Software Release Notice
Developed or Modified Software

1. Software Name and Project Number:: TPA (Total-System Performance Assessment) Version: 5.1

2. Software Function: Conduct post-closure performance calculations of the potential geologic repository at Yucca Mountain, Nevada, as an aid to developing risk insights.

3. Summary of Actions:
❑ New Software ☒ Update to Existing Software ❑ Software Retirement

4. Software Development

4a. Software Requirements Description (SRD) Date Approved: ___June 11, 2007 __
4b. Software Development Plan (SDP) Date Approved: ___May 10, 2005 ____
4c. Software Change Report (SCR) Nos: _ See Attachment A. _____
4d. User's Guide Date Date Approved___Expected on July 27, 2007 _____
4e. Enclosed: ☒ Copy of Program Title Block ☒ Sample Source Code Header Block

Developer: R. Janetzke R. Janetzke | Date: June 19, 2007

Remarks:

5. Software Installation

5a. Computer Platform(s): Personal Computer
5b. Operating System(s): Windows/XP
5c. Programming Language(s): Lahey Fortran LF95

5d. Installation Testing: ☒ Passed Testing Performed on: June 19, 2007
Description of Testing Performed:

5e. Archive Copy: ☒ Enclosed ❑ Not Available, Why:

Installation Performed by: R. Janetzke R. Janetzke | Date:June 19,2007

Remarks:

6. Software Assessment

6a. Acceptance Testing:
❑ Enclosed ❑ Documented in Scientific Notebook No. _____
☒ Documented in SCRs (see above)_____

6b. Validation Status:
☒ Full Validation ❑ Limited Validation Date of Validation: 6/21/07
❑ Not Validated, Explain:

Software Developer: R. Janetzke R. Janetzke | Date: ~~6-19-07~~ 6-21-07

Remarks:

7. Approval

Manager: J. Winterle J. Winterle | Date 6/21/2007

Remarks:

7. QA Verification

SRN Number: 423

Software Custodian M. Simpson for R. Briant | Date: 6/21/07

Remarks:

TOP–6–2 (12/2004)

Attachment A

4c. Software Change Report (SCR) Nos:

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C Program Name:        TPA - Total-System Performance Assessment Code
C File Name:           %M%
C File Date:           %G%
C Release Version:     5.1
C
C Client Name:         USNRC
C                      U. S. Nuclear Regulatory Commission
C                      NRC Office of Nuclear Material Safety and Safeguards
C                      Division of High Level Waste Repository Safety
C
C Contract Number:     NRC 02-02-012
C
C NRC Contact:         Chris Grossman (301) 492-3177
C
C CNWRA Contact:       Ron Janetzke (210) 522-3318
C                      Center for Nuclear Waste Regulatory Analyses
C                      San Antonio, Texas 78238-5166
C
C Documentation:       "Total-System Performance Assessment (TPA)
C                      Version 5.1 User Guide",
C                      Center for Nuclear Waste Regulatory Analyses
C
C NUREG-Series Designator: N/A
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C Regulatory Commission (NRC), an independent agency of the United States
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C
C = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = =
c
c  CONTENTS:  The numrecip utility module consists of the following
c             subroutine that is utilized during TPA execution:
c
c             subroutine gauleg - compute Gauss-Legendre weights
c                                 and abscissas
cc rwj 7-14-06; SCR651; Remove unused routines.
c             subroutine zbrent - search for root of function
c             subroutine zbrent1 - search for root of function
c             subroutine zbrak   - search for zero crossing of function
c             subroutine zbrak1  - search for zero crossing of function
c
c  HISTORY:   R. Manteufel (initial version)
```

```
c             S. Mohanty, R. Janetzke, R. Rice (versions through 5.0)
c             R. Rice (version 5.0 validation tests added 05/31/03)
c             G. Adams (Version 5.0.1 7-27-04) SCR480 & SCR481
c             R. Janetzke SCR651; Remove unused routines zbrent, zbrent1,
c                                 zbrak, zbrak1.
c
c = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = =

c=====================================================================
      subroutine gauleg(x1,x2,x,w,n)
c=====================================================================
c*********************************************************************
c*** This routine, gauleg, is based on the routine Gaussian        ***
c*** Quadratures (Gauss-Legrende integration) from the book         ***
c*** "Numerical Recipes in FORTRAN (Cambridge University Press,     ***
c*** Copyright (C) 1986-1992 by Numerical Recipes Software. Used by ***
c*** permission. Use of this routine other than as an integral part ***
c*** of the TPA code requires an additional license from Numerical  ***
c*** Recipes Software.  Further distribution is prohibited.         ***
c*********************************************************************
```

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C
C = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = =
c
c     CONTENTS:
c               subroutine
c                 getIntegerValue
c                 getRealArray
c                 setIntegerArray
c                 setIntegerValue
c                 setRealArray
c                 setRealValue
c                 setStringValue
c                 FindRecord
c                 getIntegerValueFormat
c                 setIntegerValueFormat
```

```
c                getRealValueFormat
c                setRealValueFormat
c                transferLines
c                getRealTable
c                setRealTable
c                getRealIntTable
c                setRealIntTable
c                getReadFormat
c
c     HISTORY:
c             3-7-06 GADAMS SCR609 : Added subroutine
c             11-21-06 R. Janetzke ; SCR667 ; Added routine FindRecord
c             3-7-06 GADAMS SCR609 : Added subroutine
c
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C
C = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = =
c
c      CONTENTS:
c                subroutine ashremob
c
c
c      HISTORY: Created 8 September 2004
c               Created to implement the AshEvolutionMode == 1 option
c
c               For calculation of the inhalation dose, utilizing
c               offline results from the TEPHRA code modeling
c               stratified windfield during modeled eruptions
c               models inhalation dose only
c
```

```
c
C      ASHREMOB HISTORY:
c                          created by D.J. Sylvester, SwRI
c           1-30-05 rwj    SCR522; Add amtuejected to argument list.
c           2-08-05 rwj    SCR523; Reconcile code with pseudocode.
c           6-01-05 asl    SCR482; Reconcile code with pseudocode.
c           6-01-05 asl    SCR568; Reconcile code with pseudocode.
c          12-01-05 jmm    SCR620; Add Headers to ashremob.out
c          12-09-05 jmm    SCR619; Scale the MTU of HLW entrained in an eruption.
c          07-27-06 jmm    SCR654; changes to mass loading.
c          12-05-06 jmm    SCR654; Correct light disturbance error message.
c          02-21-07 jmm    SCR682; changes to massloading logic
c                                  reformatting remob_lut.dat and ashremob.out
c          05-08-07 rwj    SCR686; account for MTU scaling and reformat ashremob.
out
c
c                          SCR654 changes are embedded between the 2 lines below.
cjmm 20060728 SCR654 for adding time dependence to several parameters
cjmm end SCR654 modifications
cjmm+-^--1----+----2----+----3----+----4----+----5----+----6----+----7--!-+----8
c
c=====================================================================
cc rwj 1-29-05; SCR 522
c     subroutine ashremob( irl, mxntime, mxnnucldr, ntim, tim, nnucldr,
c    &                     namesdr, dMAT, dMAP, remperyrpernuclgs )
      subroutine ashremob( irl, mxntime, mxnnucldr, ntim, tim, nnucldr,
     &                     namesdr, dMAT, dMAP, amtuejected,
     &                     remperyrpernuclgs )
c=====================================================================
c      NAME:
c               ashremob
c
c      PURPOSE: Compute inhalation doseage per nuclide (remperyrpernuclgs)
c               based on stratifed wind model after an eruption
c
c      INPUT:
c               irl            = current realization
c               mxntime        = integer, size to dimension arrays
c               mxnnucldr      = integer, size to dimension arrays
c               ntim           = integer, maximum number of times used
c                                to dimension arrays
c               tim(ntim)      = double precision, array of times
c               nnucldr        = integer, maximum number of nuclides used
c                                to dimension arrays
c               namesdr(nnucldr) = character*6, names of nuclides to be
c                                tracked
c               amtuejected      = double precision, amount of spent
c                                  fuel ejected during volcanic event.
c
c
c      OUTPUT:
c               remperyrpernuclgs[mxntime,nnucldr] = double precision,
c                                array of annual EDE (effective dose
c                                equivalent) per nuclide
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C
C = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = =
c
c     CONTENTS:
c               subroutine ccdfindexed
c               subroutine checknr
c               subroutine checknsa
c               subroutine cleanupwd
c               subroutine cumfail
c               subroutine epaccdf
c               subroutine epaccdf_c
c               subroutine findPkMnDose
c               subroutine putfailwp
c               subroutine setfiles
c               subroutine setup_kdrd_files
```

```
c               subroutine writedata
c               subroutine writeepaccdf
c               subroutine writehead
c               subroutine writehead2
c
c     HISTORY:
c             S. Mohanty, R. Janetzke, R. Rice, A. Lozano
c             R. Manteufel (initial version)
c             3.1.1     includes SPCRs 101 through 205
c             3.1.2     includes SPCRs 206 through 224
c             3.1.3     includes SPCRs 225 through 227
c             3.1.4     includes SPCRs 228 through 231
c             3.2       includes SPCRs 232 through 252
c             3.2.1     3.2PCbeta port of 3.2 to PC running NT4
c             3.2.2     3.2PVMbeta mod of 3.2.1 to enable PVM
c             3.2.3     includes SCRs  260 through 271
c             3.3       includes SCRs  272 through 278
c                       and    includes SCRs  280 through 287
c             4.0       includes SCRs  288 through 313
c             4.1       includes SCR   321 through 326
c             4.1c      includes SCR   331 peak mean dose
c             4.1d      includes SCR   332 tpameans.out & tpa.inp
c             4.1e      changes to ChlorideMultFactor in tpa.inp only.
c             4.1f      includes SCR   334 EPA groundwater bug fix.
c             4.1g      includes SCR   336 Add MAI loss mode in uzflow.
c             4.1h      includes SCR   335 Add checkpoint/restart.
c             4.1i      includes SCR   337 Bug fix for icheckpointinp.
c             4.1j      includes SCR   338 Increase max correlated var.
c             4.1k      includes SCR   344-part A; Improve checkpoint
c                                      performance.
c             4.2       includes SCR   344-part B; Add user option for
c                                      checkpoint.
c             4.2a      includes SCR   387 Add lhs user distributions.
c             4.2b      includes SCR   393 Remove last write of
c                                      check.pnt for good runs.
c             4.2c      includes SCR   376 Add streamtube width
c                                      multiplier.
c             4.2d      includes SCR   348 Add DSFAIL standalone code.
c             4.2e      includes SCR   373 Sample CHnv thickness.
c             4.2f      includes SCR   382 New mass load & occupancy
c                                      factors.
c             4.2g      includes SCR   365 Add weld corrosion to failt.
c             4.2h      includes SCR   395 Add drip shield data to
c                                      append files.
c             4.2i      includes SCR   374 Split UZ flow into fracture &
c                                      matrix.
c             4.2j      includes SCR   327 Remove U and scaled values
c                                      from groundwater protection
c                                      output files.
c             4.2k      includes SCR   397 Add checkpoint/restart logic
c                                      to DSFAIL.
c             4.2l      includes SCRs  367,369,370,&396 Glass,cladding,
c                                      anddiffusion in releaset.
c             4.2m      includes SCR   381 Use GENII to get DCFs for
c                                      ground surface dose.
c             4.2n      includes SCR   389 Pathway specific dose output.
c             4.2o      includes SCR   385 New seismo and mechfail
c                                      modules.
c             4.2p      includes SCR   377 Add time dependent velocities
c                                      to szft.
c             4.2q      includes SCR   379 Use new plume capture model.
c             4.2r      includes SCR   385 Minor bug fix for PC.
c             4.2s      includes SCR   384 Add ash redistribution model.
c             4.2t      includes SCR   375 Add variable dispersivity in
c                                      uzft.
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c             4.2u      includes SCR   398 Add near field chemistry
c                                      temperature epochs.
c             4.2v      includes SCR   386 Add one WP/temperature_cell
c                                      option.
c             4.2w      includes SCR   399&408 Time dependent dilution
c                                      volume and szft bug fix.
c             4.2x      includes SCR   371 Add Kd equations.
c             4.2y      includes SCR   385 Mechfail backfill & drift
c                                      degradation.
c             4.2z      includes SCR   368 Add colloids.
c             4.3       continuation of SCR385, mechfail.f bug fix.
c             4.3a      continuation of SCR371 Add partial read of
c                                      coefkdeq.dat.
c             4.3b      includes SCR   390 New runoff data files.
c             4.3c      includes SCR   346 spatial variance for infil-
c                                      tration.
c             5.0beta   includes SCR   409 Change EPA file column
c                                      heading.
c             5.0betaA  includes SCRs  415&416 Remove automatic arrays.
c             5.0betaB  includes SCR   371 Limit check Kd and Rd values.
c             5.0betaC  includes SCR   392 LF90 compiler warnings
c                                      resolved.
c             5.0betaD  includes SCR   400&410 Redefine percinfil based
c                                      on a repository area of just the
c                                      subareas selected.
c             5.0betaE  includes SCR   411&412 Remove ds_fail_time & add
c                                      Rd checks.
c             5.0betaF  includes SCR   414 New dsfailt, mechfail, and
c                                      seismo2 suite.
c             5.0betaG  includes SCR   417 Updates for Importance
c                                      Analysis.
c             5.0betaH  includes SCR   413 New data files from ITYM.
c             5.0betaI  includes SCR   394 Add WP fill time to releaset.
c             5.0betaJ  includes SCR   368 continued.  bug fix for
c                                      ebsnef2.dat in ebsrel.
c             5.0betaK  includes SCR   418 New Log10 names for colloid
c                                      Rds.
c             5.0betaL  includes SCR   392 Bug fix for ebsfilt.inp
c                                      nuclide names.
c             5.0betaM  includes SCR   420&421 New ebsfilt, and Ja243
c                                      chain change.
c             5.0betaN  includes SCR   392 Bug fix for first realiza-
c                                      tions not equal to 1, and new
c                                      chemistry data files.
c             5.0betaO  includes SCR   420 EBSFILT bug fix and Rd error
c                                      checks.
c             5.0betaP  includes SCR   368 implementation bug fix for
c                                      colloid parents.
c             5.0betaQ  includes SCR   423 Use WP temperature instead of
c                                      repository in failt.f.
c             5.0betaR  includes SCR   419 Add permanent-loss colloid
c                                      filters for the UZ.
c             5.0betaS  includes SCR   425 Bug fix for dcags 'direct
c                                      release only' file handler.
c             5.0betaT  includes SCR   428 Add user temperature
c                                      reference point.
c             5.0betaU  includes SCR   346(continued) Sample mode 3 is
c                                      now referenced as 2.
c             5.0betaV  includes SCR   439 Bug fix for initial colloid
c                                      inventories.
c             5.0betaW  includes SCR   422 Add new output to relcum.out
c                                      (WP fill time).
c             5.0betaX  This version ID (betaX) was not used.
c             5.0betaY  includes SCR   424 Add reversible colloids.
c             5.0betaZ  includes SCR   440 Bug fix for ebsrel when
```

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c                                       writing ebsfilt.inp.
c             5.0betaZa includes SCR    441 & 443 Bug fixes for szft
c                                       colloid rd parameter names and
c                                       ebsfilt & uzft colloid filter
c                                       factor.
c             5.0       2-26-03
c             5.0a      includes SCR 445 tuned NEFMKS input to avoid array overf
low.
c             5.0b      includes SCR 444 & 446 for contract #, and new failt out
put item.
c             5.0c      includes SCR 445 continued tuning of NEFMKS input file.
c             5.0d      includes SCR 446 continued tuning of FAILT output files.
c             5.0e      includes SCR 447 add nefiisz.cum output file.
c             5.0f      includes SCR 449 & 450 strmtube.dat; extend
c                                 colloid chains & new release factors.
c             5.0g      includes SCR 451 releaset fix;seismo2 error traps;
c                                 pluvial dilution flag removed.
c             5.0h      includes SCR 452,453 & 454; automatic test format and
c                                 new UZ fracture fraction method.
c             5.0i      includes SCR 453,455,456 & 426; add querystop() and
c                                 new relative humidity model for mechfail/se
ismo2.
c             5.0j      includes SCR 457,459,&460; Remove Fl enhancement, ebsfil
t integ. fix, and erratic ash thickness fix.
c             5.0k      includes SCR 461 & 465 Remove entrained WP for model 2 n
on-extrusive case (volcano.f) & iareader.f update.
c             5.0l      includes SCR 466 Omit colloid filters for layers with le
g length=0.
c             5.0m      includes SCR 464, 467, 468, & 469;mechfail debug;corrosi
on parms;repdes.dat;remove double counting in glass mode.
c             5.0n      includes SCR 465, 471 & 453; releaset fix, szft dispersi
on&Rd, numrecip.
c             5.0o      includes SCR 458 iareader stops at error message.
c             5.0p      includes Numerical Recipes disclaimer.
c             5.0q      includes SCR 472 dcags fix, array.f automated test forma
t.
c             5.0r      includes SCR 475 waste form dissolution rate enhancement
 factor.
c             5.0s      includes SCR 479 Comment $ code review for LSN.
c             5.0t      includes SCR 477 volcanic event time at max sim time.
c             5.0u      includes SCR 486 Update SZ release screening of colloids
.
c             5.0v      includes SCR 470,485,487 wpfillstats.out update & Omit g
ap fraction for glass model.
c             5.0w      includes SCR 483 AgeOfWaste/CalendarYearOfEmplacement sw
ap.
c             5.0x      includes SCR 476,478,480,481, inhibitors, DS/WP interact
ion.
c             5.0y      includes SCR 488, new climato2.dat & pre-closure RH equa
tion.
c             5.0z      includes SCR 484&489, reversible colloids & actinide_kdr
d.out.
c             5.0.0     includes SCR 517, new alluvium Kds.
c             5.0.0a    includes SCR 518, Param. spelling corrections & nfenv.rl
t fix.
c             5.0.0b    includes SCR 482, Add ASHREMOB module.
c             5.0.0c    includes SCR 490, Change geometric volcano model to dogl
eg algorithm.
c             5.0.0d    includes SCR 473, Update to tpa.inp only.
c             5.0.0e    includes SCR 520, Update post closure rel. hum. calculat
ion.
c             5.0.0f    includes SCR 522, Add amtuejected to ashremob, assign ej
ected WPs independently.
c             5.0.0g    includes SCR 523, SZFT STFF/SAV fix, ashremob.f fix.
c             5.0.0h    includes SCR 546, Increase minimum WP volume  releaset f
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or long runs.
c             5.0.0i    includes SCR 552, Handle new seed ranges and new paramet
er set.
c             5.0.0j    includes SCR 554, Handle new nuclides.dat with t0=emplac
ement time.
c             5.0.0k    includes SCR 553, Calculate thermal diffusivity, update
part. size pdf.
c             5.0.0l    includes SCR 519, Create pkmndose.res; dcags.f ashremob.
f, tpa.inp cleanup.
c             5.0.0m    includes SCR 560, New subareas (7).
c             5.0.0n    includes SCR 530, Long simulations with limited number o
f time steps.
c             5.0.0o    includes SCR 530, Long simulations with large number of
time steps.
c             5.0.0p    includes SCR 549, Time dependent subarea 'Fwet' in wpflo
w.def for releaset.
c             5.0.0q    includes SCRs 526, 547, and 561, fix indoor mass loading
, Np solub., new strmtube.dat.
c             5.0.0r    includes SCR 556, Remove gaseous C14 parameters from ebs
rel/releaset.
c             5.0.0s    includes SCR 528, ICRP72 for dcagw & dcags, inhibit use
of age groups 1-4.
c             5.0.0t    includes SCR 562, Remove fluoride from tpa.inp and adjus
t thermal model 2.
c             5.0.0u    includes SCR 564, Adjust volcano geometric model for add
itional realism.
c             5.0.0v    includes SCR 570, Update reader to handle multiple east-
west emplacement blocks.
c             5.0.0w    includes SCR 529, Add SZFT mode to run each leg individu
ally.
c             5.0.0x    includes SCR 571, Adjust tolerance on FAILT convergence
warning.
c             5.0.0y    includes SCR 555, Remove NFENV models reflux1 and reflux
2.
c             5.0.1beta includes SCRs576,552,&574 Aux code status flag, question
naire parameters, and updated volcano for ejected packages.
c             5.0.1betaA includes SCRs565,575,&578 adjust cumulative failures, c
onstrain CHnv thickness, ebsfail weld correction.
c             5.0.1betaB includes SCR 577, Adjust nefiialluv.inp format, synchro
nize Cm and AM Kd/Rd values.
c             5.0.1betaC includes SCRs566,567,568,585 Reinstate age groups, adju
st colloid counting, ebsrel.rlt, uz_revers.out, update ashremob, dike/drift inte
rsection, add courant #.
c             5.0.1betaD includes SCR 587, weld release at last time step fix, p
wise PDF mean value fix.
c             5.0.1betaE includes SCRs567,572,588 suppress double counting of re
leased colloids, enable glass for all failures, copy gnewdf.dat for ashremob.
c             5.0.1betaF includes SCR 589, adjust drift degradation at last time
 step, correct ashremob.out.
c             5.0.1betaG includes SCR 591, inter-subarea temperature consistency
, reduce flow factor.
c             5.0.1betaH includes SCR 586, replace zbrak() & zbrent() with FindR
ootRanges() & RootFind().
c             5.0.1betaI includes SCR 594, bug fix for dsfail.res.
c             5.0.1 includes SCRs 590 & 552 questionnaire updates, *_kdrd.out, *
_revers.out format change.
c             5.0.2 includes SCRs 593,595,596 & 552 subarea 8 UZ updates, minimu
m volume reduced for compliance period, reduce tolerance for All WP Failed msg.
c             5.0.2a includes SCRs 607,618 & 612 failure thresholds, ICRP72 data
, tpa_include.inp file.
c             5.0.2b includes SCR 603 include initial failures in wpsfail.res; a
dd TranslteEnv() routine.
c             5.0.2c includes SCR 620 reformat ashremob.out.
c             5.0.2d includes SCR 600 split subarea 3, add logic to avoid errors
 in non-sampled runs.
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c             5.0.2e includes SCR 552-1, 621, & 603; New Kd values, updated gnew
df.dat, separate seismic failures from failures that are not restricted to a sub
set of the subarea.
c             5.0.2f includes SCR 604 added passive ventilation.
c             5.0.2g includes SCR 605 accomodate degraded drift info in drythick
.dat.
c             5.0.2h includes SCR602 & SCR605-part 2. Select earliest full drift
 degradation time; reformat infilper.res.
c             5.0.2i includes SCR 611 irreversible colloid release determined fr
om calculated affinities and effective solubilities.
c             5.0.2j includes SCR 619&597 and updates to 602&611; add glass wast
e to ashremob.f and write relcumglass.out to ebsrel.rlt new headers for infilper
.res.
c             5.0.2k includes SCR 609&610 add new driftfail and mechfail.
c             5.0.2l includes SCR 608 incorporate drip shield and mechanical fai
lures into seepage model.
c             5.0.2m includes SCR 599 Bug fix for condxyzt; remove inner package
 credit; del ashremob.out before run.
c             5.0.2n includes SCR 614 revised layer selection scheme for UZFT.
c             5.0.2o includes SCR 610 final version of DRIFTFAIL
c             5.0.2p includes SCR 610 Bug fixes for DRIFTFAIL.
c             5.0.2q includes SCR 608, 610 & 614 bug fixes.
c             5.0.2r includes SCR 609, 610 & 614 bug fixes.
c             5.0.2s includes SCR 608, & 610 bug fixes.
c             5.0.2t includes SCR 610, & 614 bug fixes.
c             5.0.2u includes SCR 613, & 626 reduced nuclide set; update tpa.inp
c             5.1beta Version name change.
c             5.1betaA includes SCRs 598 & 628; Modified subarea 5; prevent nega
tive release.
c             5.1betaB includes SCRs 627 & 629; mechfail & ebsrel error msgs, ba
ckfill outer diameter limited, no pre-closure seismic events.
c             5.1betaC includes SCRs 652 & 653; avoid early zeroes in weld relea
se and smooth the volume of water in can vs time.
c             5.1betaD includes SCR 651; Modify seepage for weld and localized c
orrosion;
c                                        Maximum drift degradation limit;
c                                        Subarea dependent chemical conditions
c             5.1betaE includes SCR 656; Increase arrays and error checks for ch
ains.
c             5.1betaF includes SCRs654&658; Ashremob update; bug fix for nfenv
& releaset
c             5.1betaG includes SCR 660;  Added chimney/trapezoid flags to drift
driver parameter list
c             5.1betaH includes SCR 653&667 set localized corrosion failure time
 to minimum of weld and localized corrosion times.
c             5.1betaI includes SCR 654,668&669 reformat input data files.
c             5.1betaJ includes SCR 675; Reformat output files and new EPA limit
s for nuclides.dat.
c             5.1betaK includes SCRs 671,677&679 reformat files for dsfail,drift
fail, and mechfail.
c             5.1betaL includes SCRs 678 & 680; reformat files nfenv.ech, nfenv.
rlt, chlrdmf.dat, rgw*.tpa and rgw*.tpa.
c             5.1betaM includes SCRs 664 & 681 control seismic output with seism
ic flag; redesign seismic hazard curve specification format.
c             5.1betaN includes SCR 663; add p_contact and p_allowance seepage c
ontrols.
c             5.1betaO includes SCR 682; adjust ashremob.out format for large ex
ponents.
c             5.1betaP includes SCR 659; add mechfail flags for temperature & cr
eep multiplier calculations.
c             5.1betaQ includes SCR 665; use constant climate after 10,000 years
.
c             5.1betaR includes SCR 672; reformat files ebsfail.inp and ebsrel.i
np.
c             5.1betaS includes SCR 673; reformat infilper.res; add SFWettedFrac
```

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tion correlations.
c             5.1betaT includes SCR 666; incorporate the validation data set int
o tpa.inp.
c             5.1betaU includes SCR 673 continued; add controls for infilper.cum
 file.
c             5.1betaV includes SCR 684; reformat dsfailt.def; SCR666 continued,
 update tpa.inp; SCR669 continued, Lahey format fix.
c             5.1betaW includes SCR 673; WP flow controlled by WP temp;
c                               SCR 665; adjust first time step of long term cli
mate
c                               SCR 563; reformat organdf.dat, gwp_ave.res, gwpp
ktim.res
c                               SCR 685; reformat pkmndose.res, dsfailt.def, add
 DS emplacement at closure, adjust colloid conc., add filter for fracture flow,
update rock mass dens.
c             5.1betaX includes SCR 662; increase maxnumdrifts to 14,000.
c                               SCR 683; enforce consistent append flag operatio
n.
c                               SCR 685; update tpanames.dat, reformat wpsfail.r
es,
c                                        initialize data for groundwater protect
ion files.
c                               SCR 686; reformat ashremob.out file.
c                               SCR 687; adjust calculation of average gwtt.
c                               SCR 688; account for drip shield failure effects
 on seepage.
c             5.1betaY includes SCR 689; fix for ebsfilt.inp,gwppktim.res, and u
zft.ech.
c                                        Remove seismicity from reference case,
update
c                                        invert thickness/height, increase the n
umber of file units.
c             5.1betaZ includes SCR 694; Fix averages for rgwsap.tpa, align head
ers in uzft.ech, update ggenii.def and ggeniis.def, update solubility for Mo and
 Ag.
c             5.1 Version identification change and miscellaneous spelling corre
ctions.
c
cccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccc
c     Module Level History:
c       cumfail:
c         4-16-97 rwj Original text.
c         4-17-97 rwj Change algorithm to match comments.
c        12-08-07 rwr; SCR663; Task 1 - Drift Degradation Scenario Module Integr
ation
c                      (Total-System Performance Assessment Version 5.1 Beta Cod
e
c                      Validation Testing) - Account for Pcontact and Pwp_allowa
nce
c                      and adjust the number of WPs by failure type
c       epaccdf:
c               css 2/7/01 pass restart flag
c               rwj 1-27-03; SCR392 Move parameter declaration for
c                            maxrealizations to include file.
c                            parameter (NMAX=1000,NHEADER_LINES=8)
c       epaccdf_c:
c                 css 2/7/01 pass restart flag
c                 rwj 1-27-03; SCR392 Move parameter declaration for
c                              maxrealizations to include file.
c                              parameter (NMAX=1000,NHEADER_LINES=8)
c
c       exec:
c            rwe - SCR 335 - 02/23/01  added logic for checkpoint/
c                            restart operation, including calls to
c                            flush.
```

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c
c       findPkMnDose:
c         Jose M. "Marty" Menchaca, 10-03-00
c         Southwest Reseach Institute,      210-522-3860
c         Started:  10-03-00
c         revision: 10-26-00 Changed kMaxVectors to 2500 to accommodate
c                   large runs.
c                   12-05-00  Ron Janetzke, Modified to interface with
c                   the TPA executive
c       putfailwp:
c                 4-16-97 rwj Original text.
c       putfault:
c                4-7-03 gadams commented out subroutine because it had
c                been replaced by putfailwp
c       putseism:
c                4-7-03 gadams commented out subroutine because it had
c                been replaced by putfailwp
c       putvolcan:
c                4-7-03 gadams commented out subroutine because it had
c                been replaced by putfailwp
c       setfiles:
c                5-15-97 rwr original text
cccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccc
```