APPENDIX L: TIPS AND OPERATIONAL HINTS THOUGHT USEFUL TO NEW USERS

This appendix comprises a collection of useful bits of information, extracted primarily from the source code, and thought by the code sponsor to be of potential utility to new users.

```
      Usefull text extracted from source code

*!
*     Real xareas = areasp (flowrate, xtclout, hrepo, flwcnst, poroi)
**************************************************************************
*****                                                                ****
*****  Equivalent A_R_E_A of S_tuck P_ipe, repository removed        ****
*****              - - - -    -      -                               ****
**************************************************************************
*
*  PURPOSE:     Calculates equivalent area of repositoy removed on stuck
*               pipe:
*
*  AUTHORS:     Robert A. Cole
*
*  UPDATED:     02-FEB-1996  --RAC: Deleted write for DBSPALL
*                 -JUL-1994  --RAC: Created
*
*  CALLED BY:   CUTTINGS (main program)
*
*  CALLS:       NONE
*!
*     The following hardwired constants are not presently used
*     DATA ACCNST/1.128E+13/
*     DATA AVOGAD/6.022E+23/
*!
*
*     ...Source: Newton circa (1642-1727)
*     DATA GRAV/9.81/
*
*     Seconds per based on a Tropical Year of 31556926 sec
*     DATA YRPSEC/3.168876E-08/
*
*!
*     Subroutine blowout (dia, hf, perm, porof, pg, partdia, xareas)
*
**************************************************************************
*****                                                                ****
*****  Equivalent B_L_O_W  O_U_T,  calculates the equivalent area    ****
*****                               ejected by a blowout             ****
*****              - - - -  - -                                      ****
*
*  PURPOSE: Calculates final blowout radius, and back pressure,
*           and returns equivalent waste area removed
*
*           Calculates entrance mach number for different
*           Pressure ratios for isothermal flow in pipes with
*           Friction....see eq 3.9 page 63 binder, advanced fluid
*           Mechanics vol1.
*           Assumes two diameters equivalent to the annular areas
```

```
*            adjacent to the collars and drillpipe.  when mach10
*            =mach2 then the value for p2 is correct and the
*            entrance mach number= mach1=mach2.
*
*           Includes additional flow equations to calculate
*           Final blowout radius and back pressure
*             *corrected steady state flow out of waste
*             *annular area and waste surface relationship
*             *terminal velocity of spherical waste particle
*                  includes specific collar diameters
*                  modified to read from input file
*
*
*  AUTHORS:      Jerry W. Berglund & Robert A. Cole
*
*  CALLED BY:    CUTTINGS {main program}
*
*  CALLS:        NONE
*
************************************************************************
*!
*     Subroutine brgcdb( maxc, maxq, iq, lq, q, c, ierrdb )
*
************************************************************************
*****                                                              ****
*****           B_R_G_C_D_B  set up read of a BRAGFLO CDB file      ****
*****           - - - -                    -- -    ---             ****
************************************************************************
*
*  PURPOSE:     Process dynamic memory allocation for input
*               BRAGFLOW CDB file etc...
*
*  AUTHOR:      Robert A. Cole
*
*  CREATED:     02-FEB-1996  --RAC: Created from a copy of PROCDB
*
*  CALLED BY:   CUTTINGS {main program}
*
*  CALLS:       DBISIZES
*               DBITITLE
*               ADDMEM
*               DYNMEM
*               ZERODA
*               DYNMEMC
*               READBRAG
*
*  ARGUMENTS:
*  ENTRY/
*   --through subroutine call
*     MAXC    = Total no. of CHAR*1 words allocated to dynamic storage
*     MAXQ    = Total no. of words allocated to dynamic storage
*     IQ      = INTEGER Dynamic Q-array (equivalenced to Q)
*     LQ      = <LOGICAL> Dynamic Q-array (equivalenced to Q)
*     Q       = REAL Dynamic memory base array
*     C       = CHARACTER Dynamic memory base array
*     IERRDB  = INTEGER error code
*
*  LOCAL/
*     MORMEMC= No. additional words to be allocated to C array
*     MORMEMR= No. additoinal words to be allocated to Q array
```

```
*
*  EXIT/
*
*****
*************************************************************************
*!
*     Subroutine cal_bra
*************************************************************************
*****                                                                ****
*****            CALIBRATION  checks out model2 with experiments     ****
*****            --- ---                                             ****
*
*  PURPOSE:    To calibrate model2 with experimential data or WIPP data
*               also validate's model2 over possible WIPP variable
*               ranges
*              This subroutine gets activated by defining the LOGICAL
*               variable CUSP$CHECK_OUT to TRUE. This subroutine
*               expects to find the first keyword on the TXT1 input file
*               either CALIBRATE, EXPERIMENT, or VALIDATE
*
*
*  AUTHOR:      Robert A. Cole
*
*  CREATED:     02-FEB-1996  --RAC:
*
*  CALLED BY:   CUTTINGS {main program}
*
*  CALLS:       CAL_INP
*               SOLID_OUT
*
*  LOCAL/
*************************************************************************
*!
*     Subroutine cal_inp (test_funct)
*************************************************************************
*****                                                                ****
*****            CALibration INPut   Reads input for calibration     ****
*****            ---         ---                                     ****
*
*  PURPOSE:    To read input required for CALIBRATION, VERIFICATION,
*               & EXPERIMENT
*
*  AUTHOR:      Robert A. Cole
*
*  CREATED:     02-FEB-1996  --RAC:
*
*  CALLED BY:   CAL_BRA
*
*  CALLS:       NEXT0
*               NEXTW
*               NEXT_R
*               NEXT_I
*
*************************************************************************
*!
*     Subroutine drill( iwasflg, ihit, xtint, dbdiam, tunits, xnewarea)
*
*************************************************************************
*****                                                                ****
*****     D_R_I_L_L_ing  through  radwaste  repository  module       ****
```

```
*****     - - - - -                                                    ****
*
*  PURPOSE:     Calculates new borehole area based on drilling and
*               penetrating either:
*
*               (1) WIPP repository containing CH or RH type
*                   transuranic waste, or
*               (2) Hypothetical INEL/WINCO repository containing
*                   HLW/SNF waste.
*
*  AUTHORS:     Jerry W. Berglund
*               Jonathan S. Rath
*
*  CALLED BY:   CUTTINGS {main program}
*
*  CALLS:       QAABORT
*               INTERFACE
*               FRICTION {REAL function}
*               F11 {REAL function}
*               F12 {REAL function}
*               F13 {REAL function}
*               F21 {REAL function}
*               F22 {REAL function}
*               F23 {REAL function}
*               F31 {REAL function}
*               F32 {REAL function}
*               F33 {REAL function}
*               EF1 {REAL function}
*               EF2 {REAL function}
*               EF3 {REAL function}
*
*  ARGUMENTS:
*   ENTRY/
*    --through subroutine call
*      IWASFLG= WIPP TRU waste type flag [INTEGER]
*             = 1; Contact Handled (CH) TRU waste
*             = 2; Remote Handled (RH) TRU waste
*      IHIT   = Intrusion (or hit) index [INTEGER]
*      XTINT  = Time of this intrusion (or hit) [REAL]
*      DBDIAM = Drill Bit Diameter for this intrusion (or hit);
*               (Outside diameter of drillstring annulus) [REAL]
*      TUNITS = Units of time (i.e. seconds, years, etc...) [CHAR*8]
*
************************************************************************
*!    Integer function fgrad (input)
************************************************************************
*****                                                                ****
*
*  PURPOSE:   To determine the number of unique radionuclides
*
*  AUTHOR:     Robert A. Cole
*
*  CREATED:    02-FEB-1996  --RAC:
*
*  CALLED BY:  PROCIN
*
*****                                                                ****
************************************************************************
*!
*     Real function gasers (xdbdia, flowrate, drate, depth, hrepo,
```

```
*                              flwcnst, poroi)
*************************************************************************
*****                                                                ****
*****  Equivalent G_A_S_ E_R_o_S_i_o_n,    repository removed        ****
*****                - - - -    -      -                            ****
*
*  PURPOSE:     Calculates equivalent area of repositoy removed because
*               gas erosion:
*
*  AUTHORS:     Robert A. Cole
*
*  UPDATED:     02-FEB-1996  --RAC: Deletet write for DBSPALL
*               xx-JUL-1994  --RAC: Created
*
*  CALLED BY:   CUTTINGS (main program)
*
*  CALLS:       NONE
*
*  ARGUMENTS:
*   ENTRY/
*    --through function arguments
*      DHOLE  = Radius of borehole
*      FLOWRATE=Recommended (from handbook formula) drilling fluid
*               (mud) flowrate based on drillstring diameter [REAL].
*      TCLOUT = Cleanout time for stuck pipe (s)
*      HREPO  = Height of repository (m)
*      POROI  = Initial porosity
*
*   EXIT/
*    --through fucntion value
*      GASERS = Equivalent area of repository removed (REAL)
*
*************************************************************************
*!
*     Subroutine gencut( iwasflg, diammod, aintc,   tint,    nnic,
*    $                   radchn,  nucnam,  MAPSAV,  idmtrl,  halfy,
*    $                   awt,     actcnv,  xmoles,  eparel,  cipmsq,
*    $                   cizero,  sumci,   radhis,  xnorm,   xinvt0,
*    $                            cizersv, xporo,   xprgs,   xprbr,
*    $                   xsatb,   mapinv,  c,       q,       kultp )
*************************************************************************
*****                                                                ****
*****      G_E_N_erate  amount  of  C_U_T_tings  module              ****
*****      - - -                    - - -                            ****
*
*  PURPOSE:     Determines the drill cuttings (in Curies) brought to
*               the surface.  Using the intrusion borehole diameter
*               and intrusion time, the routine determines the amount
*               of cuttings, and ages the cuttings to the intrusion
*               time.
*
*  AUTHORS:     Harold J. Iuzzolino
*               Jonathan S. Rath
*
*  MODIFIED:    Robetr A. Cole
*
*
*  CALLED BY:   CUTTINGS (main program)
*
*  CALLS:       WRTANA
```

```
*                QAMAXERR
*                WRPLFIL
*
*   FUNCTIONS:   QUANKG
*                GINDX
*                GJNDX
*
*   ARGUMENTS:
*    ENTRY/
*     --through subroutine call
*       IWASFLG= radWASte type FLaG (INTEGER)
*              = 1; WIPP Contact Handled (CH) TRU waste
*              = 2; WIPP Remote Handled (RH) TRU waste
*              = 3; INEL/WINCO HLW/SNF
*       DIAMMOD= Outside diameter of drillstring annulus, for each
*                intrusion or hit, array (REAL).
*       AINTC  = Borehole area, as computed by DRILL routine array
*       TINT   = Intrusion times of each hit, in SECONDS array (REAL)
*       NNIC   = No. of Nuclides in each decay chain, array (INTEGER)
*       RADCHN = Names of radioisotopes in each chain, array (CHAR*8)
*       NUCNAM = Names of radioisotopes used by CUTTINGS (CHARACTER*8)
*       IDMTRL = Names of Generic Radioisotope Data Base (GRDB)
*                entries, array (CHARACTER*8)
*       HALFY  = Half-Life of each radioisotope in GRDB [years],
*                array (REAL)
*       AWT    = Atomic WeighT of each radioisotope in GRDB [Kg/Mole],
*                array (REAL)
*       ACTCNV = ACTivity CoNVersion of each radioisotope in
*                GRDB [Ci/Kg], array (REAL)
*       XMOLES = Dummy array used (REAL)
*       CIMPSQ = CURIES per SQ. METER at time zero (REAL)
*       CIZERO = CURIES of each radioisotope, at time zero (REAL)
*       EPAREL = EPA normalization factor for each radioisotope in
*                GRDB, array (REAL)
*       MAPSAV = Map of unique names of radioisotopes to be saved
*                 MAPSAV(I) .GT. 0 save
*                 MAPSAV(I) .EQ. 0 do not save
*                to output CAMDAT and debug/diagnostics file (CHAR).
*       CIZERSV= Values of radioisotopes to be written to the
*                output CAMDAT and debug/diagnostics file (REAL).
*       C      = Dynamic base array (CHARACTER*1)
*       Q      = Dynamic base array (REAL)
*
*   LOCAL/
*
*   EXIT/
*     --through subroutine call
*       RADHIS = Radioisotope Inventory (Curies) History array [REAL]
*       SUMCI  = Sum of all hits (in Curies) for each radioisotope
*                array (REAL)
*       XNORM  = Normalized radioisotope relaese array (REAL)
*       XINVT0 = Inventory at time=0, array [REAL]
*
*!
*                          Types of data sets
*                          ------------------
*
*   INPUT/
*     BINARY: in units 'IDB'
*     ASCII:  in units 'INPUTP','INPUTF','INPSDB'
```

```
*     BINARY: in UNITS 'IBRAG'
*
*   OUTPUT/
*     BINARY: in units 'ODB', 'DB_BIN'
*     ASCII:  in units 'ICTRN', 'IHISTO','IPLT1','IPLT2','IPLT3',
*                      'NHISTO','NOUTFL','NVERFY', 'DB_ASC'
*
*                              Files used
*                              ----------
*
*   $DEFINE  logical-name   file-path-name
*
*   logical file name   unit  description
*
*   'CUSP_INP$TXT0'       1    Input text file (REQUIRED) (Radionuclide
*                               input, Model & Site specific properities)
*                                 or if CUSP_INP$TXT0 is not defined
*   'CUSP_INP$BIN0'       1    Input binary file (REQUIRED) (Radionuclide
*                               input, Model & Site specific properities)
*                                 or
*   'CUSP_INP$TXT1'       2    Input text file (REQUIRED) (Drilling
*                               properities and to controll testing inputs
*   'CUSP_INP$BRAGCDB'    7    Input BRAGFLOW CDB file (OPTIONAL)
*   'CUSP_OUT$DBG'        8    Output debug File
*   'CUSP_INP$CDB'       10    Input Computational Data Base (REQUIRED)
*   'CUSP_OUT$CDB'       11    Output CDB File (REQUIRED)
*
*                              The following files are (OPTIONAL):
*   'CUSP_OUT$NVERFY'     9    Output verify File
*   'CUSP_OUT$IHISTO'    20    Output Radionuclide Inventory History
*   'CUSP_OUT$NHISTO'    21    Output Normalized History file
*   'CUSP_OUT$PLT1'      22    Output radioisotope decay plot file (long)
*   'CUSP_OUT$PLT2'      23    Output radioisotope decay plot file (medium
*   'CUSP_OUT$PLT2'      24    Output radioisotope decay plot file (short)
*   'CUSP_OUT$ICTRN'     25    Output CCDFPERM transfer file
*
*
*                              The following files are required for
*                               CUSP$PRE_CUTTINGS:
*
*   'CUSP_INP$CDB'       10    Input Computational Data Base (REQUIRED)
*   'CUSP_INP$SDB'        4    Secondary Data Base Flatfile
*                               (REQUIRED pre_cuttings)
*   'CUSP_INP$TXT1'       2    Input text file (REQUIRED) (Drilling
*                               properities and to controll testing inputs
*   'CUSP_OUT$DBG'        8    Output debug File
*   'CUSP_OUT$DB_ASC'    12    Output  ascii SDB file
*   'CUSP_OUT$DB_BIN'    13    Output binary SDB file
*
*************************************************************************
*!
*************************************************************************
****              PARBIN0                                              ****
*                                                                       ****
*   PURPOSE:      reads a CUTTINGS binary file for parameters inputs    ****
*                                                                       ****
*   AUTHOR:       Robert A. Cole                                        ****
*                                                                       ****
*   UPDATED:      02-FEB-1996  --RAC: First Ed.                         ****
*                                                                       ****
```

```
*  CALLED BY:    PROBIN                                                  ****
*                                                                        ****
*  CALLS:        QAABORT                                                 ****
*                                                                        ****
*****                                                                   ****
*!
*     Subroutine partxt0
************************************************************************
****                                                                    ****
****        P_A_R_a_m_e_t_e_r_s SCAN of  T_e_X_T  file                   ****
****        - - -                       -   - -                         ****
*
*  PURPOSE:      reads a CUTTINGS input text file for parameters inputs
*
*  AUTHOR:       Robert A. Cole
*
*  UPDATED:      02-FEB-1996  --RAC: First Ed.
*
*  CALLED BY:    PROCIN
*                MAIN (CHK_OUT)
*
*  CALLS:        NEXT0
*                NEXT_I
*                NEXT_R
*
*  ARGUMENTS:
*  ENTRY/
*    --through subroutine call (none)
*
************************************************************************
*!
*     Subroutine prepro( fidb, ftxt0, fbin0, ftxt1, fodb, fbrg )
*
*  PURPOSE:     Interacts with DEC DCL stream to determine input &
*                outputs file and logical settings
*
************************************************************************
*!
*     Subroutine probin( maxq,    maxc,     iq,      lq,       q,
*    $                   c,       komat,    outmat,  iwasflg,  tunits,
*    $                   nqarec,  c(lqainfo) )
************************************************************************
****                                                                    ****
*
*  PURPOSE:     Processes the CUTTINGS binary file (BIN0) information
*                       & the CUTTINGS ASCII  file (TXT1) information
*
*  AUTHOR:      Robert A. Cole
*  CALLED BY:   CUTTINGS {main program}
*
*  CALLS:       SCABIN0
*               SCATXT1
*               PARBIN0
*               ADDMEM2
*               DYNMEM
*               DYNMEMC
*               ZERODA
*               REABIN0
*               REATXT1
*               REAEPA
```

```
*
*  ARGUMENTS:
*  ENTRY/
*   --through subroutine call
*     MAXQ    = Total no. of REAL words allocated (INTEGER)
*     MAXC    = Total no. of CHARACTER*1 words allocated (INTEGER)
*     IQ      = INTEGER Dynamic Q-array (equivalenced to Q)
*     LQ      = <LOGICAL> Dynamic Q-array (equivalenced to Q)
*     Q       = REAL Dynamic memory base array
*     C       = CHARACTER Dynamic memory base array
*
*  EXIT/
*   --through subroutine call
*     MAXQ    = Total no. of REAL words allocated (INTEGER)
*     MAXC    = Total no. of CHARACTER*1 words allocated (INTEGER)
*     KOMAT   = CAMDAT material index to which CUTTINGS output
*               variables will be written as material property values
*               (INTEGER)
*     OUTMAT = CAMDAT material name to which CUTTINGS output
*               variables will be written as material property values
*               (CHARACTER*8)
*     IWASFLG= radWASte type FLaG (INTEGER)
*            = 1; WIPP Contact Handled (CH) TRU waste
*            = 2; WIPP Remote Handled (RH) TRU waste
*            = 3; INEL/WINCO HLW/SNF waste(s)
*     TUNITS = Units associeated with the time of intrusions (CHAR*8)
*
*****************************************************************************
*!
*     Subroutine prosdb( maxc, maxq, iq, lq, q, c , iwasflg, qainfo )
*
*****************************************************************************
****                                                                     ****
*                                                                       ****
*  PURPOSE:     Read a flat ascii flat to extract properities &         ****
*                data from the INGRESS data base                        ****
*                                                                       ****
*  AUTHOR:      Robert A. Cole                                          ****
*                                                                       ****
*  UPDATED:     02-FEB-1996  --RAC: First Ed.                           ****
*                                                                       ****
*  CALLED BY:   PROSDB  used by PRE_CUSP                                ****
*                                                                       ****
*  CALLS:       SCATXT0                                                 ****
*               SDBQUERY                                                ****
*               REASDB                                                  ****
*               PROCIN                                                  ****
*               CMDREAD                                                 ****
*               CHCASE                                                  ****
*               BLANK                                                   ****
*               SORT                                                    ****
*               QAABORT                                                 ****
*                                                                       ****
****                                                                     ****
*!
*****************************************************************************
****             REABIN0                                                 ****
*                                                                       ****
*  PURPOSE:     Reads a CUTTINGS binary file                            ****
*                                                                       ****
```

```
*  AUTHOR:       Rovert A. Cole                                          ****
*                                                                        ****
*  UPDATED:      02-FEB-1996  --RAC: First Ed.                           ****
*                                                                        ****
*  CALLED BY:    PROBIN                                                  ****
*                                                                        ****
*  CALLS:        QABORT                                                  ****
*                                                                        ****
****                                                                     ****
*!
*     Subroutine readbrag (diammod, poro, presgas,
*    &                     presbrn, SATGASX, nhits, tint,
*    &                     ele_n, ele_id, ele_blk, att_n,
*    &                     gridvol, prop_n, lvar_b, ele_prp,
*    &                     ele_hprp, ilog, MULTP, ierrdb)
************************************************************************
*
*  PURPOSE:   To extract the BRAD CDB file information
*
*    Arguments to this subroutine
*
*     MULTP    = Number  of multiple intrusions into BRAGCDB file at
*                  same intrusion time
*     DIAMMOD  = the drill diameter
*     PORO     <= the porosity in the repository
*     PRESGAS  <= the pressure of the gas in the repository
*     PRESBRN  <= the pressure of the brine in the repository
*     SATGASX  <= the saturation of the brine in the repository
*     NHITS    => number of intrusions
*     TINT     => the intrusion times
*     ELE_N    <= the element block names
*     ELE_ID   <= the element block id's
*     ELE_BLK  <= the number of elements per block
*     ATT_N    <= the attributes names
*     GRIDVOL  <= the array for the grid volumes
*     PROP_N   <= the property names
*     LVAR_B   <= logical property table
*     ELE_PRP  <= element property values
*     ELE_HPRP <= element history property values
*     IERRDB   <= the error flag returned from call to "DBI---"
*
************************************************************************
*!
************************************************************************
****                                                                    ****
*                                                                       ****
*  PURPOSE:      Extract a property value from an INGRES data base      ****
*                                                                        ****
*  AUTHOR:       Robert A. Cole                                          ****
*                                                                        ****
*  UPDATED:      02-FEB-1996  --RAC: First Ed.                           ****
*                                                                        ****
*  CALLED BY:    PROSDB  used by PRE_CUSP                                ****
*                                                                        ****
*  CALLS:        SDBGETL                                                 ****
*                QAABORT                                                 ****
*                                                                        ****
****                                                                    ****
*!
************************************************************************
```

```
****              SCABIN0                                          ****
*                                                                  ****
*  PURPOSE:       Reads a binary parameter/data file for           ****
*                         sizing parameters                        ****
*                                                                  ****
*  AUTHOR:        Robert A. Cole                                   ****
*                                                                  ****
*  UPDATED:       02-FeB-1996  --RAC: First Ed.                    ****
*                                                                  ****
*  CALLED BY:     PROCIN                                           ****
*                                                                  ****
*  CALLS:                                                          ****
*                                                                  ****
****                                                               ****

      Usefull text extracted from include code

*!
*     /BLOWPROP/ (from FORTRAN statement: include 'CUSP_BLOWPROP.INC')
*
*     PURPOSE:     Provide common space for model 1 & model 2 properties
*                   & WIPP site specific properties
*
*     AUTHOR:      Robert A. Cole
*
*     UPDATED:     02-FEB-1996  --RAC: Added model2
*
*      BRAGCDB = <LOGICAL> <default true>
*                  true    <=> reads BRAGFLOW "CDB", WIPP run
*                  false   <=> check out runs, test problems
*
*      CHK_OUT = <LOGICAL> <default false>
*                  false   <=> WIPP run
*                  true    <=> calibration for experiments
*
*      MODTYPE = Model type:
*                MODEL1
*                MODEL2
*
*      Model 1 & 2 specific inputs:
*
*      The following values are input through the code via
*       the logical input file CUSP_INP$TXT0:
*
*      PR_MAX = The maximum pressure allowed by model
*      PR_MIN = The minimum pressure allowed by model
*      PE_MAX = The maximum permeability allowed by model
*      PE_MIN = The minimum permeability allowed by model
*      PCUT   = Pressure (Pa) which defines the border between the
*               erosion phase and the blowout phase
*      PGAS   = Pressure (Pa) which defines the border between the gas
*               erosion phase and the stuck pipe phase
*      KCRIT  = Permeability which defines the phase border the blowout
*               phase and the gas-erosion/stuck pipe phase
*
*      Model 2 specific inputs:
*
*      DELTR  = Delta radius for derivative in stress calculation
*      FGE    = Gravity     effectiveness factor
*      FSE    = Strength    effectiveness factor
```

```
*       FCE    = Cementation effectiveness factor
*       CEMSIG = Cementation Stress
*       ITER   = Number of iteration to solve for reynolds number
*       SUFTEN = Surface Tension
*
*       Hydrogen specific constants (or Air for Experiments)
*
*       KGAS   = Ration of specific heats (unitless)
*       RGAS   = Gas Constant
*       VISC   = Hydrogen viscosity
*       CHY*   = Hydrogen sound speed (m/s), calculated from:
*                  CHY = SQRT (KGAS * RGAS * TREPO)
*
*       Repository/site specific inputs:
*
*       TREPO  = Temperature of repository (K)
*       RHO1*  = Gas Density in WIPP room  (kg/m**3), calcutated from:
*                RHO1 = PG / TREPO / RGAS
*       PSUF   = Surface presure (Pa)
*       DEPTH  = Distance from repository depth to depth where casing
*                is set (m)
*       HREPO  = Height of repository at burial time       (4m)
*       RPANEL = The equivalent radius of 1 panel     (910.0m**2)
*       ROOM   = The equivalent radius of 1 room      (11,640m**2)
*       RHOS   = Waste particle density (kg/m**3)
*       INPORO = Initial repository porosity
*                Use in CALIBRATION runs
*                Production run uses value from BRAG CDB file
*
*       Drilling specific inputs:
*
*       L1     = Collar Length (m)
*       L2     = Drill pipe length (m)
*       COLDIA = Collar diameter (m)
*       PIPED  = Drill pipe diameter (m)
*       FRICTF = Friction factor (unitless)
*       FLWCNST= Percent volume of material that is carried by Drilling
*                mud (unitless)
*
*
*       APORO  = A constant in equation to determine permeability as a
*                function of porosity
*       NPORO  = N constant in equation to determine permeability as a
*                function of porosity
*
*                permeability = APORO *  porosity ** NPORO
*
******
************************************************************************
*!
*     /BRGPAR/ ($include 'CUSP_BRGPAR.INC')
*      HEADER_B  = Character description of problem, etc...
*      IMAX_B    = No. of I-lines in grid
*      JMAX_B    = No. of J-lines in grid
*      KMAX_B    = No. of K-lines in grid
*      LESSEL_B  = List of Element Side sets concatenated Element List
*      LESSNL_B  = List of Element Side sets concatenated Nodes associate
*                  with each element side set Node List
*      LNPSNL_B  = List of Nodal Point set concatenated Nodes List
*      MAXNENO_B = Max. no. of nodes of any element
```

```
*      NDIM_B     = Number of physical DIMensions
*      NDBCAM_B   = CAMDAT versoin number
*      NELBLK_B   = Number of ELement BLocKs in mesh
*      NELX_B     = No. of elements along X-axis of mesh
*      NELY_B     = No. of elements along Y-axis of mesh
*      NELZ_B     = No. of elements along Z-axis of mesh
*      NQAREC_B   = Number of QA records
*      NSTEP_B    = No. of time steps in input CAMDAT (INTEGER)
*      NUMEL_B    = NUmber of ELeMents in mesh
*      NUMNOD_B   = NUMber of NODes in mesh
*      NUMNPS_B   = No. of Nodal Point Sets
*      NUMESS_B   = No. of Element Side Sets
*      NUQATR_B   = No. of UniQue ATtRibute names
*      NUQPR0_B   = No. of UniQUe PRoperty names (old)
*      NUQPRP_B   = No. of UniQUe PRoPerty names (new)
*      NVAREL_B   = No. of ELEMENT type ANALYSIS variables
*      NXINFO_B   = No. of information records
*
******
************************************************************************
*!
************************************************************************
*     /CMM_INP/ ($include 'CUSP_CAL_INP.INC')
*      FSEMIN  = Minimum FSE
*      DELFSE  = Delta  FSE
*      IFSE    = No of increment of FSE
*      FGEMIN  = Minimum FGE
*      DELFGE  = Delta  FGE
*      JFGE    = No of increment of FGE
*      FCEMIN  = Minimum FCE
*      DELFCE  = Delta  FCE
*      KFCE    = No of increment of FCE
*      SATMIN  = Minimum SAT
*      DELSAT  = Delta  SAT
*      ISA     = No of increment of SAT
*      PGMIN   = Minimum PG
*      DELPG   = Delta  PG
*      IPG     = No of increment of PG
*      PORMIN  = Minimum POR
*      DELPOR  = Delta  POR
*      DIA     = Diameter
*      POROST  = Porosity
*      IPOR    = No of increment of POR
*      PARTMIN = Minimum diameter
*      PARTMAX = Maximum diameter
*      PARTMUL = Particle multiplier
*      ITMAX   = Maximum number of trys for search of FGE, FSE, & FCE
*      DELERR  = Delta error on convergence
******
************************************************************************
*!
************************************************************************
*      /FILEUN/ (from FORTRAN statement: include 'CUSP_FILEUN.INC')
*       ICTRN  = Device no. of output CCDFPERM transfer file
*       IDB    = Device no. of input CAMDAT file
*       IDBSCR = Device no. of CAMDAT scratch file
*       IHISTO = Device no. of Radioisotope Inventory History file
*       INPUTP = Device no. of input text file or binary file:
*                              Model specific parameters
*                              Site specific parameters
```

```
*                              Radioisotope infomation
*      INPUTF = Device no. of input text file
*      INPSDB = Device no. of secondary data base SDB
*      IPLT1  = Device no. of plotting file #1 ("long-lived")
*      IPLT2  = Device no. of plotting file #2 ("medium-lived")
*      IPLT3  = Device no. of plotting file #3 ("short-lived")
*      NHISTO = Device no. of Normalized Release History file
*      NOUTFL = Device no. of output diagnostics/debug file
*      NVERFY = Device no. of output verify file
*      ODB    = Device no. of output CAMDAT file
*      IBRAG  = Device no. of Bragflow "CDB" file
*      DB_ASC = Device no. of output SDB  ascii file
*      DB_BIN = Device no. of output SDB binary file
*      ISCR3  = Device no. of scratch storage #3
*************************************************************************
*
*!
*************************************************************************
*    /MISCDAT/ (from FORTRAN statement: include 'CUSP_MISCDAT.INC')
*       Intrusion times are in years
*     NCHAINS = No. of unique radioisotope decay chains (INTEGER)
*     NGRAD   = No. of generic radioisotopes or radionuclides (INTEGER)
*     NHITS   = No. of hits or intrusions (INTEGER)
*     NNUC    = No. of radionuclides used in CUTTINGS (INTEGER)
*     NORIAC  = No. Of Radioisotopes In All Chains (INTEGER)
*     NRADPR  = No. of RADionuclides to be PRinted (saved to
*               output CAMDAT and written to debug/diagnostics
*               file) [INTEGER]
*     SUMCUR  = Sum of all Radioisotope inventory, in Curies (REAL)
*     MULTP   = Number of multiple hits at the same intrusion time
*               Default is 1 if there is no BRAGCDB file
******
*************************************************************************
*!
*************************************************************************
*     /RDBRAGx/ (from FORTRAN statement: include 'CUSP_RDBRAG.INC')
*
*      NULTP  = Maximum number of hits into brag calculation
*!
*************************************************************************
*    /TOOLS/  (from FORTRAN statement: include 'CUSP_TOOLS.INC')
*     DEBUG  =  <LOGICAL>for debugging dynamic memory allocation
*     DBRAG  =  <LOGICAL>for debugging reading bragflow CDB file
*     NOECHO =  <LOGICAL>for no echoing of input to the DBG file
*     VERIFY = <LOGICAL> for writing a file for verifing purposes
*     PRE_CUSP = <LOGICAL> <default false>
*                   false   <=> Calculation
*                   true    <=> Pre_cusp, read SDB data base
*     PLODEC =  <LOGICAL>for writing long, medium, and short half-life
*               radioisotope decay history plot files.
*     WRTCTRN= <LOGICAL> for writing output CCDFPERM transfer file
*     WRTHIS = <LOGICAL> for writing RAD WASTE-radioisotope inventory
*              history table.
*     WRTNHIS= <LOGICAL> for writing Normalized Radioisotope
*              Inventory History
*

      Strucure of where how TXT0 file is read in:

      SUBROUTINE PARTXT0                                              6720
```

```
                                                        Absolute line nunber ^^^^
      IF (CMD .NE. 'MODEL_DATA') GO TO 100                                    74
      IF (CMD .EQ. 'RADIONUCLIDE_DATA') GO TO 900                             75
      IF (CMD .EQ. 'EOF')                GO TO 900                            81
      IF (CMD .EQ. 'PR_MAX') THEN                                             85
      IF (CMD .EQ. 'PR_MIN') THEN                                             92
      IF (CMD .EQ. 'PE_MAX') THEN                                             99
      IF (CMD .EQ. 'PE_MIN') THEN                                            106
      IF (CMD .EQ. 'PCUT') THEN                                              113
      IF (CMD .EQ. 'PGAS') THEN                                              120
      IF (CMD .EQ. 'KCRIT') THEN                                             127
      IF (CMD .EQ. 'DELTR') THEN                                             134
      IF (CMD .EQ. 'FGE') THEN                                               141
      IF (CMD .EQ. 'FSE') THEN                                               148
      IF (CMD .EQ. 'FCE') THEN                                               155
      IF (CMD .EQ. 'CEMENT') THEN                                            162
      IF (CMD .EQ. 'ITER') THEN                                              169
      IF (CMD .EQ. 'SUFTEN') THEN                                            176
      IF (CMD .EQ. 'KGAS') THEN                                              183
      IF (CMD .EQ. 'RGAS') THEN                                              190
      IF (CMD .EQ. 'VISC') THEN                                              197
      IF (CMD .EQ. 'TREPO') THEN                                             204
      IF (CMD .EQ. 'PSUF') THEN                                              211
      IF (CMD .EQ. 'DEPTH') THEN                                             218
      IF (CMD .EQ. 'HREPO') THEN                                             225
      IF (CMD .EQ. 'RPANEL') THEN                                            232
      IF (CMD .EQ. 'ROOM') THEN                                              239
      IF (CMD .EQ. 'RHOS') THEN                                              246
      IF (CMD .EQ. 'L1') THEN                                                253
      IF (CMD .EQ. 'L2') THEN                                                260
      IF (CMD .EQ. 'COLDIA') THEN                                            267
      IF (CMD .EQ. 'PIPED') THEN                                             274
      IF (CMD .EQ. 'ROUGHP') THEN                                            281
      IF (CMD .EQ. 'FLWCNST') THEN                                           288
      IF (CMD .EQ. 'APORO') THEN                                             295
      IF (CMD .EQ. 'NPORO') THEN                                             302
      IF (CMD .EQ. 'MODEL1') THEN                                            309
      IF (CMD .EQ. 'MODEL2') THEN                                            317
                                                        Relative line nunber ^^^^
```

```
      SUBROUTINE REATXT0( NNIC,   RADCHN, IDMTRL, NUCNAM,                    9513
                                                        Absolute line nunber ^^^^
      IF (CMD .NE. 'RADIONUCLIDE_DATA')  GO TO 100                            122
      IF (CMD .EQ. 'EOF') GO TO 500                                           129
      IF (CMD(1:5) .EQ .'CHAIN') THEN                                         131
      IF (CMD .EQ. 'SAVE') THEN                                               162
      IF (CMD .EQ. '<TABLE_INPUTS') THEN                                      182
        IF (CMD .EQ. 'END_TABLES>') GO TO 110                                 188
      IF (CMD(1:1) .EQ. '*') THEN                                             237
          IF (CMD .EQ.   'AWT') THEN                                          254
          IF (CMD .EQ.   'HALFS') THEN                                        261
          IF (CMD .EQ.   'ACTCNV') THEN                                       268
          IF (CMD .EQ.   'EPAREL') THEN                                       275
          IF (CMD .EQ.   'INVEN') THEN                                        282
                                                        Relative line nunber ^^^^
```

```
      SUBROUTINE SCATXT0( IWASFLG, NAMELB, KOMAT,  OUTMAT, IDMTRL,       11038
                                                    Absolute line nunber ^^^^
      IF (CMD .NE. 'RADIONUCLIDE_DATA') GO TO 100                         133
      IF (CMD .EQ. 'EOF')    GO TO 900                                    139
      IF (CMD(1:5).EQ.'CHAIN') THEN                                       144
        IF (CMD(1:4).EQ.'SAVE')THEN                                       177
      IF (CMD(1:6) .EQ. 'INV_AR') THEN                                    203
      IF (CMD(1:6) .EQ. 'RHW_AR') THEN                                    221
      IF (CMD(1:3) .EQ. 'WUF') THEN                                       239
      IF (CMD(1:7) .EQ. 'OUT_MAT') THEN                                   257
      IF (CMD(1:6) .EQ. 'RADWAS') THEN                                    295
          IF (CMD(1:3) .EQ. 'CON' .OR.                                    301
     &        CMD(1:2) .EQ. 'CH')       THEN                             ^
          IF (CMD(1:3) .EQ. 'REM' .OR.                                    306
     &        CMD(1:2) .EQ. 'RH')       THEN                             ^
          IF (CMD(1:3) .EQ. 'INE') THEN                                   311
       IF (CMD(1:8) .EQ .'REP_NAME') THEN                                 325
       IF (CMD(1:8) .EQ .'REP_GEOL') THEN                                 346
       IF (CMD(1:6) .EQ .'DISPOS') THEN                                   365
       IF (CMD(1:4) .EQ .'PACK') THEN                                     385
       IF (CMD .EQ. '<TABLE_INPUTS') THEN                                 405
         IF (CMD .EQ. 'END_TABLES>') GO TO 120                            413
         IF (CMD(1:1) .EQ. '*') THEN                                      415
                                                    Relative line nunber ^^^^
```

Strucure of where how TXT1 file is read in:

```
      SUBROUTINE REATXT1( IASPRP,  NAMELB,  NMATPR, XMATPR, TINT,         10016
                                                    Absolute line nunber ^^^^
      IF (CMD .EQ. 'EOF') GO TO 666                                       108
      IF (CMD .EQ. 'UNITS') THEN                                          113
          IF (CMD .EQ. 'SECONDS')THEN                                     119
      IF (CMD .EQ. 'TINTR') THEN                                          135
      IF (CMD .EQ. 'DIAMMOD') THEN                                        165
      IF (CMD .EQ. 'TCLOUT') THEN                                         194
      IF (CMD .EQ. 'PARTDIA') THEN                                        222
      IF (CMD .EQ. 'CEMENT') THEN                                         250
      IF (CMD .EQ. 'FGE') THEN                                            278
      IF (CMD .EQ. 'FSE') THEN                                            306
      IF (CMD .EQ. 'FCE') THEN                                            334
      IF (CMD .EQ. 'POROSITY') THEN                                       362
      IF (CMD .EQ. 'PRESSURE') THEN                                       390
      IF (CMD .EQ. 'SATBRIN') THEN                                        418
                                                    Relative line nunber ^^^^
```

```
      SUBROUTINE SCATXT1( IWASFLG, IASPRP, XMATPR, NAMELB, NMATPR,        11604
                                                    Absolute line nunber ^^^^
      IF (CMD .EQ. 'EOF') GO TO 90                                        115
      IF (CMD(1:5) .EQ. 'NHITS') THEN                                     117
      IF (CMD .EQ. 'EOF') GO TO 999                                       162
      IF (CMD(1:5) .EQ. 'TINTR') THEN                                     165
      IF (CMD .EQ. 'DIAMMOD') THEN                                        194
```

```
IF (CMD .EQ. 'TCLOUT') THEN                                          223
IF (CMD .EQ. 'PARTDIA') THEN                                         252
IF (CMD .EQ. 'DNSFLUID') THEN                                        281
IF (CMD .EQ. 'DOMEGA') THEN                                          307
IF (CMD .EQ. 'ABSROUGH') THEN                                        334
IF (CMD .EQ. 'TAUFAIL') THEN                                         361
IF (CMD .EQ. 'VISCO') THEN                                           388
IF (CMD .EQ. 'YLDSTRSS') THEN                                        415
IF (CMD(1:5) .EQ. 'INTR_' .AND. BRAGCDB) THEN                        442
    IF (CMD .EQ. 'NO_GRDVOL') THEN                                   477
IF (CMD .EQ. 'DIABRAG') THEN                                         509
IF (CMD .EQ. 'GRIDVOL') THEN                                         530
IF (CMD .EQ. 'PORO_NM') THEN                                         551
IF (CMD .EQ. 'PRGS_NM') THEN                                         572
IF (CMD .EQ. 'PRBR_NM') THEN                                         593
IF (CMD .EQ. 'SATG_NM') THEN                                         614
IF (CMD .EQ. 'POROSITY') THEN                                        635
IF (CMD .EQ. 'PRESS') THEN                                           668
IF (CMD .EQ. 'SATBRIN') THEN                                         697
                                          Relative line nunber ^^^^
```

END OF APPENDIX L