

Appendix K: FORTRAN Program to Convert NUTS's Binary Output to a Readable Format

NUTS_BIN_READ Procedure:

A FORTRAN listing for the procedures that can be used to read the binary files from NUclide Transport System (NUTS) is provided in this appendix. A description of the variables and a descriptive line before the main functions of the procedure are also included to increase the readability of the subroutines.

```
C
C***** START SUBROUTINE NUTS_BIN_READ *****
C
C          SUBROUTINE NUTS_BIN_READ
C
C-----
C
C          NUTS_BIN_READ
C
C          Purpose:
C          -----
C          This subroutine reads NUTS output binary file
C
C          Author:      Ali A. Shinta
C          -----
C
C          Call:  BRE33D, BRE23D
C
C          Arguments:
C          -----
C  DXGRID      Grid block length in x-direction
C  DYGRID      Grid block length in y-direction
C  DZGRID      Grid block length in z-direction
C  ZTIME       Total time
C  IFLAGTIME   Flag = 0 for time = 0 and 1 otherwise
C  NO_TIMESTEP Time step no.
C  SDATE       Date of the run
C  STIME       Time of the run
C  NPNAME      Program name
C  NVERSION    Program version no.
C  NREVDAT     Revision date
C  NCPUNAME    Name of the machine on which the run is conducted
C  ANSWERTEST Flag to tell if the input is from BRAGFLO or stand alone file
C  FINFILETYPE Output files type
C  COMBTITLE   A combination of NUTS title and BRAGFLO or TEST run title
C  INTITLE     BRAGFLO or TEST run title
C  NUTS_TITLE  NUTS title
C  IDIMENSION  No. of dimensions
C  RADINPUT    Nuts input file name
C  FILE_NAME   BRAGFLO or test run input file name
C  RADOUTDBG   NUTS ASCII debug output file name
C  RADOUTPUT   NUTS output file name
C  RADOUTBIN   Output Binary name
C  RADOUTASC   Output ASCII file name
C  MEDIUM     Type of the porous medium (fracture, matrix, etc..)
C  FRACTUR    Logical flag to identify fracture continuum
C  MATRIX     Logical flag to identify matrix continuum
C  SINGLE_POROSITY Logical flag to identify single-porosity system
C  DUAL_POROSITY Logical flag to identify dual-porosity
C  DUAL_PERMEABILITY Logical flag to identify dual-permeability system
C  NBLOCK     Total number of grid blocks
C  NX OR IMAX No. of grid blocks in x-direction
C  NY OR JMAX No. of grid blocks in y-direction
C  NZ OR KMAX No. of grid blocks in z-direction
```

C NOCONTINUM No. of continuum
C NO_PHASES Number of phases
C X Grid block x-coordinate
C Y Grid block x-coordinate
C Z Grid block x-coordinate
C AXGRID Interblock area in x-direction (I,I-1)
C AYGRID Interblock area in y-direction (J,J-1)
C AZGRID Interblock area in z-direction (K,K-1)
C VRGRID Grid volume
C PHREQ Flag to identify pH dependency (Y/N)
C PHGRID Grid block ground water pH
C NSITES No. of radioactive sites
C NUCLIDE Total number of radionuclide
C SITE_NAME Name of the disposal site
C COMPONENT_NAME Component name
C NAME Component name
C Daughter_NAME Component daughter name
C ELEMENT_NAME Element name
C GROUP_NAME Group under which the isotope is classified, i.e: U for U235,238,.....etc.
C PARENT_NAME Component parent name
C NCOMPONENT No. of the components in each site
C WASTEVOL Site's waste.vol in M3
C COMPINT Initial inventory of the component in Kg.
C XMOLWT Molecular weight
C XLAMDA Decay constant of the component in 1/s.
C RAD Character to identify the component radioactivity (radioactive and not_radioactive)
C NOELEMENT No. of the input elements
C ELSOLB_LIMIT_COR Element solubility limit (Kg/M3) of block I
C ELTEMP_SOLB Logical variable to identify if the element solubility is temperature dependent
C ELEMNT_SOLE_LIMIT Element solubility limit
C C0-5 Solubility parameters for temperature dependency correlation
C PHASETYPE Phase type to be transported (liquid or gas)
C EQCI Intercept of the equilibrium line for gas solubility in the ground water
C EQCS Slope of the equilibrium line for gas solubility in the ground water
C IWASTE Waste matrix, 1=waste node, 0=no-waste node.
C ADSTYEM or F Flag to identify whether sorption is considered (Y/N)
C MAT_ISOOTHERM Type of the adsorp. isotherm in the matrix
C L/l=Linear,F/f=Freundlich,LA/La/la=Langumir
C FRAC_ISOOTHERM Type of the adsorp. isotherm in the fracture
C L/l=Linear,F/f=Freundlich,LA/La/la=Langumir
C MSORPTION Flag to identify whether the component is sorbable in the matrix (ADSORP/NON_ADSORP)
C MADSTEMPDEP Logical flag to identify whether the component sorption is temp. dependent
C FSORPTION Flag to identify whether the component is sorbable in the matrix (ADSORP/NON_ADSORP)
C FADSTEMPDEP Logical flag to identify whether the component sorption is temp. dependent

C XLMGRID Linear sorption coefficient in the matrix ((M3 fluid)/(Kg solid))
C XLFGRID Linear sorption coefficient in the fracture ((M3 fluid)/(Kg solid))
C XFDCMGRID Freundlich coefficient in the matrix (dimensionless).
C XFDCMGRID Freundlich distribution coefficient in the matrix ((M3 fluid)/(Kg solid)).
C XLCMGRID Langumir coefficient in the matrix (dimensionless).
C XLDCMGRID Langumir distribution coefficient in the matrix
C XFCFGRID Freundlich coefficient in the fracture (dimensionless).
C XFDFGRID Freundlich distribution coefficient in the fracture ((M3 fluid)/(Kg solid)).
C XLCFGRID Langumir coefficient in the fracture (dimensionless).
C XLDFGRID Langumir distribution coefficient in the fracture
C REFTEMPKD Reference temperature of Kd measurment
C ADSEXPCEFF Coefficient to adjust sorption at new temperature



C RHOGRID Grid block rock density (kg/m3)
 C MDISPREQ Flag to identify whether there is dispersion in the matrix (Y/N)
 C FDISPREQ Flag to identify whether there is dispersion in the matrix (Y/N)
 C MFDISPREQ Flag to identify whether there is dispersion between matrix and fracture (Y/N)
 C ALLMGRID Longitudinal matrix dispersivity
 C ALLFGRID Longitudinal fracture dispersivity
 C ALTMGRID Transverse matrix dispersivity
 C ALTFGRID Transverse fracture dispersivity
 C FORMGRID Matrix tortousity
 C FORFGRID Matrix tortousity
 C DMOL Molecular diffusion at reference temperature (M2/s.)
 C DMOLTEMP Logical flag to identify whether the molecular diffusion is temperature dependent (T./F.)
 C TREF Reference temperature (K)
 C VISREF Viscosity at reference temperature TREF (Pa/s)
 C FSTATUSINJ Flag to identify whether there is injection in the fracture (Y/N)
 C MSTATUSINJ Flag to identify whether there is injection in the matrix (Y/N)
 C STOCKMAN Logical flag to identify whether NUTS interfaces with actinide source submodel
 C TIMEMSTRT Starting time of injection/production in the matrix (s)
 C TIMEEND Ending time of injection/production in the matrix (s)
 C TIMEFSTRT Starting time of injection/production in the fracture (s)
 C TIMEFEND Ending time of injection/production in the fracture (s)
 C CONCINJGRID Concentration of the injected component j in grid i of the matrix (kg/m3)
 C CONCINFGRID Concentration of the injected component j in grid i of the fracture (kg/m3)
 C FDIRICHLET Flag to identify whether dirichlet B.C. is available in the fracture (T/F)
 C MDIRICHLET Flag to identify whether dirichlet B.C. is available in the matrix (T/F)
 C CONCDIRGRID Specified concentration for D.B.C. in the matrix block (kg/m3)
 C CONCDIRFGRID Specified concentration for D.B.C. in the matrix block (kg/m3)
 C IPRFRQA Frequency of print in ASCII file (ex:5=each 5 timesteps)
 C IPRFRQB Frequency of print in BINARY file
 C IPRNTFA Flag to print the fracture variable in ASCII file
 C IPRNTFB Flag to print the fracture variable in BINARY file
 C IPRNTMA Flag to print the matrix variable in ASCII file
 C IPRNTMB Flag to print the matrix variable in BINARY file
 C IPRNTMC Flag to print the matrix variable in CDB file
 C VAR Printed variable name
 C DEBUG Logical flag to generate debug file and variables
 C SWMOLDGRID Matrix saturation at time level n
 C PORMOLDGRID Matrix porosity at time level n
 C SWFOLDGRID Fracture saturation at time level n
 C PORFOLDGRID Fracture porosity at time level n
 C BRVOLGRID Brine volume in each matrix grid (m3)
 C SUMM_DISGRID Matrix total mass per grid block of the dissolved isotopes
 C SUMF_DISGRID Fracture total mass per grid block of the dissolved isotopes
 C SUMM_PRECIPGRID Matrix total mass per grid block of the precipitated isotopes
 C SUMF_PRECIPGRID Fracture total mass per grid block of the precipitated isotopes
 C SUMM_TOTALGRID Matrix total mass per grid block of the dissolved, precipitated, and sorbed isotopes
 C SUMF_TOTALGRID Fracture total mass per grid block of the dissolved, precipitated, and sorbed isotopes
 C CSUMM_DISGRID Matrix total curies per grid block of the dissolved isotopes
 C CSUMF_DISGRID Fracture total curies per grid block of the dissolved isotopes
 C CSUMM_PRECIPGRID Matrix total curies per grid block of the precipitated isotopes
 C CSUMF_PRECIPGRID Fracture total curies per grid block of the precipitated isotopes
 C CSUMM_TOTALGRID Matrix total curies per grid block of the dissolved, precipitated, and sorbed isotopes
 C CSUMF_TOTALGRID Fracture total curies per grid block of the dissolved, precipitated, and sorbed isotopes
 C CM Concentration of the isotope in the matrix at time level n+1
 C CMOLD Concentration of the isotope in the matrix at time level n
 C CF Concentration of the isotope in the fracture at time level n+1
 C CFOLD Concentration of the isotope in the fracture at time level n
 C BLOCF_DIS_MASSGRID Fracture mass of dissolved isotope per grid volume Kg/(M3 rock).



C BLOCM_DIS_MASSGRID Matrix mass of dissolved isotope per grid volume in Kg/(M3 rock).
C BLOCF_PRC_MASSGRID Fracture mass of precipitated isotope per grid volume Kg/(M3 rock).
C BLOCM_PRC_MASSGRID Matrix mass of precipitated isotope per grid volume Kg/(M3 rock).
C ADPRCONM_TOTAL_MASSGRID Total mass resulted from dissolved, precipitated and sorbed isotopes in the matrix
C ADPRCONF_TOTAL_MASSGRID Total mass resulted from dissolved, precipitated and sorbed isotopes in the fracture
C VOLM_CONC_CURIESGRID Equivalent curies of the volumetric concentration in the matrix
C VOLF_CONC_CURIESGRID Equivalent curies of the volumetric concentration in the fracture
C DISM_MASS_CURIESGRID Curies of the dissolved mass per grid block in the matrix
C DISF_MASS_CURIESGRID Curies of the dissolved mass per grid block in the fracture
C PRCIPM_MASS_CURIESGRID Curies of the precipitated mass per grid block in the matrix
C PRCIPF_MASS_CURIESGRID Curies of the precipitated mass per grid block in the matrix
C TOTALM_MASS_CURIESGRID Curies of the total mass (dissolved + sorbed + Precipitate) per grid block in the matrix
C TOTALF_MASS_CURIESGRID Curies of the total mass (dissolved + sorbed + Precipitate) per grid block in the fracture
C FLUXJMIMGRID Fluxes crossing grid block lower interface in y-direction in the matrix (kg/s)
C FLUXJFLMGRID Fluxes crossing grid block lower interface in y-direction in the fracture (kg/s)
C FLUXIMIMGRID Fluxes crossing grid block left interface in x-direction in the matrix (kg/s)
C FLUXIFLMGRID Fluxes crossing grid block left interface in x-direction in the fracture (kg/s)
C CONDMMASSGRID Gas mass that dissolve in the grid block brine of the matrix (kg)
C CONDFMASSGRID Gas mass that dissolve in the grid block brine of the matrix (kg)
C QWXF_GRID Water interblock rate in x-direction in the fracture (m3/s)
C QWYF_GRID Water interblock rate in y-direction in the fracture (m3/s)
C QWZF_GRID Water interblock rate in z-direction in the fracture (m3/s)
C QWXM_GRID Water interblock rate in x-direction in the matrix (m3/s)
C QWYM_GRID Water interblock rate in y-direction in the matrix (m3/s)
C QWZM_GRID Water interblock rate in z-direction in the matrix (m3/s)
C QPRMGRID Matrix production rate (M3 /s)
C QINMGRID Matrix injection rate (M3 /s)
C BLOCKMBMMAX Maximum residual among matrix blocks
C CMBIM Isotope material balance error for the time step in the matrix
C CMBTM Cumulative isotope material balance error in the matrix
C SUMRTM Cumulative residuals in the matrix
C SUMQTM Cumulative sources in the matrix
C BLOCKMBFMAX Maximum residual among fracture blocks
C CMBIF Isotope material balance error for the time step in the fracture
C CMBTF Cumulative isotope material balance error in the fracture
C SUMRTF Cumulative residuals in the fracture
C SUMQTF Cumulative sources in the fracture
C JBIN NUTS binary output file unit number

C*****
C*****

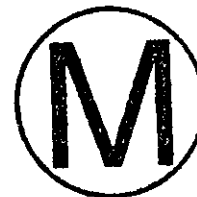
C-----
C
C INCLUDE 'PARAMBR.INC'
C INCLUDE 'BINRHEAD.INC'
C COMMON/D3SIZE/NX,NY,NZ
C INTEGER NX,NY,NZ,I,J,KK

C
C----- READ TIME INFORMATION -----
C



```
      READ(JBIN)ZTIME,IFLAGTIME,NO_TIMESTEP_
C
C!!!!!!!!!!!!!!!!!!!!!!!!!!!! START READING INITIAL VARIABLES !!!!!!!!!!!!!!!!!!!!!
C
      IF(IFLAGTIME .EQ. 0) THEN
C
C----- READ PROGRAM HEADINGS (QA INFORMATION) -----
C
      READ (JBIN) SDATE
      READ (JBIN) STIME
      READ (JBIN) NPNAME
      READ (JBIN) NVERSION
      READ (JBIN) NREVDATE
      READ (JBIN) NCPUNAME
C
C----- READ THE RUN TITLES AND FILES' TYPE -----
C
      READ(JBIN) ANSWERTEST,FINFILETYPE
      READ(JBIN) COMBTITLE,INTITLE,NUTS_TITLE
C
C----- READ THE FILES' NAMES -----
C
      READ(JBIN) RADINPUT,FILE_NAME,RADOUTPUT
      IF(FINFILETYPE .EQ. 'ASC' .OR. FINFILETYPE .EQ. 'ASC-BIN'
1 .OR. FINFILETYPE .EQ. 'ASC-CDB' .OR. FINFILETYPE .EQ.
2 'ASC-BIN-CDB' .OR. DEBUG)
3 READ(JBIN) RADOUTASC
      IF(FINFILETYPE .EQ. 'BIN' .OR. FINFILETYPE .EQ. 'ASC-BIN'
1 .OR. FINFILETYPE .EQ. 'BIN-CDB' .OR. FINFILETYPE .EQ.
2 'ASC-BIN-CDB')
3 READ(JBIN) RADOUTBIN
      IF(FINFILETYPE .EQ. 'CDB' .OR. FINFILETYPE .EQ. 'ASC-CDB'
1 .OR. FINFILETYPE .EQ. 'BIN-CDB' .OR. FINFILETYPE .EQ.
2 'ASC-BIN-CDB')
3 READ(JBIN) RADOUTCDB
C
C----- READ MEDIA TYPE AND LOGICAL CONTROLS -----
C
      READ(JBIN) MEDIUM,FRACTURE,MATRIX,SINGLE_POROSITY,
      & DUAL_POROSITY,DUAL_PERMEABILITY
C
C----- READ THE TOTAL NUMBER OF GRID BLOCKS -----
C
      READ(JBIN) NBLOCK
C
C----- READ DIMENSIONS OUTPUT -----
C
      READ(JBIN) IDIMENSION,NX,NY,NZ,DIRECTION
      READ(JBIN) NOCONTINUM,NO_PHASES
C
C----- Grid Grid Block Length (x-direction)
C
      CALL BRE33D(DXGRID,JBIN)
C
C----- Grid Grid Block Width (y-direction)
C
      CALL BRE33D(DYGRID,JBIN)
C
C----- Grid Grid Block Hight (z-direction)
C
      CALL BRE33D(DZGRID,JBIN)
C
C----- READ Grid Block X,Y,Z COORDINATE
C
      CALL BRE33D(X,JBIN)
      CALL BRE33D(Y,JBIN)
      CALL BRE33D(Z,JBIN)
```

```
C
C----- Read Grid Block Volume -----
C
C      CALL BRE33D(VRGRID,JBIN)
C
C----- Read Interface Area in x-direction -----
C
C      CALL BRE33D(AXGRID,JBIN)
C
C----- Read Interface Area in y-direction -----
C
C      CALL BRE33D(AYGRID,JBIN)
C
C----- Read Interface Area in z-direction -----
C
C      CALL BRE33D(AZGRID,JBIN)
C
C----- Read Ground Water pH -----
C
C      READ(JBIN) PHREQ
C      IF(PHREQ .EQ. 'Y' .OR. PHREQ .EQ. 'y') CALL BRE33D(PHGRID,JBIN)
C----- WASTE INFORMATION -----
C
C      READ(JBIN) NUCLIDE, NSITES
C----- SITE INFORMATION -----
C
C      READ(JBIN) (SITE_NAME(I), NCOMPONENT(I), WASTEVOL(I),
C      & I=1, NSITES)
C      READ(JBIN) (NAME(I), DAUGHTER_NAME(I), PARENT_NAME(I),
C      & GROUP_NAME(I), I=1, NUCLIDE)
C
C      READ(JBIN) (XMOLWT(I), RAD(I), XLAMDA(I), COMPINT(I), I=1, NUCLIDE)
C----- SOLUBILITY DATA -----
C
C      READ(JBIN) NOELEMENT
C      READ(JBIN) (ELTEMP_SOLB(I), I = 1, NOELEMENT)
C      DO I = 1, NOELEMENT
C        IF(.NOT. ELTEMP_SOLB(I)) THEN
C
C<<<<<<<<<> ELEMENT NAME, TEMP. DEPENDENCY, SOLUBILITY LIMIT
C
C      READ(JBIN) ELEMENT_NAME(I), ELEMNT_SOLB_LIMIT(I)
C        ELSE
C
C<<<<<<<<<> ELEMENT NAME, TEMP. DEPENDENCY, CORRELATION PARAMETERS
C
C      READ(JBIN) ELEMENT_NAME(I), C0(I), C1(I), C2(I),
C      & C3(I), C4(I), C5(I)
C      ENDIF
C      END DO
C----- GAS EQUILIBRIUM LINE CONSTANTS -----
C
C      IF(PHASETYPE .EQ. 'G')
C      & READ(JBIN) (EQCI(I), EQCS(I), I = 1, NUCLIDE)
C----- WASTE MATRIX -----
C
C      READ(JBIN) ((IWASTE(I, J), I=1, NBLOCK), J=1, NUCLIDE)
C----- SORPTION INPUT INFORMATION -----
C
C***** MATRIX SORPTION
C
C      IF(MATRIX) THEN
C      READ(JBIN) ADSTYPEM
C      IF(ADSTYPEM .EQ. 'N' .OR. ADSTYPEM .EQ. 'n') GO TO 100
```



```
      READ(JBIN) MAT_ISOOTHERM
      READ(JBIN) (NAME(J),MSORPTION(J),MADSTEMPDEP(J),J=1,NUCLIDE)
C
C----- LINEAR DISTRIBUTION COEFFICIENTS -----
C
      IF(MAT_ISOOTHERM.EQ.'L'.OR.MAT_ISOOTHERM.EQ.'l') THEN
      DO 10 J = 1, NUCLIDE
      CALL BRE23D(XLMGRID,JBIN,J)
100  CONTINUE
      ENDIF
C
C----- FREUNDLICH DISTRIBUTION COEFFICIENTS -----
C
      IF(MAT_ISOOTHERM.EQ.'F'.OR.MAT_ISOOTHERM.EQ.'f') THEN
      DO 20 J = 1, NUCLIDE
      CALL BRE23D(XFDCMGRID,JBIN,J)
200  CONTINUE
      DO 30 J = 1, NUCLIDE
      CALL BRE23D(XFCMGRID,JBIN,J)
300  CONTINUE
      ENDIF
C
C----- LANGUIMIR DISTRIBUTION COEFFICIENTS -----
C
      IF(MAT_ISOOTHERM.EQ.'LA'.OR.MAT_ISOOTHERM.EQ.'La'
      & .OR.MAT_ISOOTHERM.EQ.'la') THEN
      DO 40 J = 1, NUCLIDE
      CALL BRE23D(XLDCMGRID,JBIN,J)
400  CONTINUE
      DO 50 J = 1, NUCLIDE
      CALL BRE23D(XLCMGRID,JBIN,J)
500  CONTINUE
      ENDIF
1000 CONTINUE
      ENDIF
C
C***** FRACTURE SORPTION
C
      IF(FRACTURE) THEN
      READ(JBIN) ADSTYPEF
      IF(ADSTYPEF.EQ.'N'.OR.ADSTYPEF.EQ.'n') GO TO 200
      READ(JBIN) FRAC_ISOOTHERM
      READ(JBIN) (NAME(J),FSORPTION(J),FADSTEMPDEP(J),J=1,NUCLIDE)
C
C----- LINEAR DISTRIBUTION COEFFICIENTS -----
C
      IF(FRAC_ISOOTHERM.EQ.'L'.OR.FRAC_ISOOTHERM.EQ.'l') THEN
      DO 110 J = 1, NUCLIDE
      CALL BRE23D(XLFGGRID,JBIN,J)
1100 CONTINUE
      ENDIF
C
C----- FREUNDLICH DISTRIBUTION COEFFICIENTS -----
C
      IF(FRAC_ISOOTHERM.EQ.'F'.OR.FRAC_ISOOTHERM.EQ.'f') THEN
      DO 120 J = 1, NUCLIDE
      CALL BRE23D(XFDCFGRID,JBIN,J)
1200 CONTINUE
      DO 130 J = 1, NUCLIDE
      CALL BRE23D(XFCFGRID,JBIN,J)
1300 CONTINUE
      ENDIF
C
C----- LANGUIMIR DISTRIBUTION COEFFICIENTS -----
C
      IF(FRAC_ISOOTHERM.EQ.'LA'.OR.FRAC_ISOOTHERM.EQ.'La'
      & .OR.FRAC_ISOOTHERM.EQ.'la') THEN
      DO 140 J = 1, NUCLIDE
      CALL BRE23D(XLDCFGRID,JBIN,J)
1400 CONTINUE
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DO 150 J = 1, NUCLIDE
CALL BRE23D(XLCFGRID,JBIN,J)
150 CONTINUE
ENDIF
200 CONTINUE
ENDIF

C
C----- REFERENCE TEMP. AND SORPTION EXPONENT -----
C
IF((ADSTYPEF .EQ. 'Y' .OR. ADSTYPEF .EQ. 'y') .OR.
& (ADSTYPEM .EQ. 'Y' .OR. ADSTYPEM .EQ. 'y')) THEN
DO I = 1, NUCLIDE
IF (FADSTEMPDEP(I) .OR. MADSTEMPDEP(I))
& READ (JBIN) NAME (J) , REFTEMP (J) , ADSEXP (J)
END DO
ENDIF

C
C----- ROCK DENSITY OUTPUT -----
C
IF (ADSTYPEM .EQ. 'N' .OR. ADSTYPEM .EQ. 'n' .AND.
& ADSTYPEF .EQ. 'N' .OR. ADSTYPEF .EQ. 'n') GO TO 300
CALL BRE33D(RHOGRID,JBIN)

C
300 CONTINUE

C
C----- DISPERSION -----
C
IF (SINGLE_POROSITY .AND. FRACTURE) READ (JBIN) FDISPREQ
IF (SINGLE_POROSITY .AND. MATRIX) READ (JBIN) MDISPREQ
IF (DUAL_POROSITY .OR. DUAL_PERMEABILITY)
& READ (JBIN) MDISPREQ, MFDISPREQ, FDISPREQ

C
C***** MATRIX
C
IF (MATRIX) THEN
IF (MDISPREQ .EQ. 'N' .OR. MDISPREQ .EQ. 'n') GO TO 400

C
C----- MATRIX LONGITUDINAL DISPERSIVITY -----
C
CALL BRE33D(ALLMGRID,JBIN)

C
C----- ROCK TRANSVERSE DISPERSIVITY -----
C
CALL BRE33D(ALTMGRID,JBIN)

C
C----- ROCK TORTUOSITY DATA -----
C
CALL BRE33D(TORMGRID,JBIN)

C
400 CONTINUE
ENDIF

C
C***** FRACTURE
C
IF (FRACTURE) THEN
IF (FDISPREQ .EQ. 'N' .OR. FDISPREQ .EQ. 'n') GO TO 500

C
C----- FRACTURE LONGITUDINAL DISPERSIVITY -----
C
CALL BRE33D(ALLFGRID,JBIN)

C
C----- FRACTURE TRANSVERSE DISPERSIVITY -----
C
CALL BRE33D(ALTFFGRID,JBIN)

C
C----- FRACTURE TORTUOSITY DATA -----
C
CALL BRE33D(TORFFGRID,JBIN)

500 CONTINUE
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                                ENDIF
C
C-----MOLECULAR DIFFUSION DATA -----
C
      IF((MDISPREQ .EQ. 'Y' .OR. MDISPREQ .EQ. 'y') .OR.
        & (FDISPREQ .EQ. 'Y' .OR. FDISPREQ .EQ. 'y')) THEN
        READ(JBIN) (DMOLTEMDEP(I), I = 1, NUCLIDE)
        DO I = 1, NUCLIDE
          IF(.NOT. DMOLTEMDEP(I)) THEN
C
C<<<<<<<<<<> MOLECULAR DIFFUSION,TEMP. DEPENDENCY
C
          READ(JBIN) DMOL(I)
          ENDIF
          IF(DMOLTEMDEP(I)) THEN
C
C<<<<<<<<<<> MOLECULAR DIFFUSION,TEMP. DEPENDENCY,REF. TEMP & VISCOSITY
C
          READ(JBIN) DMOL(I),TREF(I),VISREF(I)
          ENDIF
          END DO
          ENDIF
C
C----- INJECTION HISTORY -----
C
      IF(SINGLE_POROSITY .AND. FRACTURE)
        & READ(JBIN) FSTATUSINJ,STOCKMAN
C
      IF(SINGLE_POROSITY .AND. MATRIX)
        & READ(JBIN) MSTATUSINJ,STOCKMAN
C
      IF(DUAL_POROSITY .OR. DUAL_PERMEABILITY)
        & READ(JBIN) MSTATUSINJ,FSTATUSINJ,STOCKMAN
C
      IF(STOCKMAN) GO TO 901
C
C***** MATRIX
C
          IF(MATRIX) THEN
            IF(MSTATUSINJ .EQ. 'N' .OR. MSTATUSINJ .EQ. 'n') GO TO 700
            READ(JBIN) TIMEMSTRT, TIMEFEND
            DO 600 J = 1,NUCLIDE
              CALL BRE23D(CONCINJMGRID,JBIN,J)
            600 CONTINUE
            700 CONTINUE
          ENDIF
C
C***** FRACTURE
C
          IF(FRACTURE) THEN
            IF(FSTATUSINJ .EQ. 'N' .OR. FSTATUSINJ .EQ. 'n') GO TO 900
            READ(JBIN) TIMEFSTRT, TIMEFEND
            DO 800 J = 1,NUCLIDE
              CALL BRE23D(CONCINJFGRID,JBIN,J)
            800 CONTINUE
            900 CONTINUE
          ENDIF
          901 CONTINUE
C
C----- SPECIFY DIRICHLET B.C. IF ANY -----
C
      IF(SINGLE_POROSITY .AND. FRACTURE) READ(JBIN) FDIRICHLET
      IF(SINGLE_POROSITY .AND. MATRIX) READ(JBIN) MDIRICHLET
      IF(DUAL_POROSITY .OR. DUAL_PERMEABILITY)
        & READ(JBIN) MDIRICHLET,FDIRICHLET
C
C***** MATRIX
C
          IF(MATRIX) THEN
            IF(MDIRICHLET) THEN

```

```
DO 902 J = 1,NUCLIDE
CALL BRE23D(CONCDIRMGRID,JBIN,J)
902 CONTINUE
ENDIF
ENDIF
C
C***** FRACTURE
C
C          IF(FRACTURE) THEN
IF(FDIRICHLET) THEN
DO 904 J = 1,NUCLIDE
CALL BRE23D(CONCDIRFGRID,JBIN,J)
904 CONTINUE
ENDIF
ENDIF
C----- READ PRINT FLAGS OF THE BINARY FILE -----
C----- SPECIFY NUMBER OF OUTPUT ARRAYS AND THEIR TITLES -----
C
IF(FINFILETYPE .EQ. 'BIN' .OR. FINFILETYPE .EQ. 'ASC-BIN'
1 .OR. FINFILETYPE .EQ. 'BIN-CDB' .OR. FINFILETYPE .EQ.
2 'ASC-BIN-CDB'.OR. DEBUG) THEN
C
C***** MATRIX
C
C          IF(MATRIX) THEN
READ(JBIN) (IPRNTMB(I), I = 1, NMVARB)
DO 910 I = 1, NVARTIT/2
IF(IPRNTMB(I) .GT. 0) READ(JBIN) VAR(I)
910 CONTINUE
ENDIF
C
C***** FRACTURE
C
C          IF (FRACTURE) THEN
READ(JBIN) (IPRNTFB(I), I = 1, NFVARB)
KK = 0
DO 920 I = NVARTIT/2+1, NVARTIT
KK = KK + 1
IF(IPRNTFB(KK) .GT. 0) READ(JBIN) VAR(I)
920 CONTINUE
ENDIF
ENDIF
C
C***** READ PRINT FLAGS OF ASCII FILES
C
IF(FINFILETYPE .EQ. 'ASC' .OR. FINFILETYPE .EQ. 'ASC-BIN'
1 .OR. FINFILETYPE .EQ. 'ASC-CDB' .OR. FINFILETYPE .EQ.
2 'ASC-BIN-CDB'.OR. DEBUG) THEN
C
C***** FRACTURE OUTPUT FLAGS
C
IF(FRACTURE) READ(JBIN) (IPRNTFA(I), I = 1, NFVARA)
C
C***** MATRIX OUTPUT FLAGS
C
IF(MATRIX) READ(JBIN) (IPRNTMA(I), I = 1, NMVARA)
ENDIF
C
C***** READ PRINT FLAGS OF CDB FILES
C
IF(FINFILETYPE .EQ. 'CDB' .OR. FINFILETYPE .EQ. 'ASC-CDB'
1 .OR. FINFILETYPE .EQ. 'BIN-CDB' .OR. FINFILETYPE .EQ.
2 'ASC-BIN-CDB'.OR. DEBUG) THEN
C
C***** FRACTURE OUTPUT FLAGS
C
IF(FRACTURE) READ(JBIN) (IPRNTFC(I), I = 1, NFVARC)
C
C***** MATRIX OUTPUT FLAGS
C
```

