
      open (unit=ireaddilutionfile,file='dilution.dat',status='old')
```

print statement added for testing purposes

```
179   continue
      read (ireaddilutionfile, '(a80)', end=905, err=908) aline
      iline = iline+1
      if (aline(1:2) .eq. 'TI' .or.
  &       aline(1:2) .eq. 'ti' .or.
  &       aline(1:2) .eq. '**' )   go to 179

      read (aline, *, end=905, err=908) numberpumpratescwct

      if (numberpumpratescwct .lt. 2) then
        print *, ' ***>>> Error in DCAGW <<<*** '
        print *, ' check number of pump rates in dilution.dat'
        print *, ' for capture widths and thicknesses'
        print *, ' (numberpumprates .lt. 2)'
        print *, ' numberpumprates = ',numberpumpratescwct
         STOP
      endif

      if (numberpumpratescwct .gt. maxpumprates) then
        print *, ' ***>>> Error in DCAGW <<<*** '
        print *, ' check number of pump rates in dilution.dat'
        print *, ' for capture widths and thicknesses'
        print *, ' (numberpumprates .gt. maxpumprates)'
        print *, ' numberpumprates = ',numberpumpratescwct
        print *, ' maxpumprates = ',maxpumprates
         STOP
      endif

181   continue
      read (ireaddilutionfile, '(a80)', end=905, err=908) aline
      iline = iline+1
      if (aline(1:2) .eq. '**' ) go to 181

      read (aline, *, end=905, err=908) numberaqthicknesscwct

      if (numberaqthicknesscwct .lt. 2) then
        print *, ' ***>>> Error in DCAGW <<<*** '
        print *, ' check number of values for aquifer thickness '
        print *, ' in dilution.dat'
        print *, ' (numberaqthicknesscwct .lt. 2)'
        print *, ' numberaqthickness = ',numberaqthicknesscwct
        STOP
      endif

      if (numberaqthicknesscwct .gt. maxaqthickness) then
        print *, ' ***>>> Error in DCAGW <<<*** '
        print *, ' check number of values for aquifer thickness '
        print *, ' in dilution.dat'
        print *, ' (numberaqthicknesscwct .gt. maxaqthickness)'
        print *, ' numberaqthickness = ',numberaqthicknesscwct
        print *, ' maxaqthickness = ',maxaqthickness
        STOP
      endif

183   continue
      read (ireaddilutionfile, '(a80)', end=905, err=908) aline
      iline = iline+1
      if (aline(1:2) .eq. '**' ) go to 183

      read (aline, *, end=905, err=908)
  &       (tableaqthicknesscw(j),j=1,numberaqthicknesscwct)

      read (ireaddilutionfile, '(a80)') aline
      iline = iline+1

      do ipumprates = 1, numberpumpratescwct

        read (ireaddilutionfile, *, end=905, err=908)
  &         tablepumpratescw(ipumprates),
  &         (tablecapwidth(ipumprates,j),j=1,numberaqthicknesscwct)
        iline = iline+1

      enddo

185   continue
      read (ireaddilutionfile, '(a80)', end=905, err=908) aline
      iline = iline+1
      if (aline(1:2) .eq. '**' ) go to 185

      read (aline, *, end=905, err=908)
  &       (tableaqthicknessct(j),j=1,numberaqthicknesscwct)
```

```
      read (ireaddilutionfile, '(a80)') aline
      iline = iline+1

      do ipumprates = 1, numberpumpratescwct

        read (ireaddilutionfile, *, end=905, err=908)
     &        tablepumpratesct(ipumprates),
     &        (tablecapthick(ipumprates,j),j=1,numberaqthicknesscwct)
        iline = iline+1

      enddo

      do icheck = 1, numberpumpratescwct
        if(tablepumpratescw(icheck) .ne.
     &    tablepumpratesct(icheck)) then
          print *, ' ***>>> Error in DCAGW <<<*** '
          print *, ' check pump rates in dilution.dat'
          print *, ' - the pump rates for capture width and'
          print *, '   capture thickness should be the same '
          print *, ' capture width pump rate = ',
     &              tablepumpratescw(icheck)
          print *, ' capture thickness pump rate = ',
     &              tablepumpratesct(icheck)
          print *, '  '
          STOP
        else
          tablepumpratescwct(icheck) = tablepumpratescw(icheck)
        endif
      enddo

      do icheck = 1, numberaqthicknesscwct
        if (tableaqthicknesscw(icheck) .ne.
     &       tableaqthicknessct(icheck)) then
          print *, ' ***>>> Error in DCAGW <<<*** '
          print *, ' check aquifer thickness in dilution.dat'
          print *, ' - the aquifer thickness for capture width and'
          print *, '   capture thickness should be the same '
          print *, ' capture width aquifer thickness = ',
     &              tableaqthicknesscw(icheck)
          print *, ' capture thickness aquifer thickness = ',
     &              tableaqthicknessct(icheck)
          print *, '  '
          STOP
        else
          tableaqthicknesscwct(icheck) = tableaqthicknesscw(icheck)
        endif
      enddo

187   continue
      read (ireaddilutionfile, '(a80)', end=905, err=908) aline
      iline = iline+1
      if (aline(1:2) .eq. '**' ) go to 187

      read (aline, *, end=905, err=908) numberpumpratessl

      if (numberpumpratessl .lt. 2) then
        print *, ' ***>>> Error in DCAGW <<<*** '
        print *, ' check number of pump rates in dilution.dat'
        print *, ' for screen length - (numberpumprates .lt. 2)'
        print *, ' numberpumprates = ',numberpumpratessl
        STOP
      endif

      if (numberpumpratessl .gt. maxpumprates) then
        print *, ' ***>>> Error in DCAGW <<<*** '
        print *, ' check number of pump rates in dilution.dat'
        print *, ' for screen length'
        print *, ' (numberpumprates .gt. maxpumprates)'
        print *, ' numberpumprates = ',numberpumpratessl
        print *, ' maxpumprates = ',maxpumprates
        STOP
      endif

      do iscreenlength = 1, numberpumpratessl
189     continue
        read (ireaddilutionfile, '(a80)', end=905, err=908) aline
        iline = iline+1
        if (aline(1:2) .eq. '**' ) go to 189
        read (aline, *, end=905, err=908)
     &        tablepumpratessl(iscreenlength),
```

```
     &          tablescreenlength(iscreenlength)
        enddo

  191   continue
        read (ireaddilutionfile, '(a80)', end=905, err=908) aline
        iline = iline+1
        if (aline(1:2) .eq. '**' ) go to 191

        if (aline(1:9) .ne. 'endoffile' ) then
          print *, ' ***>>> Error in DCAGW <<<*** '
          print *, ' "endoffile" not reached in dilution.dat'
          print *, ' look on line = ', iline
          print *, '  '
          STOP
        endif

        close ( ireaddilutionfile )

cc rwr 9/6/00 modified for groundwater protection calculations
        if (gwpc .eq. 1) then
          call clearchar( 60, name )
          name = 'NumberOfRealizations'
          inumberreal = ispquery( name )
          numberreal =  ivaluesp ( inumberreal )

          call clearchar( 60, name )
          name = 'DurationOfCompliancePeriod[yr]'
          idurationcp = ispquery( name )
          durationcp =  valuesp ( idurationcp )

          ireadorgandf = igetunitnumber('dcagw   ')
          call clearchar(80,command)
          command = 'cp ' // dpath // 'data/organdf.dat .'
          istatus=zportsh(command)
          if(istatus .ne. 0) then
            print *, ' ***>>> Error in DCAGW <<<*** '
            print *, ' Failure copying organdf.dat'
            print *, ' command = ', command
            print *, ' Status = ', istatus
            STOP
          endif

          iline=1
          open (unit=ireadorgandf,file='organdf.dat',status='old')
  182     continue
          read (ireadorgandf, '(a80)', end=910, err=911) aline
          iline = iline+1
          if (aline(1:2) .eq. 'TI' .or.
     &      aline(1:2) .eq. 'ti' .or.
     &      aline(1:2) .eq. '**' )   go to 182
          backspace(ireadorgandf)
          do iorgandf = 1,43
            read (ireadorgandf, 184) nucname(iorgandf),
     &        dosefactor(iorgandf,1), dosefactor(iorgandf,2),
     &        dosefactor(iorgandf,3), dosefactor(iorgandf,4),
     &        dosefactor(iorgandf,5), dosefactor(iorgandf,6),
     &        dosefactor(iorgandf,7), dosefactor(iorgandf,8)
          enddo
          do iorgandf = 1,5
            read(ireadorgandf,'(d8.2)' ) epasf(iorgandf)
          enddo
          do iini1 = 1, ntim
            uconcsum(iini1)=0.0d0
            aconcsum(iini1)=0.0d0
            rconcsum(iini1)=0.0d0
            epadosetotalsum(iini1) = 0.0d0
            do iini2 = 1,8
              epadoseave(iini1,iini2) = 0.0d0
            enddo
          enddo

        endif
  184   format(3x,a6,2x,d8.2,7(8x,d8.2))
        close(ireadorgandf)

        ikey =39231
      end if

cc
cc mam 01/24/00 Add call to run genii standalones.
cc
```

```
cc      Run GENII programs (envin and env) to make DCF files.

cc rwj 2-12-00 Add realization number.
cc      call gentpa()
        call gentpa( irl )

        cutoffpt = valuesp( icutoffpt)
        dist  = valuesp( idist )

        pump5 = valuesp (ipump5 )
cc rwj 8-23-00
cc     Remove old importance analysis method.
cc      pump5 = aiafilter ('WellPumpingRateAtCriticalGroup5km[gal/day]',
cc   &                      pump5 )
        pump20 = valuesp (ipump20 )
cc rwj 8-23-00
cc     Remove old importance analysis method.
cc      pump20= aiafilter('WellPumpingRateAtCriticalGroup20km[gal/day]',
cc   &                     pump20 )
        plume5 = valuesp (iplume5 )
        amix20 = valuesp (iamix20 )

cc jrw 02/02/00 next two lines added to implement a pluvial pump rate

        pluvpump20 = valuesp (ipluvpump20)
        pluvswitch = valuesp (ipluvswitch)

cc jrw 07/21/00 next two lines added to implement groundwater protection

        pumpgwp = valuesp (ipumpgwp)
        frplumegwp = valuesp (ifrplumegwp)

        aqthickness5km = valuesp (iaqthickness5km )

        userplumefraction = valuesp( iuserplumefraction )
        userdilutionvolume= valuesp( iuserdilutionvolume )


        if (cutoffpt .ge. farfielddist) then
          print *, '***>>> WARNING in DCAGW <<<***'
          print *,'In tpa.inp, the far field distance set by '
          print *,'"DistanceToReceptorGroup[km][should_be_10_or_20]"'
          print *,'is less than or equal to the'
          print *,'cutoffpt',cutoffpt,' which is set by'
          print *,'"DistanceCutoffForDoseConversionDualityInDCAGS[km]"'
          print *,'- the distance to receptor group'
          print *,'  will be ',dist
          print *, '***>>> WARNING in DCAGW <<<***'
          cutoffpt = farfielddist - 1.0d-10
        endif
        if (cutoffpt .le. anearfielddist) then
          print *, '***>>> WARNING in DCAGW <<<***'
          print *,'In tpa.inp, the near field distance set by '
          print *,'"DistanceToReceptorGroup[km][should_be_10_or_20]"'
          print *,'is greater than or equal to the'
          print *,'cutoffpt',cutoffpt,' which is set by'
          print *,'"DistanceCutoffForDoseConversionDualityInDCAGS[km]"'
          print *,'- the distance to receptor group'
          print *,'  will be ',dist
          print *, '***>>> WARNING in DCAGW <<<***'
          cutoffpt = anearfielddist + 1.0d-10
        endif

cc convert from tpa.inp units (gal/day) to dcagw units (m3/yr)
      pump5 =  ( pump5* 365.25d0 / 264.172d0 )
      pump20 =  ( pump20* 365.25d0 / 264.172d0 )

cc jrw added to implement a pluvial well pump rate
      pluvpump20 = ( pluvpump20*365.25d0 / 264.172d0)

cc jrw 7/21/00 added to implement groundwater protection
      pumpgwp = ( pumpgwp*365.25d0 / 264.172d0)

      if( dist .lt. cutoffpt ) then
        pump = pump5
        pumpm3perday = pump / 365.25d0
        dilutionvolume = pump

        if (dilflg .eq. 1) dilutionvolume = userdilutionvolume
     &                                     * 365.25d0 / 264.172d0
```

```
      amix = plume5

      if ((aqthickness5km .gt.
     &    tableaqthicknesscwct(numberaqthicknesscwct)) .or.
     &    (aqthickness5km .lt. tableaqthicknesscwct(1))) then
          print *, ' ***>>> Error in DCAGW <<<*** '
          print *, ' check aquifer thickness in dilution.dat and the'
          print *, ' values specified in "tpa.inp"'
          print *, ' - the sampled value for aquifer thickness is'
          print *, '   outside the range for data in dilution.dat'
          print *, ' sampled value for aquifer thickness (m) = ',
     &              aqthickness5km
          print *,' in dilution.dat - aq thickness lower limit (m) = ',
     &              tableaqthicknesscwct(1)
          print *,' in dilution.dat - aq thickness upper limit (m) = ',
     &              tableaqthicknesscwct(numberaqthicknesscwct)
          print *, '  '
          STOP
      endif

      if ((pumpm3perday .gt. tablepumpratessl(numberpumpratessl)) .or.
     &    (pumpm3perday .lt. tablepumpratessl(1)) .or.
     &    (pumpm3perday.gt.tablepumpratescwct(numberpumpratescwct)).or.
     &    (pumpm3perday .lt. tablepumpratescwct(1))) then
          print *, ' ***>>> Error in DCAGW <<<*** '
          print *, ' check pump rates in dilution.dat and the'
          print *, ' values specified in "tpa.inp"'
          print *, ' - the sampled value for pump rate is outside'
          print *, '   of the range for the data in dilution.dat '
          print *,' sampled value for pump rate (m3/d) = ',pumpm3perday
          print *, ' '
          print *, ' for screen length:'
          print *,' in dilution.dat - pump rate lower limit (m^3/d) = '
     &              ,tablepumpratessl(1)
          print *,' in dilution.dat - pump rate upper limit (m^3/d) = '
     &              ,tablepumpratessl(numberpumpratessl)
          print *, ' '
          print *, ' for capture widths and thicknesses:'
          print *,' in dilution.dat - pump rate lower limit (m^3/d) = '
     &              ,tablepumpratescwct(1)
          print *,' in dilution.dat - pump rate upper limit (m^3/d) = '
     &              ,tablepumpratescwct(numberpumpratescwct)
          print *, '  '
          STOP
      endif

cc find screenlength

          outputarray(1) = 0.0d0
          ainputarray(1) = pumpm3perday
          numbervalues = 1

          call maplist(numberpumpratessl,tablepumpratessl,
     &                 tablescreenlength,numbervalues,
     &                 ainputarray,outputarray)

          screenlength = outputarray(1)

cc find capture width

          do imaplist = 1,numberaqthicknesscwct
            do iassign = 1,numberpumpratescwct
              dummyarray(iassign) = tablecapwidth(iassign,imaplist)
            enddo

            call maplist(numberpumpratescwct,tablepumpratescwct,
     &                   dummyarray,numbervalues,
     &                   ainputarray,outputarray)

            amaplistarray(imaplist) = outputarray(1)
          enddo

          ainputarray(1) = aqthickness5km

          call maplist(numberaqthicknesscwct,tableaqthicknesscwct,
     &                 amaplistarray,numbervalues,
     &                 ainputarray,outputarray)

          capturewidth = outputarray(1)

cc find capture thickness
```

```
        outputarray(1) = 0.0d0
        ainputarray(1) = pumpm3perday
        numbervalues = 1

        do imaplist = 1,numberaqthicknesscwct
          do iassign = 1,numberpumpratescwct
            dummyarray(iassign) =
     &        tablecapthick(iassign,imaplist)
          enddo

          call maplist(numberpumpratescwct,tablepumpratescwct,
     &                 dummyarray,numbervalues,
     &                 ainputarray,outputarray)

          amaplistarray(imaplist) = outputarray(1)
        enddo

        ainputarray(1) = aqthickness5km

        call maplist(numberaqthicknesscwct,tableaqthicknesscwct,
     &               amaplistarray,numbervalues,
     &               ainputarray,outputarray)

        capturethickness = outputarray(1)

cc determine fraction mass captured

      pi = 4.0d0*datan(1.0d0)
      if (screenlength .ge. amix .or.
     &     capturethickness .ge. 0.90d0*aqthickness5km) then
        fractionmasscaptured = capturewidth / totaltubewidth
      elseif (screenlength .le. amix .and.
     &        capturethickness .ge. amix) then
        part1 = capturewidth * screenlength
        part2 = (capturewidth/(2.0d0*
     &          (capturethickness - screenlength)))*
     &          ((amix - screenlength)*dsqrt((capturethickness -
     &          screenlength)**2.0d0 - (amix - screenlength)**2.0d0)
     &          + (capturethickness - screenlength)**2.0d0 *
     &          dasin((amix - screenlength)/(capturethickness -
     &          screenlength)))
        part3 = amix * totaltubewidth
        fractionmasscaptured = (part1 + part2) / part3
      elseif (screenlength .le. amix .and.
     &        capturethickness .le. amix) then
        part1 = capturewidth * screenlength
        part2 = (pi / 2.0d0) * (capturewidth / 2.0d0) *
     &          (capturethickness - screenlength)
        part3 = amix * totaltubewidth
        fractionmasscaptured = (part1 + part2) / part3

      if (plumflg .eq. 1) fractionmasscaptured = userplumefraction

      else
        print *,' ***>>> Error in DCAGW <<<***'
        print *,' conditions for determining fraction'
        print *,' mass capture are not met'
        print *,' '
        print *,' plumethickness = ',amix
        print *,' capture width = ',capturewidth
        print *,' total stream tube width = ',totaltubewidth
        print *,' screen length = ',screenlength
        print *,' capture depth = ',capturethickness
        print *,' '
        STOP
      endif
    else
      pump = pump20
      amix = amix20

      flowinmixingzone = sumflow * amix

      if ( flowinmixingzone .gt. pump ) then
        dilutionvolume = flowinmixingzone
      else
        dilutionvolume = pump
      endif

      if(dilutionvolume.lt.aveqm3peryrallsafromuz)then
        dilutionvolume = aveqm3peryrallsafromuz
```

```
        endif

        if (dilflg .eq. 1) dilutionvolume = userdilutionvolume
     &                                    * 365.25d0 / 264.172d0

        fractionmasscaptured = 1.0d0

      endif

      if (plumflg .eq. 1) fractionmasscaptured = userplumefraction

      if (fractionmasscaptured .gt. 1.0d0) then
        fractionmasscaptured = 1.0d0
      endif

      if (fractionmasscaptured .lt. 0.0d0) then
        fractionmasscaptured = 0.0d0
      endif
cc rwj 9-15-00
cc SCR 324
      dkGvalue = 100.0d0

cc rwr 9/6/00 modified for groundwater protection calculations
cc            initialize
        do iinit1 = 1, ntim
          uconc(iinit1)=0.0d0
          aconc(iinit1)=0.0d0
          rconc(iinit1)=0.0d0
          epadosetotal(iinit1) = 0.0d0
          do iinit2 = 1,8
            epadosesum(iinit1,iinit2) = 0.0d0
            do iinit3 = 1,nnucl
              epadose(iinit1,iinit3,iinit2) = 0.0d0
            enddo
          enddo
        enddo
        do iinit1 = 1,12
          do iinit2 = 1,2
            epapktim(iinit1,iinit2) = 0.0d0
          enddo
        enddo

        do j=1,ntim
cc jrw 02/02/00 modified to implement user-specified time of climate change
        dKG = 0.22d0 * (dMAT(j)-32.d0)-dMAP(j)
        if (tim(j).gt.pluvswitch.and.dKG.lt.dKGvalue.and.dist.gt.
     &      cutoffpt) then
          pump = pluvpump20
          if (pluv.eq.0) then
           dKGvalue = 0.22d0 * (dMAT(j) - 32.d0) - dMAP(j)
           pluv = 1
          endif
        elseif (dist.gt.cutoffpt) then
          pump = pump20
          pluv = 0
        endif

cc use drinking water dose conversion factors if the distance to the
cc critical group is less than 20 km away from the source.
cc
cc data from EPA, 1988, Limiting Values of Radionuclide INtake and Air
cc Concentration and Dose Conversion Factors for Inhalation,
cc Submersion and Ingestion. EPA-520/1-88-020, Washington, DC
cc Environmental Protection Agency
cc
cc which is same data as DOE, 1988, Internal Dose Conversion Factors
cc for Calculation of Dose to the Public. DOE/EH-0071, Washington, DC,
cc U.S. Department of Energy
cc
c       If the dMAT and dMAP are such that the climate is classified
c       as semi-arid, use pluvial DCF's.
c
c       There is no difference between the pluvial and
c       non-pluvial DCF's except for a small fraction added to the
c       pluvial DCF's for testing.
c

       if( dist .lt. cutoffpt ) then

cc jrw 02/02/00 modified to implement user input time to pluvial conditions
        if (pluv.eq.0) then
```

```
c
c       These DCF's are for the CIRWU in today's biosphere
c
         open(unit=i1,file='gw_cb_ci.dat',status='old')
         do while (0.lt.1)
cc Handle leading digits in comment lines which produce I/O errors.
          read(i1, '(a10)') char
          if (char.eq.'start_data') then
           goto 200
          end if
         end do
200      continue

         read(i1,*) char

         do k=1,43

          read(i1,*) char,dcf(k)

          dwdcf(j,k) = dcf(k)
         end do
         close(unit=i1)

cc jrw 02/02/00 modified to implement user input time to pluvial conditions
        elseif (pluv.eq.1) then
c
c       These DCF's are for the CIRWU in a pluvial biosphere
c
         open(unit=i1,file='gw_pb_ci.dat',status='old')
         do while (0.lt.1)
cc Handle leading digits in comment lines which produce I/O errors.
          read(i1, '(a10)') char
          if (char.eq.'start_data') then
           goto 300
          end if
         end do
300      continue

         read(i1,*) char

         do k=1,43

          read(i1,*) char,dcf(k)

          dwdcf(j,k) = dcf(k)
         end do
         close(unit=i1)
         end if
        else if (dist.ge.cutoffpt) then
cc
cc use mean groundwater pathway dose conversion factors
cc if the distance from source to critical group is more than
cc 20 km away. The DCFs are in units of [(rem/yr)/(pCi/liter)]
cc to convert to units of [(rem/yr)/(Ci/m^3)],
cc multiply by 10^9
cc
cc data from P.A. LaPlante, S.J. Maheras, and M.S. Jarzemba
cc Initial Analysis of Selected Site-Specific Dose Assessment
cc Parameters and Exposure Pathways Applicable to a Groundwater
cc Release Scenario at Yucca Mountain, CNWRA 95-018,
cc September, 1995, San Antonio, TX, Center for Nuclear Waste
cc Regulatory Analyses
cc
        if (pluv.eq.0) then
        dilutionvolume=pump

c
c       These DCF's are for the ADFR in today's biosphere
c
         open(unit=i1,file='gw_cb_ad.dat',status='old')
         do while (0.lt.1)
cc Handle leading digits in comment lines which produce I/O errors.
          read(i1, '(a10)') char
          if (char.eq.'start_data') then
           goto 400
          end if
         end do
400      continue

         read(i1,*) char
```

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```
         do k=1,43

          read(i1,*) char, dcfde(k), dcfinh(k), dcfinga(k), dcfingp(k),
     &               dcfdw(k), dcfmlk(k)

          dcf(k)=dcfde(k)+dcfinh(k)+dcfinga(k)+dcfingp(k)+
     &           dcfdw(k)+dcfmlk(k)
          dwdcf(j,k) = dcfdw(k)
         end do
         close(unit=i1)

        else if (pluv.eq.1) then
        dilutionvolume=pump

c
c       These DCF's are for the ADFR in a pluvial biosphere
c
         open(unit=i1,file='gw_pb_ad.dat',status='old')
         do while (0.lt.1)
cc Handle leading digits in comment lines which produce I/O errors.
          read(i1, '(a10)') char
          if (char.eq.'start_data') then
           goto 500
          end if
         end do
500      continue

         read(i1,*) char

         do k=1,43

          read(i1,*) char, dcfde(k), dcfinh(k), dcfinga(k), dcfingp(k),
     &               dcfdw(k), dcfmlk(k)

          dcf(k)=dcfde(k)+dcfinh(k)+dcfinga(k)+dcfingp(k)+
     &           dcfdw(k)+dcfmlk(k)
          dwdcf(j,k) = dcfdw(k)
         end do
         close(unit=i1)
         end if
        end if
        if( dist .lt. cutoffpt ) then
        do k = 1, nnucl
          ik = indexperiso( names(k) )
            if( ciperyrallsafromsz(j,k) .lt. 0.0d0 ) then
              print *, ' ***>>> Error in DCAGW <<<*** '
              print *, ' ciperyrallsafromsz(j,k) .lt. 0.0d0 '
              print *, ' ciperyrallsafromsz(j,k) = ',
     &                 ciperyrallsafromsz(j,k)
              print *, ' j = ', j
              print *, ' k = ', k
              print *, ' '
              STOP
            endif
            remperyrpernuclgw(j,k)=dcf(ik)*ciperyrallsafromsz(j,k) /
     &                            dilutionvolume *
     &                            fractionmasscaptured

cc rwr 9/6/00 modified for groundwater protection calculations
cc    jrw 7-14-00 calculate uranium and gross alpha concentrations in the water
cc    and convert to units of pCi/L (Ci/m3 * 1e9 = pCi/L)
           if (gwpc.eq.1) then
             rnconc(j,k)=ciperyrallsafromsz(j,k)/pumpgwp*frplumegwp*1e9
             do ifind = 1,43
               if (nucname(ifind) .eq. names(k)) then
                 ifound = ifind
                 goto 194
               endif
             enddo
  194        continue
             if (idecaytype(ifound).eq.4) then
                uconc(j)=uconc(j)+rnconc(j,k)
             elseif (idecaytype(ifound) .eq. 2 .or.
     &         idecaytype(ifound) .eq. 3) then
               aconc(j)=aconc(j)+rnconc(j,k)
               if (idecaytype(ifound).eq.3) then
                 rconc(j)=rconc(j)+rnconc(j,k)
               endif
             elseif (idecaytype(ifound) .eq. 1) then
cc rwr 9/6/00 note the following conversion
cc            to change from pCi/L to mrem/yr, multiply
```

```
cc            rnconc(pCi/L) by 2 L/d, 365 d/yr, 1.0d5 mrem/Sv,
cc            3.7d10 Bq/Ci, and 1.0d-12 Ci/pCi and the dose factor (Sv/Bq)
               do kkk = 1,8
                 epadose(j,k,kkk) = rnconc(j,k)*2.0d0*365.25d0*
     &             dosefactor(ifound,kkk)*1.0d5*3.7d10*1.0d-12
               enddo
             endif
           endif

cc rwr 9/6/00 determine the total dose using tpa code dw dcfs
           epadosetotal(j) = epadosetotal(j)+rnconc(j,k)*
     &             dwdcf(j,ik)*1.0d-6
        enddo

        do isumall1 = 1, 8
          do isumall2 = 1, nnucl
            epadosesum(j,isumall1) = epadosesum(j,isumall1) +
     &        epadose(j,isumall2,isumall1)
          enddo
        enddo
      else
cc
cc 10^6 Gallon = 3785.41 Meter^3
cc 1 Year = 365.25 Day
cc 1 Meter^3 = 264.172 Gallon
cc
cc (Ci/m^3)   = (Ci/yr)*(Gal/day)*(day/yr)*(m^3/Gallon)
cc pumprate = (m^3/yr) = (Gal/day)*(365day/yr)*(m^3/264Gallon)

        do k = 1, nnucl
          ik = indexperiso( names(k) )
            if( ciperyrallsafromsz(j,k) .lt. 0.0d0 ) then
              print *, ' ***>>> Error in DCAGW <<<*** '
              print *, ' ciperyrallsafromsz(j,k) .lt. 0.0d0 '
              print *, ' ciperyrallsafromsz(j,k) = ',
     &                  ciperyrallsafromsz(j,k)
              print *, ' j = ', j
              print *, ' k = ', k
              print *, ' '
              STOP
            endif
            remperyrpernuclgw(j,k)=dcf(ik)*ciperyrallsafromsz(j,k) /
     &                              dilutionvolume *
     &                              fractionmasscaptured
cc rwr 9/6/00 modified for groundwater protection calculations
cc    jrw 7-14-00 calculate uranium and gross alpha concentrations in the water
cc    and convert to units of pCi/L (Ci/m3 * 1e9 = pCi/L)
           if (gwpc.eq.1) then
             rnconc(j,k)=ciperyrallsafromsz(j,k)/pumpgwp*frplumegwp*1e9
             do ifind = 1,43
               if (nucname(ifind) .eq. names(k)) then
                 ifound = ifind
                 goto 195
               endif
             enddo
  195        continue
             if (idecaytype(ifound).eq.4) then
                uconc(j)=uconc(j)+rnconc(j,k)
             elseif (idecaytype(ifound) .eq. 2 .or.
     &         idecaytype(ifound) .eq. 3) then
               aconc(j)=aconc(j)+rnconc(j,k)
               if (idecaytype(ifound).eq.3) then
                 rconc(j)=rconc(j)+rnconc(j,k)
               endif
             elseif (idecaytype(ifound) .eq. 1) then
cc rwr 9/6/00 note the following conversion
cc            to change from pCi/L to mrem/yr, multiply
cc            rnconc(pCi/L) by 2 L/d, 365 d/yr, 1.0d5 mrem/Sv,
cc            3.7d10 Bq/Ci, and 1.0d-12 Ci/pCi and the dose factor (Sv/Bq)
               do kkk = 1,8
                 epadose(j,k,kkk) = rnconc(j,k)*2.0d0*365.25d0*
     &             dosefactor(ifound,kkk)*1.0d5*3.7d10*1.0d-12
               enddo
             endif

cc rwr 9/6/00 determine the total dose using tpa code dw dcfs
             epadosetotal(j) = epadosetotal(j)+rnconc(j,k)*
     &         dwdcf(j,ik)*1.0d-6
           endif
        enddo
```

```
        if (gwpc.eq.1) then
          do isumall1 = 1, 8
            do isumall2 = 1, nnucl
              epadosesum(j,isumall1) = epadosesum(j,isumall1) +
     &          epadose(j,isumall2,isumall1)
            enddo
          enddo
        endif
      endif
      enddo


cc rwr 9/6/00 modified for groundwater protection calculation
cc            determine peak and time of peak in the compilance period
      if (gwpc.eq.1) then
        do ipeak = 1,ntim
          if (tim(ipeak) .le. durationcp) then
            if(epapktim(1,1) .lt. aconc(ipeak)) then
              epapktim(1,1)=aconc(ipeak)
              epapktim(1,2)=tim(ipeak)
            endif
            if(epapktim(2,1) .lt. uconc(ipeak)) then
              epapktim(2,1)=uconc(ipeak)
              epapktim(2,2)=tim(ipeak)
            endif
            if(epapktim(3,1) .lt. rconc(ipeak)) then
              epapktim(3,1)=rconc(ipeak)
              epapktim(3,2)=tim(ipeak)
            endif
            do ipeak2 = 1,8
              if(epapktim(ipeak2+3,1).lt.epadosesum(ipeak,ipeak2)) then
                epapktim(ipeak2+3,1)=epadosesum(ipeak,ipeak2)
                epapktim(ipeak2+3,2)=tim(ipeak)
              endif
            enddo
            if(epapktim(12,1) .lt. epadosetotal(ipeak)) then
              epapktim(12,1)=epadosetotal(ipeak)
              epapktim(12,2)=tim(ipeak)
            endif
          endif
        enddo
        do isetduration = 1,12
          if(epapktim(isetduration,2) .le. 1.0d-5)
     &      epapktim(isetduration,2) = durationcp
        enddo
      endif

cc rwr 9/6/00 determine the total dose over all realizations (use tpa dcfs)
        if (gwpc.eq.1) then
          do isumall = 1,ntim
            aconcsum(isumall) = aconcsum(isumall) + aconc(isumall)
            rconcsum(isumall) = rconcsum(isumall) + rconc(isumall)
            uconcsum(isumall) = uconcsum(isumall) + uconc(isumall)
            epadosetotalsum(isumall) = epadosetotalsum(isumall) +
     &        epadosetotal(isumall)
          enddo

cc rwr 9/6/00 modified for groundwater protection calculation
cc            accumulate for determining average, then divide
cc            by number of realizations
          do isumall1 = 1,8
            do isumall2 = 1,ntim
              epadoseave(isumall2,isumall1) =
     &          epadoseave(isumall2,isumall1) +
     &          epadosesum(isumall2,isumall1)
            enddo
        enddo
      write(iwriteepapktim,'(5x,i5,5x,24(1pe14.5,2x))')irl,
     &  epapktim(1,1)/epasf(1),epapktim(1,2),epapktim(2,1)/epasf(2),
     &  epapktim(2,2),epapktim(3,1)/epasf(3),epapktim(3,2),
     &  epapktim(4,1)/epasf(4),epapktim(4,2),epapktim(5,1)/epasf(4),
     &  epapktim(5,2),epapktim(6,1)/epasf(4),epapktim(6,2),
     &  epapktim(7,1)/epasf(4),epapktim(7,2),epapktim(8,1)/epasf(4),
     &  epapktim(8,2),epapktim(9,1)/epasf(4),epapktim(9,2),
     &  epapktim(10,1)/epasf(4),epapktim(10,2),epapktim(11,1)/epasf(4),
     &  epapktim(11,2),epapktim(12,1)/epasf(5),epapktim(12,2)
      if (irl .eq. numberreal) then
        do iaverage1 = 1,8
          do iaverage2 = 1,ntim
            epadoseave(iaverage2,iaverage1) =
     &        epadoseave(iaverage2,iaverage1)/dble(numberreal)
```

```
          enddo
        enddo
        do iaverage = 1,ntim
          if(tim(iaverage) .le. durationcp) then
            aconcsum(iaverage) = aconcsum(iaverage)/dble(numberreal)
            rconcsum(iaverage) = rconcsum(iaverage)/dble(numberreal)
            uconcsum(iaverage) = uconcsum(iaverage)/dble(numberreal)
            epadosetotalsum(iaverage) =
     &        epadosetotalsum(iaverage)/dble(numberreal)
            write(iwriteepa_ave,'(13(1pe14.5,2x))')tim(iaverage),
     &        aconcsum(iaverage)/epasf(1),uconcsum(iaverage)/epasf(2),
     &        rconcsum(iaverage)/epasf(3),
     &        (epadoseave(iaverage,jj)/epasf(4),jj=1,8),
     &        epadosetotalsum(iaverage)/epasf(5)
          endif
        enddo
        close(iwriteepa_ave)
        close(iwriteepapktim)
      endif
      endif

      return

889   continue
      print *, ' ***>>> Error in DCAGW <<<*** '
      print *, ' Error reading strmtube.dat '
      print *, ' end of file reached unexpectedly'
      print *, ' look on line = ', iline
      print *, '  '
      STOP

903   continue
      print *, ' ***>>> Error in DCAGW <<<*** '
      print *, ' can not read from strmtube.dat'
      print *, ' check the format '
      print *, ' look on line = ', iline
      print *, '  '
      STOP

905   continue
      print *, ' ***>>> Error in DCAGW <<<*** '
      print *, ' Error reading dilution.dat '
      print *, ' end of file reached unexpectedly'
      print *, ' look on line = ', iline
      print *, '  '
      STOP

908   continue
      print *, ' ***>>> Error in DCAGW <<<*** '
      print *, ' can not read from dilution.dat'
      print *, ' check the format '
      print *, ' look on line = ', iline
      print *, '  '
      STOP


cc rwr 9/6/00 modified for groundwater protection calculations
910   continue
      print *, ' ***>>> Error in DCAGW <<<*** '
      print *, ' Error reading organdf.dat '
      print *, ' end of file reached unexpectedly'
      print *, ' look on line = ', iline
      print *, '  '
      STOP

911   continue
      print *, ' ***>>> Error in DCAGW <<<*** '
      print *, ' can not read from organdf.dat'
      print *, ' check the format '
      print *, ' look on line = ', iline
      print *, '  '
      STOP


      end

c=====================================================================
cc rwj 2-12-00 Add realization number.
cc    subroutine gentpa()
      subroutine gentpa( irl )
c=====================================================================
```

62/119

```
c
c Called by dcagw to create DCF tables for tpa input.
c - copy genii data and executable files
c - read in parameters from tpa.inp
c - re-make *.def files
c - run standalone genii codes (envin and env)
c - call gentodcf which writes out gw_cb_ad.dat, gw_pb_ad.dat,
c                                  gw_cb_ci.dat, gw_pb_ci.dat.
c
c by M. Muller, SwRI
c
c List of data files:      * = needed to run envin and env
c * FILENAME.DAT           ! = needed for sub gentodcf
c * ggamen.dat
c * grmdlib.dat
c ! * ggrdf.dat
c ! * ggenii.def/inp
c ! * gdefault.def/inp
c * gftrans.def/inp
c * gbioac1.dat
c * gdosinc2.dat
c ! gnewdf.dat   (not part of original genii data)
c
c Output files from envin.e and env.e
c ! genv.out
c ggenii.out
c genv.in
c gmedia.out
c gwork.buf
c ggenii2.out    (not usually output - conditional)
c
c = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = =

      implicit double precision (a-h,o-z)
      implicit integer (i-n)

      character*60 name
      character*60 command
      character*120 aline
      include 'path.i'

      common /append/iiappend_flag, iiappend_lower, iiappend_upper,
     &               iappend_flag, iappend_lower, iappend_upper,
     &               iselectappend

      dimension i_rlvir(2), i_ovir(2), i_fir(2), i_gir(2),
     &          i_hir(2), i_pfir(2), i_hfir(2), i_bffir(2),i_rmffir(2),
     &          i_rlvit(2), i_ovit(2), i_fit(2), i_git(2),
     &          i_hit(2), i_pfit(2), i_hfit(2), i_bffit(2),i_rmffit(2)

      dimension i_dwcr(6), i_rlvcr(6), i_ovcr(6), i_fcr(6), i_gcr(6),
     &          i_bcr(6), i_pcr(6), i_rmcr(6), i_ecr(6), i_riet(6),
     &          i_rir(6), i_scet(6)

      common /save_ipointers/
     &       i_rag, i_rifi, i_doss, i_rmlf, i_yipip, i_rlvir, i_ovir,
     &       i_fir, i_gir, i_hir, i_pfir, i_hfir, i_rlvit, i_ovit,
     &       i_fit, i_git, i_hit, i_pfit, i_hfit, i_pfgt, i_hfgt,
     &       i_bffdf, i_rmffdf, i_bffgt, i_rmffgt,
     &       i_bffir, i_rmffir, i_bffit, i_rmffit,
     &       i_dwcr, i_rlvcr, i_ovcr, i_fcr, i_gcr, i_bcr, i_pcr,
     &       i_rmcr, i_ecr, i_riet, i_rir, i_scet,
     &       i_pusf, i_ausf, i_dscm, i_dspu, i_dsu, i_dsam, i_dsnp,
     &       i_dsth, i_dsra, i_dspb, i_dscs, i_dsi, i_dstc, i_dsni,
     &       i_dscl, i_dsc, i_dsse, i_dsnb, i_sbd, i_svwc

      save ikey

      external igetunitnumber
      external ispquery
      external valuesp
      external ivaluesp
      integer  zportsh
      external zportsh

      if (ikey.ne.39233) then

c       Copy over genii executables (env and envin)

        call clearchar(60,command)
        command = 'cp ' // path // 'codes/envin.e .'
```

```
      istatus=zportsh(command)
      if( istatus .ne. 0 ) then
        print *, ' ***>>> Error in Gentpa <<<*** '
        print *, ' failed to copy envin.e with:'
        print *, ' istatus = sh( ', command, ' )   =',istatus
        stop
      endif
      call clearchar(60,command)
      command = 'cp ' // path // 'codes/env.e .'
      istatus=zportsh(command)
      if( istatus .ne. 0 ) then
        print *, ' ***>>> Error in Gentpa <<<*** '
        print *, ' failed to copy env.e with:'
        print *, ' istatus = sh( ', command, ' )    =',istatus
        stop
      endif

c     Copy over genii data files (opened by envin,env standalones)

      call clearchar(60,command)
      command = 'cp ' // dpath // 'data/FILENAME.DAT .'
      istatus=zportsh(command)
      if( istatus .ne. 0 ) then
        print *, ' ***>>> Error in Gentpa <<<*** '
        print *, ' failed to copy FILENAME.DAT with:'
        print *, ' istatus = sh( ', command, ' )    =',istatus
        stop
      endif
      call clearchar(60,command)
      command = 'cp ' // dpath // 'data/gbioac1.dat .'
      istatus=zportsh(command)
      if( istatus .ne. 0 ) then
        print *, ' ***>>> Error in Gentpa <<<*** '
        print *, ' failed to copy gbioac1.dat with:'
        print *, ' istatus = sh( ', command, ' )    =',istatus
        stop
      endif
      call clearchar(60,command)
      command = 'cp ' // dpath // 'data/gdosinc2.dat .'
      istatus=zportsh(command)
      if( istatus .ne. 0 ) then
        print *, ' ***>>> Error in Gentpa <<<*** '
        print *, ' failed to copy gdosinc2.dat with:'
        print *, ' istatus = sh( ', command, ' )    =',istatus
        stop
      endif
      call clearchar(60,command)
      command = 'cp ' // dpath // 'data/ggamen.dat .'
      istatus=zportsh(command)
      if( istatus .ne. 0 ) then
        print *, ' ***>>> Error in Gentpa <<<*** '
        print *, ' failed to copy ggamen.dat with:'
        print *, ' istatus = sh( ', command, ' )    =',istatus
        stop
      endif
      call clearchar(60,command)
      command = 'cp ' // dpath // 'data/ggrdf.dat .'
      istatus=zportsh(command)
      if( istatus .ne. 0 ) then
        print *, ' ***>>> Error in Gentpa <<<*** '
        print *, ' failed to copy ggrdf.dat with:'
        print *, ' istatus = sh( ', command, ' )    =',istatus
        stop
      endif
      call clearchar(60,command)
      command = 'cp ' // dpath // 'data/grmdlib.dat .'
      istatus=zportsh(command)
      if( istatus .ne. 0 ) then
        print *, ' ***>>> Error in Gentpa <<<*** '
        print *, ' failed to copy grmdlib.dat with:'
        print *, ' istatus = sh( ', command, ' )    =',istatus
        stop
      endif

c     Copy over gentodcf data file (opened by gentodcf.f subroutine)

      call clearchar(60,command)
      command = 'cp ' // dpath // 'data/gnewdf.dat .'
      istatus=zportsh(command)
      if( istatus .ne. 0 ) then
        print *, ' ***>>> Error in Gentpa <<<*** '
```

```
          print *, ' failed to copy gnewdf.dat with:'
          print *, ' istatus = sh( ', command, ' )    =',istatus
          stop
        endif

c       Copy over temporary definition/template (.def) files
c       The data in the files will be combined with new values
c       (parameters) from tpa.inp and written to new *.inp files.
c       These *.def files stay open through all realizations.

        call clearchar(60,command)
        command = 'cp ' // dpath // 'data/ggenii.def .'
        istatus=zportsh(command)
        if( istatus .ne. 0 ) then
          print *, ' ***>>> Error in Gentpa <<<*** '
          print *, ' failed to copy ggenii.def with:'
          print *, ' istatus = sh( ', command, ' )    =',istatus
          stop
        endif
        call clearchar(60,command)
        command = 'cp ' // dpath // 'data/gdefault.def .'
        istatus=zportsh(command)
        if( istatus .ne. 0 ) then
          print *, ' ***>>> Error in Gentpa <<<*** '
          print *, ' failed to copy gdefault.def with:'
          print *, ' istatus = sh( ', command, ' )    =',istatus
          stop
        endif
        call clearchar(60,command)
        command = 'cp ' // dpath // 'data/gftrans.def .'
        istatus=zportsh(command)
        if( istatus .ne. 0 ) then
          print *, ' ***>>> Error in Gentpa <<<*** '
          print *, ' failed to copy gftrans.def with:'
          print *, ' istatus = sh( ', command, ' )    =',istatus
          stop
        endif

c       Get unit numbers for .def and .inp files.
c       The .def files will always stay open while
c       the .inp files will be re-written as necessary.

        igeniidef   = igetunitnumber('dcagw   ')
        idefaultdef = igetunitnumber('dcagw   ')
        iftransdef  = igetunitnumber('dcagw   ')
        igeniiinp   = igetunitnumber('dcagw   ')
        idefaultinp = igetunitnumber('dcagw   ')
        iftransinp  = igetunitnumber('dcagw   ')

c       Open .def files for later modification.
c       These files stay open through all realizations.

        open (unit=igeniidef,   file='ggenii.def',   status='old')
        open (unit=idefaultdef, file='gdefault.def', status='old')
        open (unit=iftransdef,  file='gftrans.def',  status='old')


c       Read in parameters from tpa.inp

        call clearchar( 60, name )
        name =
     &    'ReceptorAgeGroup(1=Nfnt,2Tod,3PTeen,4Teen,5Adlt,6AdltFGR11)'
        i_rag  = ispquery( name )
        call clearchar( 60, name )
        name = 'InterceptionFraction/Irrigate'
        i_rifi = ispquery( name )
        call clearchar( 60, name )
        name = 'DepthOfSurfaceSoil[cm]'
        i_doss = ispquery( name )
        call clearchar( 60, name )
        name = 'AirborneMassLoadAboveSoil[g/m3]'
        i_rmlf = ispquery( name )
        call clearchar( 60, name )
        name = 'YearsOfIrrigationPriorToIntakePeriod[yr]'
        i_yipip = ispquery( name )
        call clearchar( 60, name )
        name = 'LeafyVegetableIrrigationRatePB[in/yr]'
        i_rlvir(2) = ispquery( name )
        call clearchar( 60, name )
        name = 'OtherVegetableIrrigationRatePB[in/yr]'
        i_ovir(2) = ispquery( name )
```

```
call clearchar( 60, name )
name = 'FruitIrrigationRatePB[in/yr]'
i_fir(2) = ispquery( name )
call clearchar( 60, name )
name = 'GrainIrrigationRatePB[in/yr]'
i_gir(2) = ispquery( name )
call clearchar( 60, name )
name = 'HomeIrrigationRatePB[in/yr]'
i_hir(2) = ispquery( name )
call clearchar( 60, name )
name = 'PoultryFeedIrrigationRatePB[in/yr]'
i_pfir(2) = ispquery( name )
call clearchar( 60, name )
name = 'HenFeedIrrigationRatePB[in/yr]'
i_hfir(2) = ispquery( name )
call clearchar( 60, name )
name = 'LeafyVegetableIrrigationTimePB[mo/yr]'
i_rlvit(2) = ispquery( name )
call clearchar( 60, name )
name = 'OtherVegetableIrrigationTimePB[mo/yr]'
i_ovit(2) = ispquery( name )
call clearchar( 60, name )
name = 'FruitIrrigationTimePB[mo/yr]'
i_fit(2) = ispquery( name )
call clearchar( 60, name )
name = 'GrainIrrigationTimePB[mo/yr]'
i_git(2) = ispquery( name )
call clearchar( 60, name )
name = 'HomeIrrigationTimePB[mo/yr]'
i_hit(2) = ispquery( name )
call clearchar( 60, name )
name = 'PoultryFeedIrrigationTimePB[mo/yr]'
i_pfit(2) = ispquery( name )
call clearchar( 60, name )
name = 'HenFeedIrrigationTimePB[mo/yr]'
i_hfit(2) = ispquery( name )
call clearchar( 60, name )
name = 'LeafyVegetableIrrigationRateCB[in/yr]'
i_rlvir(1) = ispquery( name )
call clearchar( 60, name )
name = 'OtherVegetableIrrigationRateCB[in/yr]'
i_ovir(1) = ispquery( name )
call clearchar( 60, name )
name = 'FruitIrrigationRateCB[in/yr]'
i_fir(1) = ispquery( name )
call clearchar( 60, name )
name = 'GrainIrrigationRateCB[in/yr]'
i_gir(1) = ispquery( name )
call clearchar( 60, name )
name = 'HomeIrrigationRateCB[in/yr]'
i_hir(1) = ispquery( name )
call clearchar( 60, name )
name = 'PoultryFeedIrrigationRateCB[in/yr]'
i_pfir(1) = ispquery( name )
call clearchar( 60, name )
name = 'HenFeedIrrigationRateCB[in/yr]'
i_hfir(1) = ispquery( name )
call clearchar( 60, name )
name = 'LeafyVegetableIrrigationTimeCB[mo/yr]'
i_rlvit(1) = ispquery( name )
call clearchar( 60, name )
name = 'OtherVegetableIrrigationTimeCB[mo/yr]'
i_ovit(1) = ispquery( name )
call clearchar( 60, name )
name = 'FruitIrrigationTimeCB[mo/yr]'
i_fit(1) = ispquery( name )
call clearchar( 60, name )
name = 'GrainIrrigationTimeCB[mo/yr]'
i_git(1) = ispquery( name )
call clearchar( 60, name )
name = 'HomeIrrigationTimeCB[mo/yr]'
i_hit(1) = ispquery( name )
call clearchar( 60, name )
name = 'PoultryFeedIrrigationTimeCB[mo/yr]'
i_pfit(1) = ispquery( name )
call clearchar( 60, name )
name = 'HenFeedIrrigationTimeCB[mo/yr]'
i_hfit(1) = ispquery( name )
call clearchar( 60, name )
name = 'PoultryFeedGrowTime[day]'
i_pfgt = ispquery( name )
```

```
call clearchar( 60, name )
name = 'HenFeedGrowTime[day]'
i_hfgt = ispquery( name )
call clearchar( 60, name )
name = 'BeefFreshForageDietFraction'
i_bffdf  = ispquery( name )
call clearchar( 60, name )
name = 'MilkFreshForageDietFraction'
i_rmffdf  = ispquery( name )
call clearchar( 60, name )
name = 'BeefFreshForageGrowTime[day]'
i_bffgt = ispquery( name )
call clearchar( 60, name )
name = 'MilkFreshForageGrowTime[day]'
i_rmffgt = ispquery( name )
call clearchar( 60, name )
name = 'BeefFreshForageIrrigationRatePB[in/yr]'
i_bffir(2) = ispquery( name )
call clearchar( 60, name )
name = 'MilkFreshForageIrrigationRatePB[in/yr]'
i_rmffir(2) = ispquery( name )
call clearchar( 60, name )
name = 'BeefFreshForageIrrigationTimePB[mo/yr]'
i_bffit(2) = ispquery( name )
call clearchar( 60, name )
name = 'MilkFreshForageIrrigationTimePB[mo/yr]'
i_rmffit(2) = ispquery( name )
call clearchar( 60, name )
name = 'BeefFreshForageIrrigationRateCB[in/yr]'
i_bffir(1) = ispquery( name )
call clearchar( 60, name )
name = 'MilkFreshForageIrrigationRateCB[in/yr]'
i_rmffir(1) = ispquery( name )
call clearchar( 60, name )
name = 'BeefFreshForageIrrigationTimeCB[mo/yr]'
i_bffit(1) = ispquery( name )
call clearchar( 60, name )
name = 'MilkFreshForageIrrigationTimeCB[mo/yr]'
i_rmffit(1) = ispquery( name )

call clearchar( 60, name )
name = 'DrinkingWaterConsumptionRate1[L/yr]'
i_dwcr(1) = ispquery( name )
call clearchar( 60, name )
name = 'LeafyVegetableConsumptionRate1[kg/yr]'
i_rlvcr(1) = ispquery( name )
call clearchar( 60, name )
name = 'OtherVegetableConsumptionRate1[kg/yr]'
i_ovcr(1) = ispquery( name )
call clearchar( 60, name )
name = 'FruitConsumptionRate1[kg/yr]'
i_fcr(1) = ispquery( name )
call clearchar( 60, name )
name = 'GrainConsumptionRate1[kg/yr]'
i_gcr(1) = ispquery( name )
call clearchar( 60, name )
name = 'BeefConsumptionRate1[kg/yr]'
i_bcr(1) = ispquery( name )
call clearchar( 60, name )
name = 'PoultryConsumptionRate1[kg/yr]'
i_pcr(1) = ispquery( name )
call clearchar( 60, name )
name = 'MilkConsumptionRate1[kg/yr]'
i_rmcr(1) = ispquery( name )
call clearchar( 60, name )
name = 'EggConsumptionRate1[kg/yr]'
i_ecr(1) = ispquery( name )
call clearchar( 60, name )
name = 'InhalationExposureTime1[hr]'
i_riet(1) = ispquery( name )
call clearchar( 60, name )
name = 'InhalationRate1[cm3/s]'
i_rir(1) = ispquery( name )
call clearchar( 60, name )
name = 'SoilContaminationExposureTime1[hr]'
i_scet(1) = ispquery( name )
call clearchar( 60, name )
name = 'DrinkingWaterConsumptionRate2[L/yr]'
i_dwcr(2) = ispquery( name )
call clearchar( 60, name )
name = 'LeafyVegetableConsumptionRate2[kg/yr]'
```

```
i_rlvcr(2) = ispquery( name )
call clearchar( 60, name )
name = 'OtherVegetableConsumptionRate2[kg/yr]'
i_ovcr(2) = ispquery( name )
call clearchar( 60, name )
name = 'FruitConsumptionRate2[kg/yr]'
i_fcr(2) = ispquery( name )
call clearchar( 60, name )
name = 'GrainConsumptionRate2[kg/yr]'
i_gcr(2) = ispquery( name )
call clearchar( 60, name )
name = 'BeefConsumptionRate2[kg/yr]'
i_bcr(2) = ispquery( name )
call clearchar( 60, name )
name = 'PoultryConsumptionRate2[kg/yr]'
i_pcr(2) = ispquery( name )
call clearchar( 60, name )
name = 'MilkConsumptionRate2[kg/yr]'
i_rmcr(2) = ispquery( name )
call clearchar( 60, name )
name = 'EggConsumptionRate2[kg/yr]'
i_ecr(2) = ispquery( name )
call clearchar( 60, name )
name = 'InhalationExposureTime2[hr]'
i_riet(2) = ispquery( name )
call clearchar( 60, name )
name = 'InhalationRate2[cm3/s]'
i_rir(2) = ispquery( name )
call clearchar( 60, name )
name = 'SoilContaminationExposureTime2[hr]'
i_scet(2) = ispquery( name )
call clearchar( 60, name )
name = 'DrinkingWaterConsumptionRate3[L/yr]'
i_dwcr(3) = ispquery( name )
call clearchar( 60, name )
name = 'LeafyVegetableConsumptionRate3[kg/yr]'
i_rlvcr(3) = ispquery( name )
call clearchar( 60, name )
name = 'OtherVegetableConsumptionRate3[kg/yr]'
i_ovcr(3) = ispquery( name )
call clearchar( 60, name )
name = 'FruitConsumptionRate3[kg/yr]'
i_fcr(3) = ispquery( name )
call clearchar( 60, name )
name = 'GrainConsumptionRate3[kg/yr]'
i_gcr(3) = ispquery( name )
call clearchar( 60, name )
name = 'BeefConsumptionRate3[kg/yr]'
i_bcr(3) = ispquery( name )
call clearchar( 60, name )
name = 'PoultryConsumptionRate3[kg/yr]'
i_pcr(3) = ispquery( name )
call clearchar( 60, name )
name = 'MilkConsumptionRate3[kg/yr]'
i_rmcr(3) = ispquery( name )
call clearchar( 60, name )
name = 'EggConsumptionRate3[kg/yr]'
i_ecr(3) = ispquery( name )
call clearchar( 60, name )
name = 'InhalationExposureTime3[hr]'
i_riet(3) = ispquery( name )
call clearchar( 60, name )
name = 'InhalationRate3[cm3/s]'
i_rir(3) = ispquery( name )
call clearchar( 60, name )
name = 'SoilContaminationExposureTime3[hr]'
i_scet(3) = ispquery( name )
call clearchar( 60, name )
name = 'DrinkingWaterConsumptionRate4[L/yr]'
i_dwcr(4) = ispquery( name )
call clearchar( 60, name )
name = 'LeafyVegetableConsumptionRate4[kg/yr]'
i_rlvcr(4) = ispquery( name )
call clearchar( 60, name )
name = 'OtherVegetableConsumptionRate4[kg/yr]'
i_ovcr(4) = ispquery( name )
call clearchar( 60, name )
name = 'FruitConsumptionRate4[kg/yr]'
i_fcr(4) = ispquery( name )
call clearchar( 60, name )
name = 'GrainConsumptionRate4[kg/yr]'
```

```
i_gcr(4) = ispquery( name )
call clearchar( 60, name )
name = 'BeefConsumptionRate4[kg/yr]'
i_bcr(4) = ispquery( name )
call clearchar( 60, name )
name = 'PoultryConsumptionRate4[kg/yr]'
i_pcr(4) = ispquery( name )
call clearchar( 60, name )
name = 'MilkConsumptionRate4[kg/yr]'
i_rmcr(4) = ispquery( name )
call clearchar( 60, name )
name = 'EggConsumptionRate4[kg/yr]'
i_ecr(4) = ispquery( name )
call clearchar( 60, name )
name = 'InhalationExposureTime4[hr]'
i_riet(4) = ispquery( name )
call clearchar( 60, name )
name = 'InhalationRate4[cm3/s]'
i_rir(4) = ispquery( name )
 call clearchar( 60, name )
name = 'SoilContaminationExposureTime4[hr]'
i_scet(4) = ispquery( name )
call clearchar( 60, name )
name = 'DrinkingWaterConsumptionRate5[L/yr]'
i_dwcr(5) = ispquery( name )
call clearchar( 60, name )
name = 'LeafyVegetableConsumptionRate5[kg/yr]'
i_rlvcr(5) = ispquery( name )
call clearchar( 60, name )
name = 'OtherVegetableConsumptionRate5[kg/yr]'
i_ovcr(5) = ispquery( name )
call clearchar( 60, name )
name = 'FruitConsumptionRate5[kg/yr]'
i_fcr(5) = ispquery( name )
call clearchar( 60, name )
name = 'GrainConsumptionRate5[kg/yr]'
i_gcr(5) = ispquery( name )
call clearchar( 60, name )
name = 'BeefConsumptionRate5[kg/yr]'
i_bcr(5) = ispquery( name )
call clearchar( 60, name )
name = 'PoultryConsumptionRate5[kg/yr]'
i_pcr(5) = ispquery( name )
call clearchar( 60, name )
name = 'MilkConsumptionRate5[kg/yr]'
i_rmcr(5) = ispquery( name )
call clearchar( 60, name )
name = 'EggConsumptionRate5[kg/yr]'
i_ecr(5) = ispquery( name )
call clearchar( 60, name )
name = 'InhalationExposureTime5[hr]'
i_riet(5) = ispquery( name )
call clearchar( 60, name )
name = 'InhalationRate5[cm3/s]'
i_rir(5) = ispquery( name )
call clearchar( 60, name )
name = 'SoilContaminationExposureTime5[hr]'
i_scet(5) = ispquery( name )
call clearchar( 60, name )
name = 'DrinkingWaterConsumptionRate6[L/yr]'
i_dwcr(6) = ispquery( name )
call clearchar( 60, name )
name = 'LeafyVegetableConsumptionRate6[kg/yr]'
i_rlvcr(6) = ispquery( name )
call clearchar( 60, name )
name = 'OtherVegetableConsumptionRate6[kg/yr]'
i_ovcr(6) = ispquery( name )
call clearchar( 60, name )
name = 'FruitConsumptionRate6[kg/yr]'
i_fcr(6) = ispquery( name )
call clearchar( 60, name )
name = 'GrainConsumptionRate6[kg/yr]'
i_gcr(6) = ispquery( name )
call clearchar( 60, name )
name = 'BeefConsumptionRate6[kg/yr]'
i_bcr(6) = ispquery( name )
call clearchar( 60, name )
name = 'PoultryConsumptionRate6[kg/yr]'
i_pcr(6) = ispquery( name )
call clearchar( 60, name )
name = 'MilkConsumptionRate6[kg/yr]'
```

```
i_rmcr(6) = ispquery( name )
call clearchar( 60, name )
name = 'EggConsumptionRate6[kg/yr]'
i_ecr(6) = ispquery( name )
call clearchar( 60, name )
name = 'InhalationExposureTime6[hr]'
i_riet(6) = ispquery( name )
call clearchar( 60, name )
name = 'InhalationRate6[cm3/s]'
i_rir(6) = ispquery( name )
call clearchar( 60, name )
name = 'SoilContaminationExposureTime6[hr]'
i_scet(6) = ispquery( name )

call clearchar( 60, name )
name = 'PlantUptakeScaleFactor'
i_pusf = ispquery( name )
call clearchar( 60, name )
name = 'AnimalUptakeScaleFactor'
i_ausf = ispquery( name )

call clearchar( 60, name )
name = 'KD_Soil_Cm[cm3/g]'
i_dscm = ispquery( name )
call clearchar( 60, name )
name = 'KD_Soil_Pu[cm3/g]'
i_dspu = ispquery( name )
call clearchar( 60, name )
name = 'KD_Soil_U[cm3/g]'
i_dsu  = ispquery( name )
call clearchar( 60, name )
name = 'KD_Soil_Am[cm3/g]'
i_dsam = ispquery( name )
call clearchar( 60, name )
name = 'KD_Soil_Np[cm3/g]'
i_dsnp = ispquery( name )
call clearchar( 60, name )
name = 'KD_Soil_Th[cm3/g]'
i_dsth = ispquery( name )
call clearchar( 60, name )
name = 'KD_Soil_Ra[cm3/g]'
i_dsra = ispquery( name )
call clearchar( 60, name )
name = 'KD_Soil_Pb[cm3/g]'
i_dspb = ispquery( name )
call clearchar( 60, name )
name = 'KD_Soil_Cs[cm3/g]'
i_dscs = ispquery( name )
call clearchar( 60, name )
name = 'KD_Soil_I[cm3/g]'
i_dsi  = ispquery( name )
call clearchar( 60, name )
name = 'KD_Soil_Tc[cm3/g]'
i_dstc = ispquery( name )
call clearchar( 60, name )
name = 'KD_Soil_Ni[cm3/g]'
i_dsni = ispquery( name )
call clearchar( 60, name )
name = 'KD_Soil_Cl[cm3/g]'
i_dscl = ispquery( name )
call clearchar( 60, name )
name = 'KD_Soil_C[cm3/g]'
i_dsc  = ispquery( name )
call clearchar( 60, name )
name = 'KD_Soil_Se[cm3/g]'
i_dsse = ispquery( name )
call clearchar( 60, name )
name = 'KD_Soil_Nb[cm3/g]'
i_dsnb = ispquery( name )
call clearchar( 60, name )
name = 'SoilBulkDensity[g/cm3]'
i_sbd  = ispquery( name )
call clearchar( 60, name )
name = 'SoilVolumetricWaterContent'
i_svwc = ispquery( name )
call clearchar( 60, name )
name = 'AnnualPrecipitation[m/yr]'
i_rain = ispquery( name )
call clearchar( 60, name )
name = 'AnnualIrrigation[m/yr]'
i_water = ispquery( name )
```

```
      call clearchar( 60, name )
      name = 'TotalAnnualEvapotranspiration[m/yr]'
      i_et = ispquery( name )

      call clearchar( 60, name )
      name = 'OutputMode(0=None,1=All,2=UserDefined)'
      iiappend_flag  =  ispquery( name )
      call clearchar( 60, name )
      name = 'UserDefinedLowerRealizationAppended'
      iiappend_lower  =  ispquery( name )

      call clearchar( 60, name )
      name = 'UserDefinedUpperRealizationAppended'
      iiappend_upper  =  ispquery( name )

      call clearchar( 60, name )
      name = 'SelectAppendFiles'
      iiselectappend  =  ispquery( name )

      ikey=39233

    end if

    iappend_flag  = ivaluesp( iiappend_flag)
    iappend_lower = ivaluesp( iiappend_lower)
    iappend_upper = ivaluesp( iiappend_upper)
    iselectappend = ivaluesp( iiselectappend)

    irag  = ivaluesp( i_rag  )
    rifi  = valuesp( i_rifi )
    doss  = valuesp( i_doss )
    rmlf  = valuesp( i_rmlf  )
    iyipip= ivaluesp( i_yipip )

    pfgt  = valuesp( i_pfgt  )
    hfgt  = valuesp( i_hfgt  )

    bffdf  = valuesp( i_bffdf  )
    rmffdf = valuesp( i_rmffdf  )
    bffgt  = valuesp( i_bffgt )
    rmffgt = valuesp( i_rmffgt )

    dwcr  = valuesp( i_dwcr(irag) )
    rlvcr = valuesp( i_rlvcr(irag) )
    ovcr  = valuesp( i_ovcr(irag) )
    fcr   = valuesp( i_fcr(irag) )
    gcr   = valuesp( i_gcr(irag) )
    bcr   = valuesp( i_bcr(irag) )
    pcr   = valuesp( i_pcr(irag) )
    rmcr  = valuesp( i_rmcr(irag) )
    ecr   = valuesp( i_ecr(irag) )
    riet  = valuesp( i_riet(irag) )
    rir    = valuesp( i_rir(irag) )
    scet  = valuesp( i_scet(irag) )

    pusf = valuesp( i_pusf )
    ausf = valuesp( i_ausf )
    dscm = valuesp( i_dscm )
    dspu = valuesp( i_dspu )
    dsu  = valuesp( i_dsu  )
    dsam = valuesp( i_dsam )
    dsnp = valuesp( i_dsnp )
    dsth = valuesp( i_dsth )
    dsra = valuesp( i_dsra )
    dspb = valuesp( i_dspb )
    dscs = valuesp( i_dscs )
    dsi  = valuesp( i_dsi  )
    dstc = valuesp( i_dstc )
    dsni = valuesp( i_dsni )
    dscl = valuesp( i_dscl )
    dsc  = valuesp( i_dsc  )
    dsse = valuesp( i_dsse )
    dsnb = valuesp( i_dsnb )
    sbd  = valuesp( i_sbd  )
    svwc = valuesp( i_svwc )

    rain = valuesp (i_rain )
    water = valuesp ( i_water )
    et = valuesp ( i_et )

c   = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = =
```

```
c     Read in .def and write modfied/combined data to .inp
c     Do two times for genii.def file, 0=current, 1=pluvial biosphere
c     = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = =

      rewind( idefaultdef )
      rewind( iftransdef )

      open(unit=idefaultinp, file='gdefault.inp', status='unknown')
      open(unit=iftransinp,  file='gftrans.inp',  status='unknown')

cc    ***
cc    *** default.inp
cc    ***

cc    Copy lines

cc    copylines(fromlun, tolun, nlines)

      call copylines(idefaultdef,idefaultinp,11)
      read(idefaultdef,'(a)') aline
      write(idefaultinp,'(1pe12.5,a)') rifi,aline(13:79)
      read(idefaultdef,'(a)') aline
      write(idefaultinp,'(1pe12.5,a)') doss,aline(13:79)
      call copylines(idefaultdef,idefaultinp,18)
      read(idefaultdef,'(a)') aline
      write(idefaultinp,'(1pe12.5,a)') rir,aline(13:79)
      call copylines(idefaultdef,idefaultinp,17)
      close(idefaultinp)

cc    ***
cc    *** ftrans.inp
cc    ***

      call copylines(iftransdef,iftransinp,3)
      do i=1,500
         read(iftransdef,'(a2,x,10e8.0)',end=300,err=300)
     &        aline,r1, rlv,rv,fr,gr, bf,po,rml,eg, r2

cc jrw 02/03/00 new lines to calculate the leaching factor
         retcoef=-1
         if(aline.eq.'AM') retcoef=dsam
         if(aline.eq.'C ') retcoef=dsc
         if(aline.eq.'CS') retcoef=dscs
         if(aline.eq.'CL') retcoef=dscl
         if(aline.eq.'CM') retcoef=dscm
         if(aline.eq.'I ') retcoef=dsi
         if(aline.eq.'PB') retcoef=dspb
         if(aline.eq.'NP') retcoef=dsnp
         if(aline.eq.'NI') retcoef=dsni
         if(aline.eq.'NB') retcoef=dsnb
         if(aline.eq.'PU') retcoef=dspu
         if(aline.eq.'RA') retcoef=dsra
         if(aline.eq.'SE') retcoef=dsse
         if(aline.eq.'TC') retcoef=dstc
         if(aline.eq.'TH') retcoef=dsth
         if(aline.eq.'U ') retcoef=dsu
         if(retcoef.ne.-1) then
c jrw 9/11/00  Formula corrected to use velocity of water in subsurface
c              instead of infiltration rate per Baes and Sharp (1983)
c           r2=(rain+water-et)/((doss/100)*(1+sbd/svwc*retcoef))
            r2=(rain+water-et)/(svwc*(doss/100)*(1+sbd/svwc*retcoef))
         endif

         write(iftransinp,
     &         '(a2,x,1p5e8.1e1, 1pe7.1e1, 1p3e8.1e1, 1pe9.1e2)')
     &        aline,r1,rlv*pusf,rv*pusf,fr*pusf,gr*pusf,
     &        bf*ausf,po*ausf,rml*ausf,eg*ausf, r2
      end do
300   continue
      close(iftransinp)


c     Do two times for genii.def file, 0=current, 1=pluvial biosphere

      do ipluvial = 0,1

         ip     = ipluvial+1
         rlvir  = valuesp( i_rlvir(ip) )
         ovir   = valuesp( i_ovir(ip) )
         fir    = valuesp( i_fir(ip) )
         gir    = valuesp( i_gir(ip) )
```

```
      hir    = valuesp( i_hir(ip) )
      pfir   = valuesp( i_pfir(ip) )
      hfir   = valuesp( i_hfir(ip) )
      rlvit  = valuesp( i_rlvit(ip) )
      ovit   = valuesp( i_ovit(ip) )
      fit    = valuesp( i_fit(ip) )
      git    = valuesp( i_git(ip) )
      hit    = valuesp( i_hit(ip) )
      pfit   = valuesp( i_pfit(ip) )
      hfit   = valuesp( i_hfit(ip) )
      bffir  = valuesp( i_bffir(ip) )
      rmffir = valuesp( i_rmffir(ip) )
      bffit  = valuesp( i_bffit(ip) )
      rmffit = valuesp( i_rmffit(ip) )

      rewind( igeniidef )

      open(unit=igeniiinp, file='ggenii.inp', status='unknown')

cc    ***
cc    *** genii.inp
cc    ***

cc    Copy lines

cc    copylines(fromlun, tolun, nlines)

      call copylines(igeniidef,igeniiinp,92)
      read(igeniidef,'(a)') aline
      write(igeniiinp,'(i4,a)') iyipip,aline(5:79)
      call copylines(igeniidef,igeniiinp,55)
      read(igeniidef,'(a)') aline
      write(igeniiinp,'(F10.1,a)') scet,aline(11:79)
      call copylines(igeniidef,igeniiinp,1)
      read(igeniidef,'(a)') aline
      write(igeniiinp,'(a,f5.1,5x,a)') aline(1:41),hir,aline(52:79)
      read(igeniidef,'(a)') aline
      write(igeniiinp,'(a,f5.1,5x,a)') aline(1:41),hit,aline(52:79)
      call copylines(igeniidef,igeniiinp,5)
      read(igeniidef,'(a)') aline
      write(igeniiinp,'(a)') aline(1:79)
      read(igeniidef,'(a)') aline
      write(igeniiinp,'(a)') aline(1:79)
      read(aline,'(i6)') iflag
      if (iflag .ne. 1) then
         call copylines(igeniidef,igeniiinp,1)
      else
         read(igeniidef,'(a)') aline
         write(igeniiinp,'(f10.6,a)') rmlf,aline(11:79)
      endif
      call copylines(igeniidef,igeniiinp,24)

      read(igeniidef,'(a)') aline
      write(igeniiinp,'(a,f7.1,x,a)') aline(1:53),dwcr,aline(62:79)
      call copylines(igeniidef,igeniiinp,7)

      read(igeniidef,'(a)') aline
      write(igeniiinp,'(a,2f6.1,x,a,f5.1,x)') aline(1:30),rlvir,
     &                                        rlvit, aline(44:72),
     &                                        rlvcr
      read(igeniidef,'(a)') aline
      write(igeniiinp,'(a,2f6.1,x,a,f5.1,x)') aline(1:30),ovir,ovit,
     &                                        aline(44:72),ovcr
      read(igeniidef,'(a)') aline
      write(igeniiinp,'(a,2f6.1,x,a,f5.1,x)') aline(1:30),fir,fit,
     &                                        aline(44:72),fcr
      read(igeniidef,'(a)') aline
      write(igeniiinp,'(a,2f6.1,x,a,f5.1,x)') aline(1:30),gir,git,
     &                                        aline(44:72),gcr
      call copylines(igeniidef,igeniiinp,8)

      read(igeniidef,'(a)') aline
      write(igeniiinp,'(a,f6.1,a,x,f6.1,a)')
     &                 aline(1:11), bcr, aline(18:23),bcr,
     &                 aline(31:79)
      read(igeniidef,'(a)') aline
      write(igeniiinp,'(a,f6.1,a,x,f6.1,a,f6.1,a,f6.1,f6.2,a)')
     &                 aline(1:11), pcr, aline(18:23),pcr,
     &                 aline(31:44),pfgt,
     &                 aline(51:53), pfir,pfit, aline(66:79)
      read(igeniidef,'(a)') aline
```

```
      write(igeniiinp,'(a,f6.1,a,x,f6.1,a)')
     &                aline(1:11), rmcr, aline(18:23),rmcr,
     &                aline(31:79)
      read(igeniidef,'(a)') aline
      write(igeniiinp,'(a,f6.1,a,x,f6.1,a,f6.1,a,f6.1,f6.2,a)')
     &                aline(1:11), ecr, aline(18:23),ecr,
     &                aline(31:44),hfgt,
     &                aline(51:53), hfir,hfit, aline(66:79)
      call copylines(igeniidef,igeniiinp,1)

      read(igeniidef,'(a)') aline
      write(igeniiinp,'(a,f6.2,f6.1,a,f6.1,f6.2,a)')
     &                aline(1:38), bffdf,bffgt,
     &                aline(51:53), bffir,bffit,aline(66:79)
      read(igeniidef,'(a)') aline
      write(igeniiinp,'(a,f6.2,f6.1,a,f6.1,f6.2,a)')
     &                aline(1:38), rmffdf,rmffgt,
     &                aline(51:53), rmffir,rmffit,aline(66:79)
      call copylines(igeniidef,igeniiinp,2)
      close(igeniiinp)


c     = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = =
cc    Run GENII programs: envin and env
c     = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = =

      if (ipluvial .eq. 0) then
         istatus=zportsh('envin.e > gentoo.out')
      else
         istatus=zportsh('envin.e >> gentoo.out')
      endif
      if( istatus .ne. 0 ) then
        print *, ' ***>>> Error in Gentpa <<<*** '
        print *, ' trouble running envin.e,  istatus=',istatus
        stop
      endif
      istatus=zportsh('env.e >> gentoo.out')
      if( istatus .ne. 0 ) then
        print *, ' ***>>> Error in Gentpa <<<*** '
        print *, ' trouble running env.e,  istatus=',istatus
        stop
      endif


c     = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = =
cc    Check if save output to append files.
c     = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = =

      if ( iappend_flag .gt. 0) then
        if ( iappend_flag .eq. 1) then
c         Reduce the size of the append files
          if (iselectappend .eq. 0 .or. iselectappend .eq. 18) then
           write( aline, '(A)') 'cat ggenii.out >> ggenii.cum'
           istatus=zportsh(aline)
           if( istatus .ne. 0 ) then
             print *, ' ***>>> Error in Gentpa <<<*** '
             print *, ' trouble with: ',aline
             stop
           endif
           call clearchar(60,command)
           write( command,'(A,I4,A,I2)')
     &          'End of Realization # ',irl,' pluvial = ',ipluvial
           call clearchar(80,aline)
           write( aline,'(A,A38,A)')
     &          'echo ''',command,''' >> ggenii.cum'
           istatus=zportsh(aline)
           if( istatus .ne. 0 ) then
             print *, ' ***>>> Error in Gentpa <<<*** '
             print *, ' trouble with: ',aline
             stop
           endif
          endif
        else
           if (( irl .ge. iappend_lower) .and.
     &          (irl .le. iappend_upper)) then
           if (iselectappend .eq. 0 .or. iselectappend .eq. 18) then
            write( aline, '(A)') 'cat ggenii.out >> ggenii.cum'
            istatus=zportsh(aline)
            if( istatus .ne. 0 ) then
              print *, ' ***>>> Error in Gentpa <<<*** '
              print *, ' trouble with: ',aline
```

```
                stop
              endif
              call clearchar(60,command)
            write( command,'(A,I4,A,I2)')
     &            'End of Realization # ',irl,' pluvial = ',ipluvial
              call clearchar(80,aline)
              write( aline,'(A,A38,A)')
     &          'echo ''',command,''' >> ggenii.cum'
              istatus=zportsh(aline)
              if( istatus .ne. 0 ) then
                print *, ' ***>>> Error in Gentpa <<<*** '
                print *, ' trouble with: ',aline
                stop
              endif
             endif
            endif
          endif
          if ( iappend_flag .eq. 1) then
c           Reduce the size of the append files
            if (iselectappend .eq. 0 .or. iselectappend .eq. 19) then
             write( aline, '(A)') 'cat genv.out >> genv.cum'
             istatus=zportsh(aline)
             if( istatus .ne. 0 ) then
               print *, ' ***>>> Error in Gentpa <<<*** '
               print *, ' trouble with: ',aline
               stop
             endif
             call clearchar(60,command)
             write( command,'(A,I4,A,I2)')
     &            'End of Realization # ',irl,' pluvial = ',ipluvial
             call clearchar(80,aline)
             write( aline,'(A,A38,A)')
     &            'echo ''',command,''' >> genv.cum'
             istatus=zportsh(aline)
             if( istatus .ne. 0 ) then
               print *, ' ***>>> Error in Gentpa <<<*** '
               print *, ' trouble with: ',aline
               stop
             endif
            endif
          else
             if (( irl .ge. iappend_lower) .and.
     &           (irl .le. iappend_upper)) then
              if (iselectappend .eq. 0 .or. iselectappend .eq. 19) then
               write( aline, '(A)') 'cat genv.out >> genv.cum'
               istatus=zportsh(aline)
               if( istatus .ne. 0 ) then
                 print *, ' ***>>> Error in Gentpa <<<*** '
                 print *, ' trouble with: ',aline
                 stop
               endif
               call clearchar(60,command)
             write( command,'(A,I4,A,I2)')
     &            'End of Realization # ',irl,' pluvial = ',ipluvial
               call clearchar(80,aline)
               write( aline,'(A,A38,A)')
     &          'echo ''',command,''' >> genv.cum'
               istatus=zportsh(aline)
               if( istatus .ne. 0 ) then
                 print *, ' ***>>> Error in Gentpa <<<*** '
                 print *, ' trouble with: ',aline
                 stop
               endif
              endif
             endif
          endif
        endif


c       = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = =
cc      (Post) Process output to make new dcf tables.
cc      ipluvial = 0 = current (nonpluvial) biosphere, 1 = pluvial
cc      irag     = 1,2,3,4,5,6 = Receptor Age Group
cc                 1=Infant,2=Toddler,3=PreTeen,
cc                 4=Teen,5=Adult (all ICRP72), 6=Adult(FGR11)
c       = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = =

        call gentodcf(ipluvial, irag)

c mas -  checks to append files gw_cb_ad.dat and gw_pb_ad.dat to dcf.cum
```

```
      if (iappend_flag .eq. 1) then
        if (ipluvial .eq. 0) then
          write( aline, '(A)') 'cat gw_cb_ad.dat >> dcf.cum'
        else
          write( aline, '(A)') 'cat gw_pb_ad.dat >> dcf.cum'
        endif
        istatus=zportsh(aline)
        if( istatus .ne. 0) then
          print *, '***>>> Error in Gentpa <<<***'
          print *, ' trouble with: ',aline
          stop
        endif
        call clearchar(60, command)
        write( command,'(A,I4,A,I2)') 'End of Realization # ',irl,
     &                                ' pluvial = ',ipluvial
        call clearchar(80,aline)
        write( aline,'(A,A38,A)') 'echo ''',command,''' >> dcf.cum'
        istatus=zportsh(aline)
        if ( istatus .ne. 0 ) then
          print *, '***>>> Error in Gentpa <<<***'
          print *, ' trouble with: ',aline
          stop
        endif
      endif
      if (iappend_flag .eq. 2) then
        if (iselectappend .eq. 0 .or. iselectappend .eq. 20) then
          if (( irl .ge. iappend_lower) .and.
     &        (irl .le. iappend_upper)) then
            if (ipluvial .eq. 0) then
              write( aline, '(A)') 'cat gw_cb_ad.dat >> dcf.cum'
            else
              write( aline, '(A)') 'cat gw_pb_ad.dat >> dcf.cum'
            endif
            istatus=zportsh(aline)
            if( istatus .ne. 0 ) then
              print *, ' ***>>> Error in Gentpa <<<*** '
              print *, ' trouble with: ',aline
              stop
            endif
            call clearchar(60,command)
            write( command,'(A,I4,A,I2)') 'End of Realization # ',
     &                                    irl,' pluvial = ',ipluvial
            call clearchar(80,aline)
            write( aline,'(A,A38,A)')
     &        'echo ''',command,''' >> dcf.cum'
            istatus=zportsh(aline)
            if ( istatus .ne. 0 ) then
              print *, ' ***>>> Error in Gentpa <<<*** '
              print *, ' trouble with: ',aline
              stop
            endif
          endif
        endif
      endif

    enddo !ipluvial=0,1

    return
    end


c=====================================================================
      subroutine copylines(ifromlun, itolun, nlines)
c=====================================================================
c
c Copy lines from first file to second file. Trim any blanks at end
c of line.
c
      implicit double precision (a-h,o-z)
      implicit integer (i-n)

      character*132 aline

      do i=1,nlines
         read(ifromlun,'(A)',end=900,err=900) aline
         do j=120,1,-1
            if (aline(j:j) .gt.' ') goto 110
         enddo
110      write(itolun,'(A)') aline(1:j)
      enddo
```

```
      return

900   write(*,*) ' '
      write(*,*)
     &     'Error in subroutine copylines(i_fromlun,i_tolun,nlines)'
      write(*,*) 'tried to read past the end of the input file.'
      write(*,*) 'i_from_file_lun=',ifromlun
      write(*,*) 'i_to_file_lun=  ',itolun
      write(*,*) 'nlines=         ',nlines
      write(*,*) ' '
      return
      end

c=====================================================================
      subroutine gentodcf(climate,age)
c=====================================================================

c mas - Subroutine GENTODCF creates pluvial/non-pluvial DCF data files for
c mas - TPA4.0 using GENII stand-alone codes (ENVIN.E and ENV.E)

c mas - Variables introduced in subroutine GENTODCF

c mas - Variables introduced in READQ section
c mas   Q               Exposure rates for each pathway(24) and radionuclide(73)
c mas   IE              1 indicates AEDE, 2 indicates CEDE
c mas   IP              Index for pathway number
c mas   IN              Index for radionuclide number
c mas   NYRINT          No. years intake
c mas   NPATH           No. of pathways used
c mas   NUCTOT          No. of radionuclides
c mas   ELTT            Element name
c mas   AWT             Atomic Wt.
c mas   PATHNAME        Pathway name
c mas   DUM3            Dummy variable*25 to count paths in env.out

c mas - Variables introduced in READEDF section
c mas   E               Temp. variable for rad. name
c mas   A               Temp. variable for rad. atomic wt.
c mas   DUM             Dummy variable*4
c mas   DAIN            FGR 12 air submersion DF
c mas   DBIN            Water surface DF
c mas   DSIN            FGR 12 soil surface DF
c mas   DD15IN          Buried waste 0.15 m cover
c mas   DD50IN          Buried waste 0.50 m cover
c mas   DD100I          Buried waste 1.0 m cover
c mas   DAIT            FGR 12 air submersion DF
c mas   DBIT            Water surface DF
c mas   DSIT            FGR 12 soil surface DF
c mas   DDIT            Buried waste DF

c mas - Variables introduced in READIDF section
c mas   AGE             Age group (1-6)
c mas   ING             Read variable for ingestion DF
c mas   INH             Read variable for inhalation DF
c mas   DFING           Temp ingestion DF
c mas   DFINH           Temp inhalation DF
c mas   DUM2            Dummy variable*10

c mas - Variables introduced in DCFCALC section
c mas   FINITE          Finite? (T/F)
c mas   CLIMATE         Non-pluvial=0, pluvial=1
c mas   SI2I            Semi-infinite/infinite weighting factor
c mas   RADNAME         Concatenated radionuclide names
c mas   I               Counter
c mas   DCFEXT          TPA indexed external DCF
c mas   DCFINH          TPA indexed inhalation DCF
c mas   DCFANI          TPA indexed animal product DCF
c mas   DCFPLA          TPA indexed plant DCF
c mas   DCFDW           TPA indexed drinking water DCF
c mas   DCFMILK         TPA indexed milk DCF

        INTEGER CLIMATE, AGE

        REAL Q(74,24)
        INTEGER IE, IP, IN, NYRINT, NPATH, NUCTOT
        CHARACTER*9 PATHNAME(24)
        CHARACTER*4 DUM
        CHARACTER*3 ELTT(74)
        CHARACTER*7 AWT(74)

        REAL DAIN, DBIN, DSIN, DD15IN, DD50IN, DD100I
```

```
   REAL DAIT(74), DBIT(74), DSIT(74), DDIT(74,3)
   CHARACTER*2 E
   CHARACTER*6 A

   REAL ING, INH, DFING(74), DFINH(74)
   CHARACTER*10 DUM2
   CHARACTER*25 DUM3

   REAL SI2I, ADJUNT, NVU4
   REAL TPADCFEXT(74), TPADCFINH(74), TPADCFANI(74)
   REAL TPADCFPLA(74), TPADCFDW(74), TPADCFMILK(74)
   CHARACTER*2 FINITE

   CHARACTER G*2, H*6, J*8
   CHARACTER*8 RADNAME(74)
   INTEGER I
   REAL DCFEXT(43), DCFINH(43), DCFANI(43), DCFPLA(43), DCFDW(43),
&       DCFMILK(43)

 character*40     fname, fnamecvt
 character*40     fn_geniiinp, fn_grdfdat, fn_envout, fn_defaultinp
 common /genfnam/ fn_geniiinp, fn_grdfdat, fn_envout, fn_defaultinp

 external igetunitnumber
 integer  zportsh
 external zportsh
 character*6 ljs
 external    ljs
 character*6 nameiso
 external    nameiso

 save ikey

   NYRINT = 1
   NPATH  = 13
   NUCTOT = 74
   ADJUNT = 3.7E9
   NVU4   = 3.7E10

 do i=1,nuctot
    TPADCFEXT(i)=0.
    TPADCFINH(i)=0.
    TPADCFANI(i)=0.
    TPADCFPLA(i)=0.
    TPADCFDW(i)=0.
    TPADCFMILK(i)=0.
 enddo
 do i=1,43
    DCFEXT(i)=0.
    DCFINH(i)=0.
    DCFANI(i)=0.
    DCFPLA(i)=0.
    DCFDW(i)=0.
    DCFMILK(i)=0
 enddo

   if (ikey .ne. 39235) then
      ifnamedat  = igetunitnumber('dcagw   ')
      ienvout    = igetunitnumber('dcagw   ')
      igrdfdat   = igetunitnumber('dcagw   ')
      inewdfdat  = igetunitnumber('dcagw   ')
      idefaultinp= igetunitnumber('dcagw   ')
      igeniiinp  = igetunitnumber('dcagw   ')
      igwaddat   = igetunitnumber('dcagw   ')
      igwcidat   = igetunitnumber('dcagw   ')

      open(ifnamedat, file='FILENAME.DAT', status='old')
      do i=1,22
         read(ifnamedat,'(i3,7x,a40)') n,fname
         if (n.eq.5.or.n.eq.10.or.n.eq.13.or.n.eq.22) then
            call zportparseunixfilenametodos(fname,fnamecvt)
            if (n.eq.5)  fn_geniiinp   = fnamecvt
            if (n.eq.10) fn_grdfdat    = fnamecvt
            if (n.eq.13) fn_envout     = fnamecvt
            if (n.eq.22) fn_defaultinp = fnamecvt
         endif
      enddo
      close(ifnamedat)
      open(inewdfdat,  file='gnewdf.dat', status='old')

      ikey = 39235
```

```
        endif
cc mam 3-15-00
cc      grdf,default should be opened and closed because
cc      are used in gentpa code (env) and not just in
cc      tpa part (this subroutine) of gentpa.

        open(ienvout,    file=fn_envout,    status='old')
        open(igrdfdat,   file=fn_grdfdat,   status='old')
        open(igeniiinp,  file=fn_geniiinp,  status='old')
        open(idefaultinp,file=fn_defaultinp,status='old')

        if (climate.eq.0) then
           open(igwaddat,file='gw_cb_ad.dat',status='unknown')
           open(igwcidat,file='gw_cb_ci.dat',status='unknown')
        else
           open(igwaddat,file='gw_pb_ad.dat',status='unknown')
           open(igwcidat,file='gw_pb_ci.dat',status='unknown')
        endif

C       Rewind files which stay open (are not closed).
        rewind( igrdfdat )
        rewind( inewdfdat )
        open(idefaultinp,file=fn_defaultinp,status='old')

c mas - ===================
c mas - READQ: reads pathway exposure rates for each TPA radionuclide from
c mas - the GENII intermediate output file ENV.OUT created by envin.e
c mas - ===================

c mas - Bypass header information in ENV.OUT and count number of
c mas - pathways for reading rest of file (in case they change).

        DUM3=""
        npathcnt=0
        DO 112 WHILE (DUM3(1:4) .NE. "C 14")
           READ (ienvout, 10) DUM3
           IF (index(DUM3,'mCi') .gt. 4) npathcnt=npathcnt+1
  112   CONTINUE

        ELTT(1) = "C "
        AWT(1)  = "14    "

c mas - Reads radionuclide name, pathway names, & exposures for first
c mas - radionuclide encountered in ENV.OUT

        DO 122 IP = 1, npathcnt
          READ (ienvout, 11) PATHNAME(IP), Q(1, IP)
  122   CONTINUE

c mas - Reads pathway exposures for all remaining radionuclides in ENV.OUT

        DO 132 IN = 2, NUCTOT

          READ (ienvout, 12, END=133,ERR=133) ELTT(IN), AWT(IN)

          do IP = 1, npathcnt
             READ (ienvout, 13) (Q(IN, IP), IE=1, NYRINT)
          enddo

  132   CONTINUE
  133   CONTINUE

        NUCTOT = IN-1

   10 FORMAT (1X, A25)
   11 FORMAT (1X, A, 8E8.1, / 9(9X, 8E8.1/))
   12 FORMAT (1X, A2, A6)
   13 FORMAT (9X, 8E8.1, / 9(9X, 8E8.1/))

c mas - ===================
c mas - READEDF: reads external exposure DFs from GGRDF.DAT
c mas - ===================

c mas - Bypass header information in GGRDF.DAT

      READ (igrdfdat, 21) DUM, DUM, DUM, DUM

c mas - Read and store external DFs for each radionuclide from GGRDF.DAT

      DO 201 IN = 1, NUCTOT
```

```
  212   CONTINUE

        READ (igrdfdat, 22) E, A, DAIN, DBIN, DSIN,
     &                      DD15IN, DD50IN, DD100I

        IF (E .EQ. ELTT(IN) .AND. A .EQ. AWT(IN)) THEN
           DAIT(IN) = DAIN
           DBIT(IN) = DBIN
           DSIT(IN) = DSIN
           DDIT(IN,1) = DD15IN
           DDIT(IN,2) = DD50IN
           DDIT(IN,3) = DD100I
           GOTO 201
         ENDIF
        GOTO 212

  201 CONTINUE

  21  FORMAT (A1/A1/A1/A1)
  22  FORMAT (a2,a6, e8.2, 5(2x,e8.2))


c mas - ===================
c mas - READIDF: reads ingestion and inhalation DFs from GNEWDF.DAT
c mas - ===================

c mas - Bypass header information in GNEWDF.DAT

      DUM2 = ""
      DO 312 WHILE (DUM2 .NE. "start_data")
         READ (inewdfdat, '(A10)') DUM2
  312   CONTINUE

c mas - Reads and stores age-specific ingestion and
c mas - inhalation DFs for each radionuclide from GNEWDF.DAT

      DO 322 IN = 1, NUCTOT

  332   CONTINUE

        IF (AGE .EQ. 1) THEN
          READ (inewdfdat, 31) E, A, ING, INH
        ELSE IF (AGE .EQ. 2) THEN
          READ (inewdfdat, 32) E, A, ING, INH
        ELSE IF (AGE .EQ. 3) THEN
          READ (inewdfdat, 33) E, A, ING, INH
        ELSE IF (AGE .EQ. 4) THEN
          READ (inewdfdat, 34) E, A, ING, INH
        ELSE IF (AGE .EQ. 5) THEN
          READ (inewdfdat, 35) E, A, ING, INH
        ELSE IF (AGE .EQ. 6) THEN
          READ (inewdfdat, 36) E, A, ING, INH
        ENDIF

        IF (E .EQ. ELTT(IN) .AND. A .EQ. AWT(IN)) THEN
           DFING(IN) = ING
           DFINH(IN) = INH
           GOTO 322
        ENDIF
       GOTO 332

  322   CONTINUE

  31  FORMAT (A2, A6, E8.2, 2X, E8.2, 100X)
  32  FORMAT (A2, A6, 20X, E8.2, 2X, E8.2, 80X)
  33  FORMAT (A2, A6, 40X, E8.2, 2X, E8.2, 60X)
  34  FORMAT (A2, A6, 60X, E8.2, 2X, E8.2, 40X)
  35  FORMAT (A2, A6, 80X, E8.2, 2X, E8.2, 20X)
  36  FORMAT (A2, A6, 100X, E8.2, 2X, E8.2)


c mas - Read value for SI2I in GDEFAULT.DEF

      DUM=""
      DO 512 WHILE (DUM .NE. "DOSE")
          READ (idefaultinp, 41) DUM
  512 CONTINUE
      READ (idefaultinp, 42) SI2I

c mas - Read value for FINITE in GGENII.INP
```

```
      READ (igeniiinp, 43) DUM,DUM,DUM,DUM,DUM,DUM,DUM,DUM,DUM,DUM
      READ (igeniiinp, 44) FINITE

      close(igeniiinp)
cc rwj 2-13-00
      close(idefaultinp)

  41    FORMAT (/A4)
  42    FORMAT (/F4.0)
  43    FORMAT (A1/A1/A1/A1/A1/A1/A1/A1/A1/A1)
  44    FORMAT (40X, A1)

c mas - ===================
c mas - DCFCALC: Calculate DCFs for all radionuclides for each of 6 TPA4.0 pathways: direct exposure,
c mas - inhalation, animal product ingestion, crop ingestion, drinking water, milk ingestion
c mas - Equations are the same as those used in GENII v1.485
c mas - ===================

      DO 532 IN = 1, NUCTOT

          DO 542 IP = 1, npathcnt

            IF (PATHNAME(IP) .EQ. "Plume") THEN

              IF (FINITE .EQ. "T") THEN
                TPADCFEXT(IN) = TPADCFEXT(IN) + Q(IN,IP) / NVU4 / 100.0
     &                          * ADJUNT
              ELSE IF (FINITE .EQ. "F") THEN
                TPADCFEXT(IN) = TPADCFEXT(IN) + Q(IN,IP) * DAIT(IN)
     &                          * ADJUNT
              END IF
            ELSE IF (PATHNAME(IP) .EQ. "Inhale") THEN
              TPADCFINH(IN) = TPADCFINH(IN) + Q(IN,IP) * DFINH(IN)
     &                        * ADJUNT
            ELSE IF (PATHNAME(IP) .EQ. "Sur Soil") THEN
              TPADCFEXT(IN) = TPADCFEXT(IN) + Q(IN,IP) * DSIT(IN)
     &                        * ADJUNT
            ELSE IF (PATHNAME(IP) .EQ. "Leaf Veg") THEN
              TPADCFPLA(IN) = TPADCFPLA(IN) + Q(IN,IP) * DFING(IN)
     &                        * ADJUNT
            ELSE IF (PATHNAME(IP) .EQ. "Oth. Veg") THEN
              TPADCFPLA(IN) = TPADCFPLA(IN) + Q(IN,IP) * DFING(IN)
     &                        * ADJUNT
            ELSE IF (PATHNAME(IP) .EQ. "Fruit") THEN
              TPADCFPLA(IN) = TPADCFPLA(IN) + Q(IN,IP) * DFING(IN)
     &                        * ADJUNT
            ELSE IF (PATHNAME(IP) .EQ. "Cereals") THEN
              TPADCFPLA(IN) = TPADCFPLA(IN) + Q(IN,IP) * DFING(IN)
     &                        * ADJUNT
            ELSE IF (PATHNAME(IP) .EQ. "Meat") THEN
              TPADCFANI(IN) = TPADCFANI(IN) + Q(IN,IP) * DFING(IN)
     &                        * ADJUNT
            ELSE IF (PATHNAME(IP) .EQ. "Poultry") THEN
              TPADCFANI(IN) = TPADCFANI(IN) + Q(IN,IP) * DFING(IN)
     &                        * ADJUNT
            ELSE IF (PATHNAME(IP) .EQ. "Cow Milk") THEN
              TPADCFMILK(IN) = TPADCFMILK(IN) + Q(IN,IP) * DFING(IN)
     &                         * ADJUNT
            ELSE IF (PATHNAME(IP) .EQ. "Eggs") THEN
              TPADCFANI(IN) = TPADCFANI(IN) + Q(IN,IP) * DFING(IN)
     &                        * ADJUNT
            ELSE IF (PATHNAME(IP) .EQ. "Soil Ing") THEN
              TPADCFPLA(IN) = TPADCFPLA(IN) + Q(IN,IP) * DFING(IN)
     &                        * ADJUNT
            ELSE IF (PATHNAME(IP) .EQ. "Swim Ing") THEN
              TPADCFDW(IN) = TPADCFDW(IN) + Q(IN,IP) * DFING(IN)
     &                       * ADJUNT
            ELSE IF (PATHNAME(IP) .EQ. "Swim Ext") THEN
              TPADCFEXT(IN) = TPADCFEXT(IN) + Q(IN,IP) * DBIT(IN)
     &                        * ADJUNT * SI2I
            ELSE IF (PATHNAME(IP) .EQ. "Boating") THEN
              TPADCFEXT(IN) = TPADCFEXT(IN) + Q(IN,IP) * DBIT(IN)
     &                        * ADJUNT
            ELSE IF (PATHNAME(IP) .EQ. "Shore") THEN
              TPADCFEXT(IN) = TPADCFEXT(IN) + Q(IN,IP) * DSIT(IN)
     &                        * ADJUNT
            ELSE IF (PATHNAME(IP) .EQ. "Water") THEN
              TPADCFDW(IN) = TPADCFDW(IN) + Q(IN,IP) * DFING(IN)
     &                       * ADJUNT
            ELSE IF (PATHNAME(IP) .EQ. "Fish") THEN
```

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```
            TPADCFANI(IN) = TPADCFANI(IN) + Q(IN,IP) * DFING(IN)
     &                      * ADJUNT
          ELSE IF (PATHNAME(IP) .EQ. "Mollusc") THEN
            TPADCFANI(IN) = TPADCFANI(IN) + Q(IN,IP) * DFING(IN)
     &                      * ADJUNT
          ELSE IF (PATHNAME(IP) .EQ. "Crustace") THEN
            TPADCFANI(IN) = TPADCFANI(IN) + Q(IN,IP) * DFING(IN)
     &                      * ADJUNT
          ELSE IF (PATHNAME(IP) .EQ. "Aqu Plnt") THEN
            TPADCFPLA(IN) = TPADCFPLA(IN) + Q(IN,IP) * DFING(IN)
     &                      * ADJUNT
          ELSE IF (PATHNAME(IP) .EQ. "Dep Soil") THEN
            TPADCFEXT(IN) = TPADCFEXT(IN) + Q(IN,IP) * DSIT(IN)
     &                      * ADJUNT
          ELSE IF (PATHNAME(IP) .EQ. "Waste") THEN
            TPADCFEXT(IN) = TPADCFEXT(IN) + Q(IN,IP) * DSIT(IN)
     &                      * ADJUNT
          END IF

  542     CONTINUE
  532 CONTINUE


c mas - Concatenate the radionuclide names and atomic weights into single parameter RADNAME

      DO 612 IN = 1, NUCTOT
          G = ELTT(IN)
          H = AWT(IN)
          IF (G(2:2) .EQ. " ") THEN
            J = G(1:1)//H
          ELSE
            J = G//H
          END IF
          RADNAME(IN) = J
  612 CONTINUE

c mas - Add 31 daughter DCFs to 43 parent DCFs and move to new arrays : DCFEXT, DCFINH,
c mas - DCFANI, DCFPLA, DCFDW, and DCFMILK

        DO 712 IN = 1, NUCTOT
          IF (RADNAME(IN) .EQ. "U238" .OR.
     &        RADNAME(IN) .EQ. "TH234".OR.
     &        RADNAME(IN) .EQ. "PA234") THEN
            I = 1
          ELSE IF (RADNAME(IN) .EQ. "CM246") THEN
            I = 2
          ELSE IF (RADNAME(IN) .EQ. "PU242" .OR. RADNAME(IN) .EQ.
     &              "NP238") THEN
            I = 3
          ELSE IF (RADNAME(IN) .EQ. "AM242M" .OR. RADNAME(IN) .EQ.
     &              "AM242" .OR. RADNAME(IN) .EQ. "CM242") THEN
            I = 4
          ELSE IF (RADNAME(IN) .EQ. "PU238") THEN
            I = 5
          ELSE IF (RADNAME(IN) .EQ. "U234") THEN
            I = 6
          ELSE IF (RADNAME(IN) .EQ. "TH230") THEN
            I = 7
          ELSE IF (RADNAME(IN) .EQ. "RA226" .OR. RADNAME(IN) .EQ.
     &              "RN222") THEN
            I = 8
          ELSE IF (RADNAME(IN) .EQ. "PB210" .OR. RADNAME(IN) .EQ.
     &              "BI210" .OR. RADNAME(IN) .EQ. "PO210") THEN
            I = 9
          ELSE IF (RADNAME(IN) .EQ. "CM243" .OR. RADNAME(IN) .EQ.
     &              "PU243") THEN
            I = 10
          ELSE IF (RADNAME(IN) .EQ. "AM243" .OR. RADNAME(IN) .EQ.
     &              "NP239") THEN
            I = 11
          ELSE IF (RADNAME(IN) .EQ. "PU239") THEN
            I = 12
          ELSE IF (RADNAME(IN) .EQ. "U235" .OR.  RADNAME(IN) .EQ.
     &              "TH231") THEN
            I = 13
          ELSE IF (RADNAME(IN) .EQ. "PA231") THEN
            I = 14
          ELSE IF (RADNAME(IN) .EQ. "AC227" .OR. RADNAME(IN) .EQ.
     &              "TH227" .OR. RADNAME(IN) .EQ. "FR223" .OR.
     &              RADNAME(IN) .EQ. "RA223") THEN
            I = 15
```

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```
      ELSE IF (RADNAME(IN) .EQ. "CM245") THEN
        I = 16
      ELSE IF (RADNAME(IN) .EQ. "PU241") THEN
        I = 17
      ELSE IF (RADNAME(IN) .EQ. "AM241") THEN
        I = 18
      ELSE IF (RADNAME(IN) .EQ. "NP237" .OR. RADNAME(IN) .EQ.
&             "PA233") THEN
        I = 19
      ELSE IF (RADNAME(IN) .EQ. "U233") THEN
        I = 20
      ELSE IF (RADNAME(IN) .EQ. "TH229" .OR. RADNAME(IN) .EQ.
&             "RA225" .OR. RADNAME(IN) .EQ. "AC225") THEN
        I = 21
      ELSE IF (RADNAME(IN) .EQ. "CM244" .OR. RADNAME(IN) .EQ.
&             "PU244" .OR. RADNAME(IN) .EQ. "U240") THEN
        I = 22
      ELSE IF (RADNAME(IN) .EQ. "PU240") THEN
        I = 23
      ELSE IF (RADNAME(IN) .EQ. "U236") THEN
        I = 24
      ELSE IF (RADNAME(IN) .EQ. "U232" .OR.
&             RADNAME(IN) .EQ. "TH232" .OR.
&             RADNAME(IN) .EQ. "RA228" .OR.
&             RADNAME(IN) .EQ. "AC228" .OR.
&             RADNAME(IN) .EQ. "TH228" .OR.
&             RADNAME(IN) .EQ. "RA224" .OR.
&             RADNAME(IN) .EQ. "PB212" .OR.
&             RADNAME(IN) .EQ. "BI212") THEN
        I = 25
      ELSE IF (RADNAME(IN) .EQ. "SM151") THEN
        I = 26
      ELSE IF (RADNAME(IN) .EQ. "CS137") THEN
        I = 27
      ELSE IF (RADNAME(IN) .EQ. "CS135") THEN
        I = 28
      ELSE IF (RADNAME(IN) .EQ. "I129") THEN
        I = 29
      ELSE IF (RADNAME(IN) .EQ. "SN126" .OR. RADNAME(IN) .EQ.
&             "SB126M" .OR. RADNAME(IN) .EQ. "SB126") THEN
        I = 30
      ELSE IF (RADNAME(IN) .EQ. "SN121M" .OR. RADNAME(IN) .EQ.
&             "SN121") THEN
        I = 31
      ELSE IF (RADNAME(IN) .EQ. "AG108M") THEN
        I = 32
      ELSE IF (RADNAME(IN) .EQ. "PD107") THEN
        I = 33
      ELSE IF (RADNAME(IN) .EQ. "TC99") THEN
        I = 34
      ELSE IF (RADNAME(IN) .EQ. "MO93") THEN
        I = 35
      ELSE IF (RADNAME(IN) .EQ. "NB94") THEN
        I = 36
      ELSE IF (RADNAME(IN) .EQ. "ZR93" .OR. RADNAME(IN) .EQ.
&             "NB93M") THEN
        I = 37
      ELSE IF (RADNAME(IN) .EQ. "SR90" .OR. RADNAME(IN) .EQ.
&             "Y90") THEN
        I = 38
      ELSE IF (RADNAME(IN) .EQ. "SE79") THEN
        I = 39
      ELSE IF (RADNAME(IN) .EQ. "NI63") THEN
        I = 40
      ELSE IF (RADNAME(IN) .EQ. "NI59") THEN
        I = 41
      ELSE IF (RADNAME(IN) .EQ. "CL36") THEN
        I = 42
      ELSE IF (RADNAME(IN) .EQ. "C14") THEN
        I = 43
      END IF

      DCFEXT(I)  = DCFEXT(I) + TPADCFEXT(IN)
      DCFINH(I)  = DCFINH(I) + TPADCFINH(IN)
      DCFANI(I)  = DCFANI(I) + TPADCFANI(IN)
      DCFPLA(I)  = DCFPLA(I) + TPADCFPLA(IN)
      DCFDW(I)   = DCFDW(I)  + TPADCFDW(IN)
      DCFMILK(I) = DCFMILK(I) + TPADCFMILK(IN)

712   CONTINUE
```

```
c mas - Writes pathway-specific DCF files for non-pluvial or pluvial climate

      IF (CLIMATE .EQ. 0) THEN
        WRITE(igwaddat,'(A)') "These DCFs are for a farming "//
     &                        "receptor group located 20 km from "//
     &                        "Yucca"
        WRITE(igwaddat,'(A)') "Mountain in a non-pluvial biosphere "//
     &                        "and are for doses due solely to"
        WRITE(igwaddat,'(A)') "direct exposure, inhalation, "//
     &                        "ingestion of animal products, "//
     &                        "ingestion"
        WRITE(igwaddat,'(A)') "of crops, ingestion of drinking "//
     &                        "water, and ingestion of milk.  Units"
        WRITE(igwaddat,'(A)') "are (rem/yr)/(Ci/m3).  DCFs include "//
     &                        "daughter contributions, are based"
        WRITE(igwaddat,'(A)') "on unit groundwater concentrations, "//
     &                        "and represent total effective dose"
        WRITE(igwaddat,'(A)') "equivalent.  DCFs are age-specific, "//
     &                        "based on choice made in tpa.inp."
      ELSE
        WRITE(igwaddat,'(A)')"These DCFs are for a farming receptor"//
     &                       " group located 20 km from Yucca"
        WRITE(igwaddat,'(A)') "Mountain in a pluvial biosphere "//
     &                        "and are for doses due solely to"
        WRITE(igwaddat,'(A)') "direct exposure, inhalation, "//
     &                        "ingestion of animal products, "//
     &                        "ingestion"
        WRITE(igwaddat,'(A)')"of crops, ingestion of drinking water"//
     &                       ", and ingestion of milk.  Units"
        WRITE(igwaddat,'(A)') "are (rem/yr)/(Ci/m3).  DCFs include "//
     &                        "daughter contributions, are based"
        WRITE(igwaddat,'(A)') "on unit groundwater concentrations, "//
     &                        "and represent total effective dose"
        WRITE(igwaddat,'(A)') "equivalent.  DCFs are age-specific, "//
     &                        "based on selection made in tpa.inp."
      END IF
      WRITE(igwaddat,'(A)') "start_data"
      WRITE(igwaddat,'(A)') "nuclide   dir exp   inh       ing ani"//
     &                    "   ing crop  ing dw    ing milk"
      DO 722 I = 1, 43
        WRITE(igwaddat,61) ljs(nameiso(i)),
     &                     DCFEXT(I), DCFINH(I), DCFANI(I),
     &                     DCFPLA(I), DCFDW(I), DCFMILK(I)
 722  CONTINUE

c mas - Writes drinking water DCF file for non-pluvial or pluvial climate

      IF (CLIMATE .EQ. 0) THEN
        WRITE(igwcidat,'(A)') "These DCFs are for a residential "//
     &                        "receptor group located 5 to 20 km"
        WRITE(igwcidat,'(A)') "from Yucca Mountain in a " //
     &                        "non-pluvial biosphere and are for " //
     &                        "doses due"
        WRITE(igwcidat,'(A)') "solely to ingestion of drinking " //
     &                        "water.  Units are (rem/yr)/(Ci/m3)."
        WRITE(igwcidat,'(A)') "DCFs include daughter " //
     &                        "contributions, are based on unit " //
     &                        "groundwater"
        WRITE(igwcidat,'(A)') "concentrations, and represent total "//
     &                        "effective dose equivalent."
        WRITE(igwcidat,'(A)') "DCFs are age-specific, based on "//
     &                        "selection made in tpa.inp."
      ELSE
        WRITE(igwcidat,'(A)') "These DCFs are for a residential "//
     &                        "receptor group located 5 to 20 km"
        WRITE(igwcidat,'(A)') "from Yucca Mountain in a pluvial "//
     &                        "biosphere and are for doses due"
        WRITE(igwcidat,'(A)') "solely to ingestion of drinking " //
     &                        "water.  Units are (rem/yr)/(Ci/m3)."
        WRITE(igwcidat,'(A)') "DCFs include daughter " //
     &                        "contributions, are based on unit " //
     &                        "groundwater"
        WRITE(igwcidat,'(A)') "concentrations, and represent total "//
     &                        "effective dose equivalent."
        WRITE(igwcidat,'(A)') "DCFs are age-specific, based on "//
     &                        "selection made in tpa.inp."
      END IF
      WRITE(igwcidat,'(A)') "start_data"
      WRITE(igwcidat,'(A)') "nuclide   ing dw"
```

```
        DO 732 I = 1, 43
           WRITE(igwcidat,62) ljs(nameiso(i)), DCFDW(I)
  732    CONTINUE
cc mam 3-15-00
cc      input files
        close (igrdfdat)
        close (idefaultinp)
cc      output files
        close (ienvout)
        close (igwaddat)
        close (igwcidat)

  61    FORMAT (a6,2x, 6(x,1pe9.2))
  62    FORMAT (a6,3x,     1pe9.2)

c mas - End of subroutine GENTODCF

        END
```

No Fix 10km Tube Out.wpd

without Fix


```
=====================================================================
          exec: Welcome to TPA Version 4.1e
       Job started: Wed Jan 31 16:21:22 2001
=====================================================================
 REPOSITORY DESIGN INFORMATION
 Subarea   Area       Waste   Number of WP
    #     [m^2]       [MTU]
    1    723591.3    11058.1        1133
    2    784763.0    11546.1        1183
    3    390372.0     5563.2         570
    4    207581.3     3445.3         353
    5    378972.8     5553.4         569
    6    424872.5     6236.6         639
    7    163938.3     2381.4         244
    8    393468.9     6588.0         675
    9    660785.5     9311.0         954
   10    589497.1     8325.3         853

 Total Area [acre]          =     1165.7629779961
 Total Buried Waste [MTU]   =     70008.480000000
 Repository AML [MTU/acre]  =     60.053785650616

 Specified Global Parameters:

                Compliance Period =  10000.0 (yr)
          Maximum Simulation Time = 100000.0 (yr)
           Number Of Realizations =      1
               Number Of Subareas =     10
               Volcanism scenario =      0 (yes=1, no=0)
                Faulting scenario =      0 (yes=1, no=0)
                 Seismic scenario =      1 (yes=1, no=0)
      Distance to Receptor Group =     10.0 (km)


 **>>> CAUTION: CHECKING OF NUCLIDES AND CHAINS IS DISABLED <<<**
 **>>> You may not be using the standard chains specified   <<<**
 **>>> in the invent module.                                <<<**
 **>>> (see "CheckNuclidesAndChains(yes=1,no=0)" in tpa.inp)<<<**

 The specified path for data  = $TPA_DATA/
 The specified path for codes = $TPA_TEST/

 **To modify global parameters or the path, stop code execution using control-C**
 Note: IEEE floating-point exception traps enabled:
    overflow;  division by zero;  invalid operation;
 See the Numerical Computation Guide, ieee_handler(3M)
-----------------------------------------------------------------------
     subarea   1 of  10           realization    1 of    1
-----------------------------------------------------------------------
 exec: calling uzflow
 exec: calling nfenv
 exec: calling ebsfail
      ebsfail: time of WP failure =    60928.4  yr
 exec: calling seismo
 exec: failed WPs from INITIAL   event =      2 at time =      0.0 yr
 exec: failed WPs from CORROSION event =   1131 at time =  60928.4 yr
  *** failed WPs: all WPs failed (  1133) ***
 exec: calling ebsrel
                 Highest release rates from Sub Area  1
             Tc99    1.7174E-02 [Ci/yr/SA] at  7.798E+04 yr
             Cs135   4.0632E-03 [Ci/yr/SA] at  7.798E+04 yr
             Pu239   1.6162E-03 [Ci/yr/SA] at  7.798E+04 yr
             Ni59    2.7706E-04 [Ci/yr/SA] at  7.798E+04 yr
             I129    2.7511E-04 [Ci/yr/SA] at  7.798E+04 yr
             Np237   2.6937E-04 [Ci/yr/SA] at  1.000E+05 yr
 exec: calling uzft
                     Highest release rates from UZ
             Tc99    1.6904E-02 [Ci/yr/SA] at  7.798E+04 yr
             I129    2.7100E-04 [Ci/yr/SA] at  7.798E+04 yr
             Np237   2.6723E-04 [Ci/yr/SA] at  1.000E+05 yr
             Se79    1.8559E-04 [Ci/yr/SA] at  7.798E+04 yr
```

```
            Cl36    1.4904E-04 [Ci/yr/SA] at  7.798E+04 yr
            Nb94    1.6053E-05 [Ci/yr/SA] at  7.798E+04 yr
 exec: calling szft
                    Highest release rates from SZ
            Tc99    1.6551E-02 [Ci/yr/SA] at  7.798E+04 yr
            I129    2.6559E-04 [Ci/yr/SA] at  7.798E+04 yr
            Np237   2.6279E-04 [Ci/yr/SA] at  1.000E+05 yr
            Cl36    1.4597E-04 [Ci/yr/SA] at  7.798E+04 yr
            Se79    1.3098E-04 [Ci/yr/SA] at  7.798E+04 yr
            U234    3.1808E-06 [Ci/yr/SA] at  7.798E+04 yr
-----------------------------------------------------------------------
    subarea   2 of  10          realization    1 of    1
-----------------------------------------------------------------------
 exec: calling uzflow
 exec: calling nfenv
 exec: calling ebsfail
     ebsfail: time of WP failure =    60928.4  yr
 exec: failed WPs from INITIAL   event =      2 at time =      0.0 yr
 exec: failed WPs from CORROSION event =   1181 at time =  60928.4 yr
  *** failed WPs: all WPs failed (  1183) ***
  *** ejected WPs:   0
 exec: calling ebsrel
                Highest release rates from Sub Area  2
            Tc99    1.1571E-03 [Ci/yr/SA] at  7.798E+04 yr
            Pu239   8.4316E-04 [Ci/yr/SA] at  7.798E+04 yr
            Cs135   2.6513E-04 [Ci/yr/SA] at  7.798E+04 yr
            Am243   3.7100E-05 [Ci/yr/SA] at  1.505E+04 yr
            Ni59    2.2193E-05 [Ci/yr/SA] at  7.798E+04 yr
            Cl4     2.1744E-05 [Ci/yr/SA] at  1.505E+04 yr
 exec: calling uzft
      *** NEFTRAN is skipped for this UZ path since no layers have significant ground water travel time. ***
                    Highest release rates from UZ
            Tc99    1.1571E-03 [Ci/yr/SA] at  7.798E+04 yr
            Pu239   8.4316E-04 [Ci/yr/SA] at  7.798E+04 yr
            Cs135   2.6513E-04 [Ci/yr/SA] at  7.798E+04 yr
            Am243   3.7100E-05 [Ci/yr/SA] at  1.505E+04 yr
            Ni59    2.2193E-05 [Ci/yr/SA] at  7.798E+04 yr
            Np237   1.9285E-05 [Ci/yr/SA] at  7.798E+04 yr
 exec: calling szft
                    Highest release rates from SZ
            Tc99    1.1348E-03 [Ci/yr/SA] at  7.798E+04 yr
            Pu239   8.3142E-05 [Ci/yr/SA] at  1.000E+05 yr
            Np237   1.8809E-05 [Ci/yr/SA] at  1.000E+05 yr
            I129    1.7608E-05 [Ci/yr/SA] at  7.798E+04 yr
            Cl36    9.7070E-06 [Ci/yr/SA] at  7.798E+04 yr
            Se79    9.5235E-06 [Ci/yr/SA] at  7.798E+04 yr
-----------------------------------------------------------------------
    subarea   3 of  10          realization    1 of    1
-----------------------------------------------------------------------
 exec: calling uzflow
 exec: calling nfenv
 exec: calling ebsfail
     ebsfail: time of WP failure =    60928.4  yr
 exec: failed WPs from INITIAL   event =      1 at time =      0.0 yr
 exec: failed WPs from CORROSION event =    569 at time =  60928.4 yr
  *** failed WPs: all WPs failed (  570) ***
 exec: calling ebsrel
                Highest release rates from Sub Area  3
            Tc99    1.6142E-03 [Ci/yr/SA] at  7.798E+04 yr
            Pu239   8.1999E-04 [Ci/yr/SA] at  7.798E+04 yr
            Cs135   3.7275E-04 [Ci/yr/SA] at  7.798E+04 yr
            Ni59    2.9609E-05 [Ci/yr/SA] at  7.798E+04 yr
            Np237   2.5738E-05 [Ci/yr/SA] at  7.798E+04 yr
            I129    2.5224E-05 [Ci/yr/SA] at  7.798E+04 yr
 exec: calling uzft
                    Highest release rates from UZ
            Tc99    1.5831E-03 [Ci/yr/SA] at  7.798E+04 yr
            Np237   2.5667E-05 [Ci/yr/SA] at  1.000E+05 yr
            I129    2.4762E-05 [Ci/yr/SA] at  7.798E+04 yr
            Se79    1.6711E-05 [Ci/yr/SA] at  7.798E+04 yr
            Cl36    1.3653E-05 [Ci/yr/SA] at  7.798E+04 yr
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            U234    2.0203E-06 [Ci/yr/SA] at  7.798E+04 yr
 exec: calling szft
                    Highest release rates from SZ
            Tc99    1.5511E-03 [Ci/yr/SA] at  7.798E+04 yr
            Np237   2.5401E-05 [Ci/yr/SA] at  1.000E+05 yr
            I129    2.4284E-05 [Ci/yr/SA] at  7.798E+04 yr
            Cl36    1.3380E-05 [Ci/yr/SA] at  7.798E+04 yr
            Se79    1.1931E-05 [Ci/yr/SA] at  7.798E+04 yr
            U234    1.6040E-06 [Ci/yr/SA] at  7.798E+04 yr
-----------------------------------------------------------------------
     subarea   4 of  10          realization    1 of    1
-----------------------------------------------------------------------
 exec: calling uzflow
 exec: calling nfenv
 exec: calling ebsfail
      ebsfail: time of WP failure =    60928.4  yr
 exec: failed WPs from INITIAL   event =      1 at time =      0.0 yr
 exec: failed WPs from CORROSION event =    352 at time =  60928.4 yr
  *** failed WPs: all WPs failed (  353) ***
 exec: calling ebsrel
                Highest release rates from Sub Area  4
            Tc99    1.2188E-03 [Ci/yr/SA] at  7.798E+04 yr
            Pu239   3.5007E-04 [Ci/yr/SA] at  7.798E+04 yr
            Cs135   2.8317E-04 [Ci/yr/SA] at  7.798E+04 yr
            Ni59    2.1620E-05 [Ci/yr/SA] at  7.798E+04 yr
            Np237   1.9321E-05 [Ci/yr/SA] at  1.000E+05 yr
            I129    1.9163E-05 [Ci/yr/SA] at  7.798E+04 yr
 exec: calling uzft
                    Highest release rates from UZ
            Tc99    1.1922E-03 [Ci/yr/SA] at  7.798E+04 yr
            Np237   1.9257E-05 [Ci/yr/SA] at  1.000E+05 yr
            I129    1.8766E-05 [Ci/yr/SA] at  7.798E+04 yr
            Se79    1.2521E-05 [Ci/yr/SA] at  7.798E+04 yr
            Cl36    1.0344E-05 [Ci/yr/SA] at  7.798E+04 yr
            Nb94    1.2521E-06 [Ci/yr/SA] at  7.798E+04 yr
 exec: calling szft
                    Highest release rates from SZ
            Tc99    1.1692E-03 [Ci/yr/SA] at  7.798E+04 yr
            Np237   1.9005E-05 [Ci/yr/SA] at  1.000E+05 yr
            I129    1.8419E-05 [Ci/yr/SA] at  7.798E+04 yr
            Cl36    1.0146E-05 [Ci/yr/SA] at  7.798E+04 yr
            Se79    9.0733E-06 [Ci/yr/SA] at  7.798E+04 yr
            U234    6.8454E-07 [Ci/yr/SA] at  7.798E+04 yr
-----------------------------------------------------------------------
     subarea   5 of  10          realization    1 of    1
-----------------------------------------------------------------------
 exec: calling uzflow
 exec: calling nfenv
 exec: calling ebsfail
      ebsfail: time of WP failure =    60928.4  yr
 exec: failed WPs from INITIAL   event =      1 at time =      0.0 yr
 exec: failed WPs from CORROSION event =    568 at time =  60928.4 yr
  *** failed WPs: all WPs failed (  569) ***
 exec: calling ebsrel
                Highest release rates from Sub Area  5
            Tc99    3.9216E-03 [Ci/yr/SA] at  7.798E+04 yr
            Cs135   9.1776E-04 [Ci/yr/SA] at  7.798E+04 yr
            Pu239   7.4487E-04 [Ci/yr/SA] at  7.798E+04 yr
            Ni59    6.6702E-05 [Ci/yr/SA] at  7.798E+04 yr
            I129    6.2116E-05 [Ci/yr/SA] at  7.798E+04 yr
            Np237   6.1502E-05 [Ci/yr/SA] at  1.000E+05 yr
 exec: calling uzft
                    Highest release rates from UZ
            Tc99    3.7974E-03 [Ci/yr/SA] at  7.798E+04 yr
            Np237   6.0949E-05 [Ci/yr/SA] at  1.000E+05 yr
            I129    6.0244E-05 [Ci/yr/SA] at  7.798E+04 yr
            Se79    3.8347E-05 [Ci/yr/SA] at  7.798E+04 yr
            Cl36    3.3185E-05 [Ci/yr/SA] at  7.798E+04 yr
            Nb94    3.7982E-06 [Ci/yr/SA] at  7.798E+04 yr
 exec: calling szft
                    Highest release rates from SZ
```

```
            Tc99     3.7533E-03 [Ci/yr/SA] at  7.798E+04 yr
            Np237    6.0266E-05 [Ci/yr/SA] at  1.000E+05 yr
            I129     5.9577E-05 [Ci/yr/SA] at  7.798E+04 yr
            Cl36     3.2805E-05 [Ci/yr/SA] at  7.798E+04 yr
            Se79     3.1859E-05 [Ci/yr/SA] at  7.798E+04 yr
            U234     1.5242E-06 [Ci/yr/SA] at  7.798E+04 yr
-----------------------------------------------------------------------
    subarea   6 of  10          realization    1 of    1
-----------------------------------------------------------------------
 exec: calling uzflow
 exec: calling nfenv
 exec: calling ebsfail
      ebsfail: time of WP failure =    60928.4  yr
 exec: failed WPs from INITIAL   event =      1 at time =      0.0 yr
 exec: failed WPs from CORROSION event =    638 at time =  60928.4 yr
  *** failed WPs: all WPs failed (  639) ***
 exec: calling ebsrel
                 Highest release rates from Sub Area  6
            Tc99     8.4773E-03 [Ci/yr/SA] at  7.798E+04 yr
            Cs135    2.0232E-03 [Ci/yr/SA] at  7.798E+04 yr
            Pu239    6.2272E-04 [Ci/yr/SA] at  7.798E+04 yr
            I129     1.3701E-04 [Ci/yr/SA] at  7.798E+04 yr
            Ni59     1.2977E-04 [Ci/yr/SA] at  7.798E+04 yr
            Np237    1.2966E-04 [Ci/yr/SA] at  1.000E+05 yr
 exec: calling uzft
                     Highest release rates from UZ
            Tc99     8.0919E-03 [Ci/yr/SA] at  7.798E+04 yr
            I129     1.3109E-04 [Ci/yr/SA] at  7.798E+04 yr
            Np237    1.2611E-04 [Ci/yr/SA] at  1.000E+05 yr
            Se79     7.6036E-05 [Ci/yr/SA] at  7.798E+04 yr
            Cl36     7.1953E-05 [Ci/yr/SA] at  7.798E+04 yr
            Nb94     7.1638E-06 [Ci/yr/SA] at  7.798E+04 yr
 exec: calling szft
                     Highest release rates from SZ
            Tc99     7.9998E-03 [Ci/yr/SA] at  7.798E+04 yr
            I129     1.2966E-04 [Ci/yr/SA] at  7.798E+04 yr
            Np237    1.2388E-04 [Ci/yr/SA] at  1.000E+05 yr
            Cl36     7.1145E-05 [Ci/yr/SA] at  7.798E+04 yr
            Se79     6.3410E-05 [Ci/yr/SA] at  7.798E+04 yr
            U234     1.1853E-06 [Ci/yr/SA] at  7.798E+04 yr
-----------------------------------------------------------------------
    subarea   7 of  10          realization    1 of    1
-----------------------------------------------------------------------
 exec: calling uzflow
 exec: calling nfenv
 exec: calling ebsfail
      ebsfail: time of WP failure =    60928.4  yr
 exec: failed WPs from CORROSION event =    244 at time =  60928.4 yr
  *** failed WPs: all WPs failed (  244) ***
 exec: calling ebsrel
                 Highest release rates from Sub Area  7
            Tc99     3.6523E-03 [Ci/yr/SA] at  7.798E+04 yr
            Cs135    8.7821E-04 [Ci/yr/SA] at  7.798E+04 yr
            Pu239    2.2305E-04 [Ci/yr/SA] at  7.798E+04 yr
            I129     5.9480E-05 [Ci/yr/SA] at  7.798E+04 yr
            Np237    5.4616E-05 [Ci/yr/SA] at  1.000E+05 yr
            Ni59     5.3349E-05 [Ci/yr/SA] at  7.798E+04 yr
 exec: calling uzft
                     Highest release rates from UZ
            Tc99     3.4588E-03 [Ci/yr/SA] at  7.798E+04 yr
            I129     5.6479E-05 [Ci/yr/SA] at  7.798E+04 yr
            Np237    5.2517E-05 [Ci/yr/SA] at  1.000E+05 yr
            Cl36     3.0970E-05 [Ci/yr/SA] at  7.798E+04 yr
            Se79     3.0184E-05 [Ci/yr/SA] at  7.798E+04 yr
            Nb94     2.9005E-06 [Ci/yr/SA] at  7.798E+04 yr
 exec: calling szft
                     Highest release rates from SZ
            Tc99     3.4197E-03 [Ci/yr/SA] at  7.798E+04 yr
            I129     5.5870E-05 [Ci/yr/SA] at  7.798E+04 yr
            Np237    5.1449E-05 [Ci/yr/SA] at  1.000E+05 yr
            Cl36     3.0625E-05 [Ci/yr/SA] at  7.798E+04 yr
```

```
            Se79    2.5211E-05 [Ci/yr/SA] at  7.798E+04 yr
            U234    4.0053E-07 [Ci/yr/SA] at  7.798E+04 yr
-----------------------------------------------------------------------
    subarea   8 of  10          realization    1 of    1
-----------------------------------------------------------------------
 exec: calling uzflow
 exec: calling nfenv
 exec: calling ebsfail
     ebsfail: time of WP failure =    60928.4  yr
 exec: failed WPs from INITIAL   event =      1 at time =      0.0 yr
 exec: failed WPs from CORROSION event =    674 at time =  60928.4 yr
  *** failed WPs: all WPs failed (  675) ***
 exec: calling ebsrel
                Highest release rates from Sub Area  8
            Tc99    5.5818E-03 [Ci/yr/SA] at  7.798E+04 yr
            Cs135   1.3049E-03 [Ci/yr/SA] at  7.798E+04 yr
            Pu239   8.8555E-04 [Ci/yr/SA] at  7.798E+04 yr
            Ni59    9.6166E-05 [Ci/yr/SA] at  7.798E+04 yr
            Np237   8.9042E-05 [Ci/yr/SA] at  1.000E+05 yr
            I129    8.8322E-05 [Ci/yr/SA] at  7.798E+04 yr
 exec: calling uzft
      *** NEFTRAN is skipped for this UZ path since no layers have significant ground water travel time. ***
                    Highest release rates from UZ
            Tc99    5.5818E-03 [Ci/yr/SA] at  7.798E+04 yr
            Cs135   1.3049E-03 [Ci/yr/SA] at  7.798E+04 yr
            Pu239   8.8555E-04 [Ci/yr/SA] at  7.798E+04 yr
            Ni59    9.6166E-05 [Ci/yr/SA] at  7.798E+04 yr
            Np237   8.9042E-05 [Ci/yr/SA] at  1.000E+05 yr
            I129    8.8322E-05 [Ci/yr/SA] at  7.798E+04 yr
 exec: calling szft
                    Highest release rates from SZ
            Tc99    5.4721E-03 [Ci/yr/SA] at  7.798E+04 yr
            Np237   8.8519E-05 [Ci/yr/SA] at  1.000E+05 yr
            I129    8.6665E-05 [Ci/yr/SA] at  7.798E+04 yr
            Pu239   8.2515E-05 [Ci/yr/SA] at  1.000E+05 yr
            Cl36    4.7724E-05 [Ci/yr/SA] at  7.798E+04 yr
            Se79    4.6613E-05 [Ci/yr/SA] at  7.798E+04 yr
-----------------------------------------------------------------------
    subarea   9 of  10          realization    1 of    1
-----------------------------------------------------------------------
 exec: calling uzflow
 exec: calling nfenv
 exec: calling ebsfail
     ebsfail: time of WP failure =    60928.4  yr
 exec: failed WPs from INITIAL   event =      2 at time =      0.0 yr
 exec: failed WPs from CORROSION event =    952 at time =  60928.4 yr
  *** failed WPs: all WPs failed (  954) ***
 exec: calling ebsrel
                Highest release rates from Sub Area  9
            Tc99    7.1764E-03 [Ci/yr/SA] at  7.798E+04 yr
            Cs135   1.6812E-03 [Ci/yr/SA] at  7.798E+04 yr
            Pu239   1.1440E-03 [Ci/yr/SA] at  7.798E+04 yr
            Ni59    1.2180E-04 [Ci/yr/SA] at  7.798E+04 yr
            I129    1.1379E-04 [Ci/yr/SA] at  7.798E+04 yr
            Np237   1.1333E-04 [Ci/yr/SA] at  1.000E+05 yr
 exec: calling uzft
      *** NEFTRAN is skipped for this UZ path since no layers have significant ground water travel time. ***
                    Highest release rates from UZ
            Tc99    7.1764E-03 [Ci/yr/SA] at  7.798E+04 yr
            Cs135   1.6812E-03 [Ci/yr/SA] at  7.798E+04 yr
            Pu239   1.1440E-03 [Ci/yr/SA] at  7.798E+04 yr
            Ni59    1.2180E-04 [Ci/yr/SA] at  7.798E+04 yr
            I129    1.1379E-04 [Ci/yr/SA] at  7.798E+04 yr
            Np237   1.1333E-04 [Ci/yr/SA] at  1.000E+05 yr
 exec: calling szft
                    Highest release rates from SZ
            Tc99    7.0539E-03 [Ci/yr/SA] at  7.798E+04 yr
            Pu239   1.2024E-04 [Ci/yr/SA] at  1.000E+05 yr
            Np237   1.1271E-04 [Ci/yr/SA] at  1.000E+05 yr
            I129    1.1193E-04 [Ci/yr/SA] at  7.798E+04 yr
            Se79    6.2832E-05 [Ci/yr/SA] at  7.798E+04 yr
```

```
            Cl36    6.1661E-05 [Ci/yr/SA] at  7.798E+04 yr
-----------------------------------------------------------------------
     subarea  10 of  10           realization    1 of    1
-----------------------------------------------------------------------
 exec: calling uzflow
 exec: calling nfenv
 exec: calling ebsfail
      ebsfail: time of WP failure =    60928.4  yr
 exec: failed WPs from INITIAL   event =      1 at time =      0.0 yr
 exec: failed WPs from CORROSION event =    852 at time =  60928.4 yr
  *** failed WPs: all WPs failed (  853) ***
 exec: calling ebsrel
                 Highest release rates from Sub Area  10
            Tc99    2.5384E-03 [Ci/yr/SA] at  7.798E+04 yr
            Pu239   9.8815E-04 [Ci/yr/SA] at  7.798E+04 yr
            Cs135   5.8831E-04 [Ci/yr/SA] at  7.798E+04 yr
            Ni59    4.5578E-05 [Ci/yr/SA] at  7.798E+04 yr
            Np237   4.0137E-05 [Ci/yr/SA] at  1.000E+05 yr
            I129    3.9811E-05 [Ci/yr/SA] at  7.798E+04 yr
 exec: calling uzft
       *** NEFTRAN is skipped for this UZ path since no layers have significant ground water travel time. ***
                    Highest release rates from UZ
            Tc99    2.5384E-03 [Ci/yr/SA] at  7.798E+04 yr
            Pu239   9.8815E-04 [Ci/yr/SA] at  7.798E+04 yr
            Cs135   5.8831E-04 [Ci/yr/SA] at  7.798E+04 yr
            Ni59    4.5578E-05 [Ci/yr/SA] at  7.798E+04 yr
            Np237   4.0137E-05 [Ci/yr/SA] at  1.000E+05 yr
            I129    3.9811E-05 [Ci/yr/SA] at  7.798E+04 yr
 exec: calling szft
                    Highest release rates from SZ
            Tc99    2.4959E-03 [Ci/yr/SA] at  7.798E+04 yr
            Pu239   1.0452E-04 [Ci/yr/SA] at  1.000E+05 yr
            Np237   4.0081E-05 [Ci/yr/SA] at  1.000E+05 yr
            I129    3.9176E-05 [Ci/yr/SA] at  7.798E+04 yr
            Se79    2.2147E-05 [Ci/yr/SA] at  7.798E+04 yr
            Cl36    2.1604E-05 [Ci/yr/SA] at  7.798E+04 yr
 exec: calling dcagw
  total tube width [m] =     5500.0000000000
Computing time differences using the 2 digit year from subroutine date is not safe after year 2000.
Computing time differences using the 2 digit year from subroutine date is not safe after year 2000.
Computing time differences using the 2 digit year from subroutine date is not safe after year 2000.
Computing time differences using the 2 digit year from subroutine date is not safe after year 2000.
                    Highest annual dose GW pathway
            Np237   4.0074E+00 [mrem/yr]  at  1.000E+05 yr
            Pu239   1.5517E+00 [mrem/yr]  at  1.000E+05 yr
            I129    2.5042E-01 [mrem/yr]  at  7.798E+04 yr
            Tc99    8.3404E-02 [mrem/yr]  at  7.798E+04 yr
            Pb210   6.1527E-02 [mrem/yr]  at  1.000E+05 yr
            Ra226   1.4860E-02 [mrem/yr]  at  1.000E+05 yr
          At end of TPI, annual dose GW pathway
            Np237   4.0074E+00 [mrem/yr]
            Pu239   1.5517E+00 [mrem/yr]
            Pb210   6.1527E-02 [mrem/yr]
            I129    1.5716E-02 [mrem/yr]
            Tc99    1.4997E-02 [mrem/yr]
            Ra226   1.4860E-02 [mrem/yr]
               sum  5.6790E+00 [mrem/yr]
 exec: end realizations

 exec: Peak Mean Dose is 5.67900E-03 rem/yr at 100000.0 yr.

 exec:  Run Successfully Completed
```

No Fix 20 Km Tube Out.wpd

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without Fix

```
=====================================================================
          exec: Welcome to TPA Version 4.1e
       Job started: Wed Jan 31 16:16:03 2001
=====================================================================
 REPOSITORY DESIGN INFORMATION
 Subarea   Area      Waste   Number of WP
    #     [m^2]      [MTU]
    1    723591.3    11058.1        1133
    2    784763.0    11546.1        1183
    3    390372.0     5563.2         570
    4    207581.3     3445.3         353
    5    378972.8     5553.4         569
    6    424872.5     6236.6         639
    7    163938.3     2381.4         244
    8    393468.9     6588.0         675
    9    660785.5     9311.0         954
   10    589497.1     8325.3         853

 Total Area [acre]          =     1165.7629779961
 Total Buried Waste [MTU]   =     70008.480000000
 Repository AML [MTU/acre]  =     60.053785650616

 Specified Global Parameters:

                Compliance Period =  10000.0 (yr)
          Maximum Simulation Time = 100000.0 (yr)
           Number Of Realizations =      1
               Number Of Subareas =     10
               Volcanism scenario =      0 (yes=1, no=0)
                Faulting scenario =      0 (yes=1, no=0)
                 Seismic scenario =      1 (yes=1, no=0)
       Distance to Receptor Group =     20.0 (km)


 **>>> CAUTION: CHECKING OF NUCLIDES AND CHAINS IS DISABLED <<<**
 **>>> You may not be using the standard chains specified   <<<**
 **>>> in the invent module.                                <<<**
 **>>> (see "CheckNuclidesAndChains(yes=1,no=0)" in tpa.inp)<<<**

 The specified path for data  = $TPA_DATA/
 The specified path for codes = $TPA_TEST/

 **To modify global parameters or the path, stop code execution using control-C**
 Note: IEEE floating-point exception traps enabled:
    overflow;  division by zero;  invalid operation;
 See the Numerical Computation Guide, ieee_handler(3M)
-----------------------------------------------------------------------
     subarea   1 of  10           realization    1 of    1
-----------------------------------------------------------------------
 exec: calling uzflow
 exec: calling nfenv
 exec: calling ebsfail
      ebsfail: time of WP failure =    60928.4  yr
 exec: calling seismo
 exec: failed WPs from INITIAL   event =      2 at time =      0.0 yr
 exec: failed WPs from CORROSION event =   1131 at time =  60928.4 yr
  *** failed WPs: all WPs failed (  1133) ***
 exec: calling ebsrel
                 Highest release rates from Sub Area  1
              Tc99    1.7174E-02 [Ci/yr/SA] at  7.798E+04 yr
              Cs135   4.0632E-03 [Ci/yr/SA] at  7.798E+04 yr
              Pu239   1.6162E-03 [Ci/yr/SA] at  7.798E+04 yr
              Ni59    2.7706E-04 [Ci/yr/SA] at  7.798E+04 yr
              I129    2.7511E-04 [Ci/yr/SA] at  7.798E+04 yr
              Np237   2.6937E-04 [Ci/yr/SA] at  1.000E+05 yr
 exec: calling uzft
                      Highest release rates from UZ
              Tc99    1.6904E-02 [Ci/yr/SA] at  7.798E+04 yr
              I129    2.7100E-04 [Ci/yr/SA] at  7.798E+04 yr
              Np237   2.6723E-04 [Ci/yr/SA] at  1.000E+05 yr
              Se79    1.8559E-04 [Ci/yr/SA] at  7.798E+04 yr
```

```
            Cl36    1.4904E-04 [Ci/yr/SA] at  7.798E+04 yr
            Nb94    1.6053E-05 [Ci/yr/SA] at  7.798E+04 yr
 exec: calling szft
 Note: IEEE floating-point exception flags raised:
    Inexact;  Underflow;
 See the Numerical Computation Guide, ieee_flags(3M)
                     Highest release rates from SZ
            Tc99    1.6222E-02 [Ci/yr/SA] at  7.798E+04 yr
            I129    2.6061E-04 [Ci/yr/SA] at  7.798E+04 yr
            Cl36    1.4312E-04 [Ci/yr/SA] at  7.798E+04 yr
            U234    3.0292E-06 [Ci/yr/SA] at  1.000E+05 yr
            Np237   2.8293E-06 [Ci/yr/SA] at  6.093E+04 yr
            U238    9.0880E-07 [Ci/yr/SA] at  1.000E+05 yr
-----------------------------------------------------------------------
     subarea   2 of  10          realization    1 of    1
-----------------------------------------------------------------------
 exec: calling uzflow
 exec: calling nfenv
 exec: calling ebsfail
      ebsfail: time of WP failure =    60928.4  yr
 exec: failed WPs from INITIAL   event =      2 at time =      0.0 yr
 exec: failed WPs from CORROSION event =   1181 at time =  60928.4 yr
  *** failed WPs: all WPs failed (  1183) ***
  *** ejected WPs:   0
 exec: calling ebsrel
                 Highest release rates from Sub Area  2
            Tc99    1.1571E-03 [Ci/yr/SA] at  7.798E+04 yr
            Pu239   8.4316E-04 [Ci/yr/SA] at  7.798E+04 yr
            Cs135   2.6513E-04 [Ci/yr/SA] at  7.798E+04 yr
            Am243   3.7100E-05 [Ci/yr/SA] at  1.505E+04 yr
            Ni59    2.2193E-05 [Ci/yr/SA] at  7.798E+04 yr
            Cl4     2.1744E-05 [Ci/yr/SA] at  1.505E+04 yr
 exec: calling uzft
       *** NEFTRAN is skipped for this UZ path since no layers have significant ground water travel time. ***
                     Highest release rates from UZ
            Tc99    1.1571E-03 [Ci/yr/SA] at  7.798E+04 yr
            Pu239   8.4316E-04 [Ci/yr/SA] at  7.798E+04 yr
            Cs135   2.6513E-04 [Ci/yr/SA] at  7.798E+04 yr
            Am243   3.7100E-05 [Ci/yr/SA] at  1.505E+04 yr
            Ni59    2.2193E-05 [Ci/yr/SA] at  7.798E+04 yr
            Np237   1.9285E-05 [Ci/yr/SA] at  7.798E+04 yr
 exec: calling szft
 Note: IEEE floating-point exception flags raised:
    Inexact;  Underflow;
 See the Numerical Computation Guide, ieee_flags(3M)
                     Highest release rates from SZ
            Tc99    1.1116E-03 [Ci/yr/SA] at  7.798E+04 yr
            I129    1.7268E-05 [Ci/yr/SA] at  7.798E+04 yr
            Cl36    9.5116E-06 [Ci/yr/SA] at  7.798E+04 yr
            Ni59    3.2545E-06 [Ci/yr/SA] at  1.000E+05 yr
            Np237   2.7980E-06 [Ci/yr/SA] at  6.093E+04 yr
            U234    2.6138E-06 [Ci/yr/SA] at  1.000E+05 yr
-----------------------------------------------------------------------
     subarea   3 of  10          realization    1 of    1
-----------------------------------------------------------------------
 exec: calling uzflow
 exec: calling nfenv
 exec: calling ebsfail
      ebsfail: time of WP failure =    60928.4  yr
 exec: failed WPs from INITIAL   event =      1 at time =      0.0 yr
 exec: failed WPs from CORROSION event =    569 at time =  60928.4 yr
  *** failed WPs: all WPs failed (  570) ***
 exec: calling ebsrel
                 Highest release rates from Sub Area  3
            Tc99    1.6142E-03 [Ci/yr/SA] at  7.798E+04 yr
            Pu239   8.1999E-04 [Ci/yr/SA] at  7.798E+04 yr
            Cs135   3.7275E-04 [Ci/yr/SA] at  7.798E+04 yr
            Ni59    2.9609E-05 [Ci/yr/SA] at  7.798E+04 yr
            Np237   2.5738E-05 [Ci/yr/SA] at  7.798E+04 yr
            I129    2.5224E-05 [Ci/yr/SA] at  7.798E+04 yr
 exec: calling uzft
```

```
                    Highest release rates from UZ
            Tc99    1.5831E-03 [Ci/yr/SA] at  7.798E+04 yr
            Np237   2.5667E-05 [Ci/yr/SA] at  1.000E+05 yr
            I129    2.4762E-05 [Ci/yr/SA] at  7.798E+04 yr
            Se79    1.6711E-05 [Ci/yr/SA] at  7.798E+04 yr
            Cl36    1.3653E-05 [Ci/yr/SA] at  7.798E+04 yr
            U234    2.0203E-06 [Ci/yr/SA] at  7.798E+04 yr
 exec: calling szft
 Note: IEEE floating-point exception flags raised:
    Inexact;  Underflow;
 See the Numerical Computation Guide, ieee_flags(3M)
                    Highest release rates from SZ
            Tc99    1.5194E-03 [Ci/yr/SA] at  7.798E+04 yr
            I129    2.3816E-05 [Ci/yr/SA] at  7.798E+04 yr
            Cl36    1.3112E-05 [Ci/yr/SA] at  7.798E+04 yr
            U234    1.4891E-06 [Ci/yr/SA] at  1.000E+05 yr
            U238    4.4369E-07 [Ci/yr/SA] at  1.000E+05 yr
            Th230   1.0252E-07 [Ci/yr/SA] at  1.000E+05 yr
-----------------------------------------------------------------------
     subarea   4 of  10          realization    1 of    1
-----------------------------------------------------------------------
 exec: calling uzflow
 exec: calling nfenv
 exec: calling ebsfail
      ebsfail: time of WP failure =    60928.4  yr
 exec: failed WPs from INITIAL   event =      1 at time =      0.0 yr
 exec: failed WPs from CORROSION event =    352 at time =  60928.4 yr
  *** failed WPs: all WPs failed (  353) ***
 exec: calling ebsrel
                Highest release rates from Sub Area  4
            Tc99    1.2188E-03 [Ci/yr/SA] at  7.798E+04 yr
            Pu239   3.5007E-04 [Ci/yr/SA] at  7.798E+04 yr
            Cs135   2.8317E-04 [Ci/yr/SA] at  7.798E+04 yr
            Ni59    2.1620E-05 [Ci/yr/SA] at  7.798E+04 yr
            Np237   1.9321E-05 [Ci/yr/SA] at  1.000E+05 yr
            I129    1.9163E-05 [Ci/yr/SA] at  7.798E+04 yr
 exec: calling uzft
                    Highest release rates from UZ
            Tc99    1.1922E-03 [Ci/yr/SA] at  7.798E+04 yr
            Np237   1.9257E-05 [Ci/yr/SA] at  1.000E+05 yr
            I129    1.8766E-05 [Ci/yr/SA] at  7.798E+04 yr
            Se79    1.2521E-05 [Ci/yr/SA] at  7.798E+04 yr
            Cl36    1.0344E-05 [Ci/yr/SA] at  7.798E+04 yr
            Nb94    1.2521E-06 [Ci/yr/SA] at  7.798E+04 yr
 exec: calling szft
 Note: IEEE floating-point exception flags raised:
    Inexact;  Underflow;
 See the Numerical Computation Guide, ieee_flags(3M)
                    Highest release rates from SZ
            Tc99    1.1452E-03 [Ci/yr/SA] at  7.798E+04 yr
            I129    1.8062E-05 [Ci/yr/SA] at  7.798E+04 yr
            Cl36    9.9416E-06 [Ci/yr/SA] at  7.798E+04 yr
            U234    6.2742E-07 [Ci/yr/SA] at  1.000E+05 yr
            U238    1.8606E-07 [Ci/yr/SA] at  1.000E+05 yr
            Np237   1.1533E-07 [Ci/yr/SA] at  6.093E+04 yr
-----------------------------------------------------------------------
     subarea   5 of  10          realization    1 of    1
-----------------------------------------------------------------------
 exec: calling uzflow
 exec: calling nfenv
 exec: calling ebsfail
      ebsfail: time of WP failure =    60928.4  yr
 exec: failed WPs from INITIAL   event =      1 at time =      0.0 yr
 exec: failed WPs from CORROSION event =    568 at time =  60928.4 yr
  *** failed WPs: all WPs failed (  569) ***
 exec: calling ebsrel
                Highest release rates from Sub Area  5
            Tc99    3.9216E-03 [Ci/yr/SA] at  7.798E+04 yr
            Cs135   9.1776E-04 [Ci/yr/SA] at  7.798E+04 yr
            Pu239   7.4487E-04 [Ci/yr/SA] at  7.798E+04 yr
            Ni59    6.6702E-05 [Ci/yr/SA] at  7.798E+04 yr
```

```
            I129    6.2116E-05 [Ci/yr/SA] at  7.798E+04 yr
            Np237   6.1502E-05 [Ci/yr/SA] at  1.000E+05 yr
exec: calling uzft
                    Highest release rates from UZ
            Tc99    3.7974E-03 [Ci/yr/SA] at  7.798E+04 yr
            Np237   6.0949E-05 [Ci/yr/SA] at  1.000E+05 yr
            I129    6.0244E-05 [Ci/yr/SA] at  7.798E+04 yr
            Se79    3.8347E-05 [Ci/yr/SA] at  7.798E+04 yr
            Cl36    3.3185E-05 [Ci/yr/SA] at  7.798E+04 yr
            Nb94    3.7982E-06 [Ci/yr/SA] at  7.798E+04 yr
exec: calling szft
Note: IEEE floating-point exception flags raised:
   Inexact;  Underflow;
See the Numerical Computation Guide, ieee_flags(3M)
                    Highest release rates from SZ
            Tc99    3.6470E-03 [Ci/yr/SA] at  7.798E+04 yr
            I129    5.7977E-05 [Ci/yr/SA] at  7.798E+04 yr
            Cl36    3.1890E-05 [Ci/yr/SA] at  7.798E+04 yr
            U234    1.3612E-06 [Ci/yr/SA] at  1.000E+05 yr
            Np237   9.3291E-07 [Ci/yr/SA] at  7.798E+04 yr
            U238    4.0874E-07 [Ci/yr/SA] at  1.000E+05 yr
-----------------------------------------------------------------------
    subarea   6 of  10          realization    1 of    1
-----------------------------------------------------------------------
exec: calling uzflow
exec: calling nfenv
exec: calling ebsfail
     ebsfail: time of WP failure =    60928.4  yr
exec: failed WPs from INITIAL   event =      1 at time =      0.0 yr
exec: failed WPs from CORROSION event =    638 at time =  60928.4 yr
 *** failed WPs: all WPs failed (  639) ***
exec: calling ebsrel
                Highest release rates from Sub Area  6
            Tc99    8.4773E-03 [Ci/yr/SA] at  7.798E+04 yr
            Cs135   2.0232E-03 [Ci/yr/SA] at  7.798E+04 yr
            Pu239   6.2272E-04 [Ci/yr/SA] at  7.798E+04 yr
            I129    1.3701E-04 [Ci/yr/SA] at  7.798E+04 yr
            Ni59    1.2977E-04 [Ci/yr/SA] at  7.798E+04 yr
            Np237   1.2966E-04 [Ci/yr/SA] at  1.000E+05 yr
exec: calling uzft
                    Highest release rates from UZ
            Tc99    8.0919E-03 [Ci/yr/SA] at  7.798E+04 yr
            I129    1.3109E-04 [Ci/yr/SA] at  7.798E+04 yr
            Np237   1.2611E-04 [Ci/yr/SA] at  1.000E+05 yr
            Se79    7.6036E-05 [Ci/yr/SA] at  7.798E+04 yr
            Cl36    7.1953E-05 [Ci/yr/SA] at  7.798E+04 yr
            Nb94    7.1638E-06 [Ci/yr/SA] at  7.798E+04 yr
exec: calling szft
Note: IEEE floating-point exception flags raised:
   Inexact;  Underflow;
See the Numerical Computation Guide, ieee_flags(3M)
                    Highest release rates from SZ
            Tc99    7.7726E-03 [Ci/yr/SA] at  7.798E+04 yr
            I129    1.2617E-04 [Ci/yr/SA] at  7.798E+04 yr
            Cl36    6.9156E-05 [Ci/yr/SA] at  7.798E+04 yr
            U234    1.1184E-06 [Ci/yr/SA] at  1.000E+05 yr
            Np237   4.1909E-07 [Ci/yr/SA] at  7.798E+04 yr
            U238    3.3968E-07 [Ci/yr/SA] at  1.000E+05 yr
-----------------------------------------------------------------------
    subarea   7 of  10          realization    1 of    1
-----------------------------------------------------------------------
exec: calling uzflow
exec: calling nfenv
exec: calling ebsfail
     ebsfail: time of WP failure =    60928.4  yr
exec: failed WPs from CORROSION event =    244 at time =  60928.4 yr
 *** failed WPs: all WPs failed (  244) ***
exec: calling ebsrel
                Highest release rates from Sub Area  7
            Tc99    3.6523E-03 [Ci/yr/SA] at  7.798E+04 yr
            Cs135   8.7821E-04 [Ci/yr/SA] at  7.798E+04 yr
```

```
            Pu239    2.2305E-04 [Ci/yr/SA] at  7.798E+04 yr
            I129     5.9480E-05 [Ci/yr/SA] at  7.798E+04 yr
            Np237    5.4616E-05 [Ci/yr/SA] at  1.000E+05 yr
            Ni59     5.3349E-05 [Ci/yr/SA] at  7.798E+04 yr
 exec: calling uzft
                     Highest release rates from UZ
            Tc99     3.4588E-03 [Ci/yr/SA] at  7.798E+04 yr
            I129     5.6479E-05 [Ci/yr/SA] at  7.798E+04 yr
            Np237    5.2517E-05 [Ci/yr/SA] at  1.000E+05 yr
            Cl36     3.0970E-05 [Ci/yr/SA] at  7.798E+04 yr
            Se79     3.0184E-05 [Ci/yr/SA] at  7.798E+04 yr
            Nb94     2.9005E-06 [Ci/yr/SA] at  7.798E+04 yr
 exec: calling szft
 Note: IEEE floating-point exception flags raised:
    Inexact;  Underflow;
 See the Numerical Computation Guide, ieee_flags(3M)
                     Highest release rates from SZ
            Tc99     3.3227E-03 [Ci/yr/SA] at  7.798E+04 yr
            I129     5.4368E-05 [Ci/yr/SA] at  7.798E+04 yr
            Cl36     2.9770E-05 [Ci/yr/SA] at  7.798E+04 yr
            U234     4.0151E-07 [Ci/yr/SA] at  1.000E+05 yr
            U238     1.2119E-07 [Ci/yr/SA] at  1.000E+05 yr
            Th230    3.1843E-08 [Ci/yr/SA] at  1.000E+05 yr
-----------------------------------------------------------------------
     subarea   8 of  10          realization    1 of    1
-----------------------------------------------------------------------
 exec: calling uzflow
 exec: calling nfenv
 exec: calling ebsfail
      ebsfail: time of WP failure =    60928.4  yr
 exec: failed WPs from INITIAL   event =      1 at time =      0.0 yr
 exec: failed WPs from CORROSION event =    674 at time =  60928.4 yr
  *** failed WPs: all WPs failed (  675) ***
 exec: calling ebsrel
                 Highest release rates from Sub Area  8
            Tc99     5.5818E-03 [Ci/yr/SA] at  7.798E+04 yr
            Cs135    1.3049E-03 [Ci/yr/SA] at  7.798E+04 yr
            Pu239    8.8555E-04 [Ci/yr/SA] at  7.798E+04 yr
            Ni59     9.6166E-05 [Ci/yr/SA] at  7.798E+04 yr
            Np237    8.9042E-05 [Ci/yr/SA] at  1.000E+05 yr
            I129     8.8322E-05 [Ci/yr/SA] at  7.798E+04 yr
 exec: calling uzft
       *** NEFTRAN is skipped for this UZ path since no layers have significant ground water travel time. ***
                     Highest release rates from UZ
            Tc99     5.5818E-03 [Ci/yr/SA] at  7.798E+04 yr
            Cs135    1.3049E-03 [Ci/yr/SA] at  7.798E+04 yr
            Pu239    8.8555E-04 [Ci/yr/SA] at  7.798E+04 yr
            Ni59     9.6166E-05 [Ci/yr/SA] at  7.798E+04 yr
            Np237    8.9042E-05 [Ci/yr/SA] at  1.000E+05 yr
            I129     8.8322E-05 [Ci/yr/SA] at  7.798E+04 yr
 exec: calling szft
 Note: IEEE floating-point exception flags raised:
    Inexact;  Underflow;
 See the Numerical Computation Guide, ieee_flags(3M)
                     Highest release rates from SZ
            Tc99     5.3598E-03 [Ci/yr/SA] at  7.798E+04 yr
            I129     8.4984E-05 [Ci/yr/SA] at  7.798E+04 yr
            Cl36     4.6760E-05 [Ci/yr/SA] at  7.798E+04 yr
            Ni59     1.3281E-05 [Ci/yr/SA] at  1.000E+05 yr
            U234     1.6618E-06 [Ci/yr/SA] at  1.000E+05 yr
            Np237    1.6232E-06 [Ci/yr/SA] at  6.093E+04 yr
-----------------------------------------------------------------------
     subarea   9 of  10          realization    1 of    1
-----------------------------------------------------------------------
 exec: calling uzflow
 exec: calling nfenv
 exec: calling ebsfail
      ebsfail: time of WP failure =    60928.4  yr
 exec: failed WPs from INITIAL   event =      2 at time =      0.0 yr
 exec: failed WPs from CORROSION event =    952 at time =  60928.4 yr
  *** failed WPs: all WPs failed (  954) ***
```

```
 exec: calling ebsrel
                 Highest release rates from Sub Area  9
             Tc99    7.1764E-03 [Ci/yr/SA] at  7.798E+04 yr
             Cs135   1.6812E-03 [Ci/yr/SA] at  7.798E+04 yr
             Pu239   1.1440E-03 [Ci/yr/SA] at  7.798E+04 yr
             Ni59    1.2180E-04 [Ci/yr/SA] at  7.798E+04 yr
             I129    1.1379E-04 [Ci/yr/SA] at  7.798E+04 yr
             Np237   1.1333E-04 [Ci/yr/SA] at  1.000E+05 yr
 exec: calling uzft
       *** NEFTRAN is skipped for this UZ path since no layers have significant ground water travel time. ***
                     Highest release rates from UZ
             Tc99    7.1764E-03 [Ci/yr/SA] at  7.798E+04 yr
             Cs135   1.6812E-03 [Ci/yr/SA] at  7.798E+04 yr
             Pu239   1.1440E-03 [Ci/yr/SA] at  7.798E+04 yr
             Ni59    1.2180E-04 [Ci/yr/SA] at  7.798E+04 yr
             I129    1.1379E-04 [Ci/yr/SA] at  7.798E+04 yr
             Np237   1.1333E-04 [Ci/yr/SA] at  1.000E+05 yr
 exec: calling szft
 Note: IEEE floating-point exception flags raised:
    Inexact;  Underflow;
 See the Numerical Computation Guide, ieee_flags(3M)
                     Highest release rates from SZ
             Tc99    6.8022E-03 [Ci/yr/SA] at  7.798E+04 yr
             I129    1.0814E-04 [Ci/yr/SA] at  7.798E+04 yr
             Cl36    5.9492E-05 [Ci/yr/SA] at  7.798E+04 yr
             Ni59    1.7432E-05 [Ci/yr/SA] at  1.000E+05 yr
             U234    2.4169E-06 [Ci/yr/SA] at  1.000E+05 yr
             Np237   1.5576E-06 [Ci/yr/SA] at  1.000E+05 yr
-----------------------------------------------------------------------
     subarea  10 of  10           realization    1 of    1
-----------------------------------------------------------------------
 exec: calling uzflow
 exec: calling nfenv
 exec: calling ebsfail
      ebsfail: time of WP failure =    60928.4  yr
 exec: failed WPs from INITIAL   event =      1 at time =      0.0 yr
 exec: failed WPs from CORROSION event =    852 at time =  60928.4 yr
  *** failed WPs: all WPs failed (  853) ***
 exec: calling ebsrel
                 Highest release rates from Sub Area  10
             Tc99    2.5384E-03 [Ci/yr/SA] at  7.798E+04 yr
             Pu239   9.8815E-04 [Ci/yr/SA] at  7.798E+04 yr
             Cs135   5.8831E-04 [Ci/yr/SA] at  7.798E+04 yr
             Ni59    4.5578E-05 [Ci/yr/SA] at  7.798E+04 yr
             Np237   4.0137E-05 [Ci/yr/SA] at  1.000E+05 yr
             I129    3.9811E-05 [Ci/yr/SA] at  7.798E+04 yr
 exec: calling uzft
       *** NEFTRAN is skipped for this UZ path since no layers have significant ground water travel time. ***
                     Highest release rates from UZ
             Tc99    2.5384E-03 [Ci/yr/SA] at  7.798E+04 yr
             Pu239   9.8815E-04 [Ci/yr/SA] at  7.798E+04 yr
             Cs135   5.8831E-04 [Ci/yr/SA] at  7.798E+04 yr
             Ni59    4.5578E-05 [Ci/yr/SA] at  7.798E+04 yr
             Np237   4.0137E-05 [Ci/yr/SA] at  1.000E+05 yr
             I129    3.9811E-05 [Ci/yr/SA] at  7.798E+04 yr
 exec: calling szft
 Note: IEEE floating-point exception flags raised:
    Inexact;  Underflow;
 See the Numerical Computation Guide, ieee_flags(3M)
                     Highest release rates from SZ
             Tc99    2.4074E-03 [Ci/yr/SA] at  7.798E+04 yr
             I129    3.7858E-05 [Ci/yr/SA] at  7.798E+04 yr
             Cl36    2.0849E-05 [Ci/yr/SA] at  7.798E+04 yr
             Ni59    6.5268E-06 [Ci/yr/SA] at  1.000E+05 yr
             U234    2.0692E-06 [Ci/yr/SA] at  1.000E+05 yr
             U238    6.2243E-07 [Ci/yr/SA] at  1.000E+05 yr
 exec: calling dcagw
  total tube width [m] =     5500.0000000000
Computing time differences using the 2 digit year from subroutine date is not safe after year 2000.
Computing time differences using the 2 digit year from subroutine date is not safe after year 2000.
Computing time differences using the 2 digit year from subroutine date is not safe after year 2000.
```

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```
Computing time differences using the 2 digit year from subroutine date is not safe after year 2000.
                    Highest annual dose GW pathway
            I129    1.6834E-02 [mrem/yr]  at  7.798E+04 yr
            Tc99    5.8850E-03 [mrem/yr]  at  7.798E+04 yr
            Np237   2.8102E-03 [mrem/yr]  at  6.093E+04 yr
            U234    3.9202E-04 [mrem/yr]  at  1.000E+05 yr
            Cl36    1.2377E-04 [mrem/yr]  at  7.798E+04 yr
            U238    1.0969E-04 [mrem/yr]  at  1.000E+05 yr
          At end of TPI, annual dose GW pathway
            I129    1.3727E-03 [mrem/yr]
            Tc99    1.1734E-03 [mrem/yr]
            Np237   1.1261E-03 [mrem/yr]
            U234    3.9202E-04 [mrem/yr]
            U238    1.0969E-04 [mrem/yr]
            Th230   7.6750E-05 [mrem/yr]
               sum  4.2668E-03 [mrem/yr]
exec: end realizations

exec: Peak Mean Dose is 2.41080E-05 rem/yr at  77979.0 yr.

exec:  Run Successfully Completed
```

strmtube.dat

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```
TITLE: TPA4 Stream Tube data for the saturated zone.
TITLE: (data from J. Winterle 1/10/00)
TITLE: (based on flow net analysis using water table contours)
TITLE: (reduced number of streamtubes to 3)
**
  3      Number of stream tubes.
**
** Flow Rates (m^3/yr/m)
**
  3
600.
730.
470.
**
** Distance to Receptor Well
** ( set 2 values: near field and far field distance in [m]
**   and match this distance with the value specified for
**   "DistanceToReceptorGroup..." in tpa.inp and with the
**   well pumping and mixing zone data for DCAGW in tpa.inp )
**
10.0, 20.0
**
** NEAR FIELD (from the repository to the 10 km boundary)
**
** STFF is the TUFF unit "Projected" in 1-D. That is, for any segment
** all of the tuff center line segments are combined into a single
** segment. The direction of this segment coincides with the direction
** from the first (westmost) point in the repository footprint
** to the first point outside (eastmost) in the repository footprint.
** For the near field, the first line with data for each streamtube
** represents the westmost point and the second line with data represents
** what was formerly the STFF/STAC boundary. Additionally, the second data
** point in the coordinate data below is not a point that lies on the
** streamtube centerline, but is a phantom point on the line
** containing the segment with endpoints on opposite sides
** of the repository.  This is required to preserve the algorithm
** that determines the mixing zone length from the nearest center
** line segment and determines the streamtube closest to the
** subarea.  The width is the weighted average width of the
** original stream tube segments.  The STAC (tuff/alluvium composite
** layer) was removed and replaced with STFF (tuff layer).
**
** The two layers in the saturated zone are STFF (saturated tuff)
** and SAV (saturated Amargosa Valley [alluvium])
**
** (NOTE: The name for the alluvium unit must be 'SAV'
**       for szft.f to recognize that there is no matrix
**       diffusion in that layer.)
**
**      (note: Streamtube lengths for 13 km modifications
**             are within 1% of the previous lengths; the
**             new lengths are based on refined streamtube
**             information.  rwr 2/27/98)
**
**      (note: because of the short travel times, the 13 km
**             lengths are assumed to reasonably represent
**             the transport to the 10 km RG.  rwr 7/9/98)
```

```
**
** Stream Tube Center Line Coordinates starting at intersection
** with west edge of repository.
1
  3       Number of stream tube points for tube 1.
UTM-x[m]   UTM-y[m]
547590.,  4076500.
547900.,  4076300.
548150.,  4076000.
**
2
  3       Number of stream tube points for tube 2.
UTM-x[m]   UTM-y[m]
547500.,  4078940.
547950.,  4078570.
548540.,  4078520.
**
3
  3       Number of stream tube points for tube 3.
UTM-x[m]   UTM-y[m]
547700.,  4081000.
548145.,  4080630.
548632.,  4080300.
**
**
**  FAR FIELD
**
** Tuff/ALLUVIUM INTERFACE DISTANCE (I/F_Dist) IS FROM EASTERN EDGE OF
REPOSITORY
  20      Number of points for tube 1.
I/F_Dist   width[m]  tube_length[m]
0.0   900., 0.
2.0   2000.,      2100.
3.0   2350.,      3100.
4.0   2250.,      4100.
5.0   1650.,      5140.
6.0   1650.,      6150.
7.0   1550.,      7160.
8.0   1050.,      8200.
9.0   800., 9300.
10.0  [redacted], 10440.
11.0  550., 11560.
12.0  500., 12690.
13.0  430., 13820.
14.0  430., 15000.
15.0  430., 16100.
16.0  430., 17240.
17.0  430., 18340.
18.0  430., 19430.
19.0  430., 20500.
20.0  430., 21563.
**
** Tuff/ALLUVIUM INTERFACE DISTANCE (I/F_Dist) IS FROM EASTERN EDGE OF
REPOSITORY
  20      Number of points for tube 2.
I/F_Dist   width[m]  tube_length[m]
0.0   3600.,      0.
```

```
2.0   3370.,      2567.
3.0   3350.,      3573.
4.0   3320.,      4795.
5.0   2980.,      5952.
6.0   3600.,      7260.
7.0   2780.,      9062.
8.0   1620.,      10865.
9.0   850., 12458.
10.0  650., 13880.
11.0  520., 15240.
12.0  390., 16430.
13.0  390., 17640.
14.0  390., 18830.
15.0  390., 19980.
16.0  390., 21110.
17.0  390., 22190.
18.0  390., 23320.
19.0  390., 24410.
20.0  390., 25490.
**
** Tuff/ALLUVIUM INTERFACE DISTANCE (I/F_Dist) IS FROM EASTERN EDGE OF
REPOSITORY
  20      Number of points for tube 3.
I/F_Dist   width[m]  tube_length[m]
0.0   1000.,      0.
2.0   1600.,      2045.
3.0   2070.,      3040.
4.0   1920.,      4135.
5.0   1830.,      5410.
6.0   1590.,      7030.
7.0   790., 10430.
8.0   720., 13100.
9.0   620., 15150.
10.0  540., 16760.
11.0  475., 18230.
12.0  430., 19550.
13.0  410., 20750.
14.0  410., 22010.
15.0  410., 23200.
16.0  410., 24350.
17.0  410., 25460.
18.0  410., 26560.
19.0  410., 27710.
20.0  410., 28800.
**
endoffile
```

Distance	Total Stream tube width (m)
10 km	700 + 650 + 540 = 1890
20 km	430 + 370 + 410 = 1230

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SOFTWARE CHANGE REPORT (SCR)

SCR No. (*Software Developer Assigns*): PA-SCR-329	**Software Title and Version:** TPA 4.1	**/Project No:** 20-1402-762

Affected Software Module(s), Description of Problem(s):

tpa.inp, drythick.dat, nuclides.dat

The reflux parameters in tpa.inp do not reflect the EDA-II design. The values in drythick.dat need to be updated. The inventory for SE79 needs to be updated with the latest value. The occupancy factor for volcanism dose needs to be updated. The layer thickness for Chnv for subarea 9 needs to be set to zero to avoid NEFTRAN array overruns.

Change Requested by:	**Change Authorized by** (*Software Developer*):
S. Mohanty, J. Weldy, P. LaPlante, R. Fedors Date:10-17-00	R. Janetzke Date: 10-18-00 R Janetzke

Description of Change(s) or Problem Resolution (*If changes not implemented, please justify*):

New values were obtained from Appendix A, D. Hughson, J. Weldy, P. LaPlante, and R. Fedors.

Implemented by:	**Date:**
R. Janetzke R. Janetzke	10-18-00

Description of Acceptance Tests:

See attached hard copy and floppy diskette.

Tested by:	**Date:**
R. Benke Roland R. Benke	01/30/01 01/30/2001

CNWRA Form TOP-5 (01/99)

Acceptance Testing of Software Change Report No. PA-SCR-329

Tester:	R. Benke
Date:	January 30, 2001
Software, Version:	TPA 4.1
Affected Modules:	*tpa.inp*, *drythick.dat*, *nuclides.dat*

Documentation Attached
The files were obtained from */solapps/cnwra/A_tpa4.1e* and saved in */tpa41e* on the attached diskette. Attachment A lists the suggested changes and values.

Change 1
The reflux parameters in *tpa.inp* do not reflect the EDA-II design.

Test 1 => PASSED
The test verified the parameter distributions in *tpa.inp* (pasted below) matched the suggested values from attachment A.

```
uniform
FractionOfCondensateRemoved[1/yr]
0.0, 0.25
**
uniform
FractionOfCondensateTowardRepository[1/yr]
0.05, 1.0
**
constant
FractionOfCondensateTowardRepositoryRemoved[1/yr]
0.0
```

Change 2
The values in *drythick.dat* need to updated.

Test 2 => PASSED
The test verified the line added into *drythick.dat* (pasted below) matched the suggested values from attachment A.

```
 18 1000.0     0.0
```

Change 3
The inventory for SE79 need to be updated with the latest value.

Test 3 => PASSED
The test verified the value added into *nuclides.dat* (pasted below) matched the suggested value from attachment A.

```
NIS,    NIS2,    NIS3,  NES,   wmole, halflife,   epalim,  CPMTU@10,  DECAY
---      ---,     ---,   ---,    ---,  [g/mol],    [yr],   [Ci/MTU],  [Ci/MTU],
 39     Se79     Se79   SE79     Se    79.0d0    1.100d6    1.00     2.71d-02
```

Change 4
The occupancy factor for the volcanism dose needs to be updated.

Test 4 => PASSED
The test verified the value in *tpa.inp* (pasted below) matched the suggested value from attachment A.

```
constant
OccupancyFactorForVolcanismDoseCalculation[-]
0.605
```

Change 5
The layer thickness for ~~Chnz~~ Chnv (typo corrected by RWJ 01/29/2001) for subarea 9 needs to be set to zero to avoid NEFTRAN array overruns.

Test 5 => PASSED
The test verified the value in *tpa.inp* (pasted below) matched the suggested value of zero.

```
constant
CHnvThickness_9SubArea[m]
0.0
```

Signature Roland R. Pace Date 01/30/2001

Attachment A

PREDECISIONAL

constant	OccupancyFactorForVolcanismDoseCalculation[-]	Fraction of time that receptor is exposed to airborne volcanic ash	~~0.485~~ 0.605	Kennedy and Strange (1992). Based on receptor spending ~~55%~~ 79% of time indoors, 20% outdoors, 1% gardening and raising alfalfa, ~~and 24% offsite.~~ Time spent indoors reduces the airborne mass load by 50% ~~and assumes no exposure while offsite.~~. The 50% reduction is based on normal soil mass loading conditions and may be conservative for volcanic ash.	**
constant	DepthOfResuspendableLayer[cm]	Thickness of the upper soil layer that is available for resuspension (cm)	0.3		
loguniform	AirborneMassLoadAboveSoil[g/m3]	Mass of soil in air above Amargosa Valley soil	5e-5, 3e-4	Based on data for particles < 100 µm from Tegen and Fung (1994), Sehmel (1977), Anspaugh et al. (1975), Soldat et al. (1973), and Rognon (1991)	JRW 3/2/00
constant	RateOfReductionOfMassLoadingFactor[1/yr]	Rate at which mass load factor goes from value above ash to value above soil following the igneous event	0.07	Anspaugh et al. (1975) and Nuclear Regulatory Commission (1975) would support a half-life of approximately 1 yr. To account for the wide distribution of ash in the surrounding area potentially replenishing fine material in the blanket, increase half-life to 10 yr.	JRW 3/2/00

**
**
** ***>>> CORRELATED PARAMETERS <<<***
**

correlateinputs	SubAreaWetFraction and ArealAverageMeanAnnualInfiltrationAtStart[mm/yr]	Correlation between subarea wet fraction and areal average mean annual infiltration at start (mm/yr)	0.631	See appendix F	**

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Subject: New inventory for Se-79
Date: Thu, 19 Oct 2000 14:50:13 -0500
From: James Weldy <jweldy@swri.edu>
To: "Ronald Janetzke (rjanetzke)" <rjanetzke@swri.edu>
CC: "Sitakanta Mohanty (smohanty)" <smohanty@swri.edu>, Gordon Wittmeyer <gwitt@swri.edu>

The new initial inventory for Se-79 is 0.0271 Ci/MTU. This change is to account for the change in the accepted value of the Se-79 half-life from 6.5e4 years to 1.1e6 years.

James Weldy

@ 10 years

4/1e 7 2.71E-2 Ci/MTU

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These are the values from Debora for Hanford dataset

— Stefanie

Table 6-1. Suggested parameter distributions for REFLUX3

Factor	Code name	Distribution	Hpa. exp	Hpa mean value exp.
FractionOfCondensateRemoved [yr^{-1}]	Shed1	uniform (0.0, 0.25)	✓	0.125
FractionOfCondensateTowardRepository [yr^{-1}]	Qfact	uniform (0.05, 1.0)	✓	0.525
FractionOfCondensateTowardRepositoryRemoved [yr^{-1}]	Shed2	constant (0.0)	✓	0,0

Insert A 10/13/2000 107/119

Table 3-1. Dryout zone thickness as a function of time for the Enhanced Design Alternative II design

Line Number	Time (yr)	Dryout Thickness (m)
1	1.0	0.0
2	10.0	0.1
3	20.0	1.0
4	30.0	1.5
5	40.0	1.7
6	50.0	1.6
7	60.0	1.5
8	70.0	1.8
9	80.0	2.9
10	100.0	4.6
11	200.0	7.3
12	300.0	7.4
13	500.0	6.6
14	600.0	5.6
15	700.0	4.7
16	800.0	3.8
17	900.0	2.7
18	1000.0	0.0

dry thickness ✓

per discussion with D. Hughson 10-13-2000

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SOFTWARE CHANGE REPORT (SCR)

SCR No. (*Software Developer Assigns*): PA-SCR-330	**Software Title and Version:** TPA 4.1	**/Project No:** 20-1402-762

Affected Software Module(s), Description of Problem(s):

sampler.f

Modify the code to enable the LHS RANDOM SAMPLE mode for an LHS flag of 0 rather than using the internal Monte Carlo routines.

Change Requested by:	**Change Authorized by** (*Software Developer*):
S. Mohanty Date:10-17-00	R. Janetzke Date: 10-18-00

Description of Change(s) or Problem Resolution (*If changes not implemented, please justify*):

The old Monte Carlo routines were removed from the newrealization routine in sampler.f. The RANDOM SAMPLE keyword was added to the lhs.inp file when the lhs flag is 0 to enable the Monte Carlo style samples from SNLLHS. A new routine called checklhsout was developed as a utility to check the size of the lhs.out file.

Implemented by:	**Date:**
R. Janetzke	11-30-00

Description of Acceptance Tests:

See attached hard copy and floppy diskette.

Tested by:	**Date:**
J. Menchaca	1/30/01

CNWRA Form TOP-5 (01/99)

TPA Version 4.1 Test Plan: PA-SCR-330

Task Description: Modify the code to enable the LHS RANDOM SAMPLER mode for an LHS flag of 0 rather than using the internal Monte Carlo routines.

Reason for Change: The old Monte Carlo routines were removed from the newrealization routine in sampler.f. The RANDOM SAMPLER keyword was added to the lhs.inp file when the lhs flag is 0 to enable the Monte Carl style samples from SNLLHS. A new routine called checklhsout was developed as a utility to check the size of the lhs.out file.

Analyst: R. Janetzke **Date:** 11/30/00

Controlled Version: **Version 4.1**
Modified Version: **Version 4.1e**

Output files to be checked:

Test 1: tpa4.1/sp.tpa and tpa4.1e/sp.tpa

Input files to be checked for correct data transfer:

Mode of documentation: 3.5" floppy, PA-SCR-330

Functional Testing

Process-level testing:

Test 1 Testing of the automatically generated sp.tpa file.

Run a multiple vector tpa4.1 run and a tpa4.1d multiple vector run both with the Latin Hypercube Sampling flag off (set to 0) and compare the two sp.tpa output files. They should be different from each other on a line by line basis.

PASSED, Each parameter values is different in each of the two files.

Test 2 Testing of the automatically generated lhs.out file.

Run a multiple vector tpa4.1 run and a tpa4.1d multiple vector run both with the Latin Hypercube Sampling flag on (set to 1) and compare the two lhs.out output files. They should be identical to each other.

PASSED, executing a diff funtion between the files revealed that there were no differences between the files.

Hand calculations: None

Final checklist:

- **Did the modification substantially change the results?**

  Test 1. Yes. The sampled parameters are completely different.

  Test 2. No.

- **Were TPA 4.1 and 4.1d compared using corresponding mean values in tpa.inp? (If NO, please state reason).**

  No. The output does not involve a mean value run but requires a multiple vector run.

- **Which nuclides were monitored to determine reasonableness of results in terms of dose.**

SOFTWARE CHANGE REPORT (SCR)

SCR No. (*Software Developer Assigns*): PA-SCR-331	**Software Title and Version:** TPA 4.1	**/Project No:** 20-1402-762

Affected Software Module(s), Description of Problem(s):

exec.f

The peak of the mean dose curve is neither displayed nor output to a file.

Change Requested by:	**Change Authorized by** (*Software Developer*):
S. Mohanty Date:10-17-00	R. Janetzke Date: 10-18-00 R. Janetzke

Description of Change(s) or Problem Resolution (*If changes not implemented, please justify*):

This feature was implemented as a post processor by J. Menchaca. The standalone module was converted into a subroutine form suitable for integration into the TPA exec.f module, by including enhanced documentation and variable I/O unit parameters. The module reads the totdose.res file and produces file pkmndose.out.

Implemented by:	**Date:**
R. Janetzke R. Janetzke	12-5-00

Description of Acceptance Tests:

See attached hard copy and floppy diskette.

Tested by:	**Date:**
J. Menchaca J. M	1/30/01

CNWRA Form TOP-5 (01/99)

TPA Version 4.1 Test Plan: PA-SCR-331

Task Description: The peak of the mean dose curve is neither displayed nor output to a file.

Reason for Change: This feature was implemented as a post processor by J. Menchaca. The standalone module was converted into a subroutine form suitable for integration into the TPA exec.f module, by including enhanced documentation and variable I/O unit parameters. The module reads the totdose.res file and produces file pkmndose.out.

Analyst: R. Janetzke **Date:** 11/30/00

Controlled Version: **Version 4.1**
Modified Version: **Version 4.1d**

Output files to be checked: pkmndose.out and doseatmeanpeak.out

Mode of documentation: 3.5" floppy, PA-SCR-331

Functional Testing

Testing of the automatically generated pkmndose.out file.

Run a multvector tpa4.1d run and then run the standalone getTimePeakMean.e executable file. Compare the differences between pkmndose.out produced by the multivector run and doseatmeanpeak.out, the file produced by the standalone program.

PASSED, absolutely no differences between the two files.

Final checklist:

- **Did the modification substantially change the results?** No

- **Were TPA 4.1 and 4.1d compared using corresponding mean values in tpa.inp? (If NO, please state reason).**

  No. The output does not involve a mean value run but requires a multivector run.

- **Which nuclides were monitored to determine reasonableness of results in terms of dose.**

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SOFTWARE CHANGE REPORT (SCR)

SCR No. (*Software Developer Assigns*): PA-SCR-332	**Software Title and Version:** TPA 4.1	**/Project No:** 20-1402-762

Affected Software Module(s), Description of Problem(s):

reader.f and sampler.f

The current method manually generating the mean value file is inefficient. An automated procedure is desired.

Change Requested by:	**Change Authorized by** (*Software Developer*):
R. Janetzke Date:10-17-00	R. Janetzke Date: 10-18-00 R. Janetzke

Description of Change(s) or Problem Resolution (*If changes not implemented, please justify*):

A new routine writemeanvalues() was developed for the reader.f module to generate the mean values for the sampled parameters in the tpa.inp file. A new file is created called tpameans.out that looks like the tpa.inp file except that all of the PDFs are changed to constants with associated mean values in place of the corresponding PDF range, and all parameter correlations are commented out. The resulting tpameans.out file can be used as an input file by renaming it to tpa.inp. In conjunction with this the sampler.f routine was modified to inhibit the invocation of the SNLLHS module when all of the parameters are constant.

Implemented by:	**Date:**
R. Janetzke R. Janetzke	12-8-00

Description of Acceptance Tests:

See attached hard copy and floppy diskette.

Tested by:	**Date:**
J. Menchaca J. M	1/30/01

CNWRA Form TOP-5 (01/99)

TPA Version 4.1 Test Plan: PA-SCR-332

Task Description: The current method manually generating the mean value file is inefficient. An automated procedure is desired.

Reason for Change: A new routine writemeanvalues() was developed for the reader.f module to generate the mean values for the sampled parameters in the tpa.inp file. A new file is created called tpameans.out that looks like the tpa.inp file except that all of the PDFs are changed to constants with associated mean values in place of the corresponding PDF range, and all parameter correlations are commented out. The resulting tpameans.out file can be used as an input file by renaming it to tpa.inp In conjunction with this the sampler.f routine was modified to inhibit the invocation of the SNLLHS module when all of the parameters are constant.

Analyst: R. Janetzke **Date:** 12/08/00

Controlled Version: **Version 4.1**
Modified Version: **Version 4.1d**

Output files to be checked:

Test 1: tpameans.out, tpa.inp

Input files to be checked for correct data transfer: None

Mode of documentation 3.5" floppy, PA-SCR-332 files

Functional Testing

Process-level testing:

Test 1 Testing of the automatically generated tpameans.out file.

Run a single vector tpa run. Take selected variables, two for each PDF (if available) and hand calculate the mean of the distribution. Compare these values with the values in tpameans.out.

The currently used PDFs are:
uniform
loguniform
normal
lognormal
triangular

logtriangular
userdistribution
beta

Additionally, make sure that all the correlations at the bottom of the tpameans.out file are commented.out.

PASSED.

Test 1.1 Testing uniform distribution:

uniform
ArealAverageMeanAnnualInfiltrationAtStart[mm/yr]
4.0, 13.0

constant
ArealAverageMeanAnnualInfiltrationAtStart[mm/yr]
8.5000000000000

uniform
DiameterOfVolcanicCone[m]
24.6, 77.9

constant
DiameterOfVolcanicCone[m]
51.250000000000

Test 1.2 Testing loguniform distribution:

loguniform
Preexponential_SFDissolutionModel2
1.2e3, 1.2e6

constant
Preexponential_SFDissolutionModel2
37947.331922021

loguniform
AirborneMassLoadAboveSoil[g/m3]
5e-5, 3e-4

constant

AirborneMassLoadAboveSoil[g/m3]
1.2247448713916D-04

Test 1.3 Testing normal distribution:

normal
CriticalRelativeHumidityAqueousCorrosion
0.6, 0.65

constant
CriticalRelativeHumidityAqueousCorrosion
0.62500000000000

normal
MilkFreshForageDietFraction
0.12, 0.98

constant
MilkFreshForageDietFraction
0.55000000000000

Test 1.4 Testing lognormal distribution:

lognormal
DripShieldFailureTime[yr]
2700.0, 20400.0

constant
DripShieldFailureTime[yr]
7421.5901261118

lognormal
NEAmountOfLargestCredibleDisplacement[m]
5.41e-2, 3.3e-1

constant
NEAmountOfLargestCredibleDisplacement[m]
0.13361511890501

Test 1.5 Testing triangular distribution:

triangular
InterceptionFraction/Irrigate

0.06, 0.4, 1.0

constant
InterceptionFraction/Irrigate
0.48666666666667

triangular
MilkFreshForageIrrigationRatePB[in/yr]
23.0, 43.0, 43.0

constant
MilkFreshForageIrrigationRatePB[in/yr]
36.333333333333

Test 1.6 Testing logtriangular distribution:

logtriangular
SolubilityNp[kg/m3]
1.2e-3, 3.4e-2, 2.4e-1

constant
SolubilityNp[kg/m3]
2.1393924964957D-02

logtriangular
AshMeanParticleLogDiameter[d_in_cm]
0.01, 0.1, 1.0

constant
AshMeanParticleLogDiameter[d_in_cm]
1.0000000000000D-01

Test 1.7 Testing userdistribution distribution:

userdistribution
ThresholdDisplacementforFaultDisruptionOfWP[m]
4
0.1
0.2
0.3
0.4

constant

ThresholdDisplacementforFaultDisruptionOfWP[m]
0.20000000000000

Test 1.8 Testing beta distribution:

beta
NWFaultZoneWidth[m]
0.5, 275.0, 1.25, 15.0

constant
NWFaultZoneWidth[m]
21.615384615385

beta
NumberOfWPsEntrainedByEjecta[]
1.0, 150.0, 1.0, 2.0

constant
NumberOfWPsEntrainedByEjecta[]
50.666666666667

Hand calculations:

All of the above tests were verified using either a hand calculator or an excel file (PA-SCR-332.xls).

PASS

Final checklist:

- **Did the modification substantially change the results?** No

- **Were TPA 4.1 and 4.1d compared using corresponding mean values in tpa.inp? (If NO, please state reason).**

  Yes. totdose.res

- **Which nuclides were monitored to determine reasonableness of results in terms of dose.**

SOFTWARE CHANGE REPORT (SCR)

SCR No. (*Software Developer Assigns*): PA-SCR-333	**Software Title and Version:** TPA 4.1	**/Project No:** 20-1402-762

Affected Software Module(s), Description of Problem(s):

tpa.inp

The ChlorideMultFactor parameter does not have the latest data range values.

Change Requested by: S. Mohanty Date:12-22-00	**Change Authorized by** (*Software Developer*): R. Janetzke Date: 12-22-00 R. Janetzke

Description of Change(s) or Problem Resolution (*If changes not implemented, please justify*):

The PDF range for this parameter was changed from (1., 30.) to (1., 3.6).

Implemented by: R. Janetzke R. Janetzke	**Date:** 1-16-01

Description of Acceptance Tests:

New parameter values are a subset of previous range, therefore no additional acceptance testing is required.

Tested by: N/A	**Date:** N/A

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