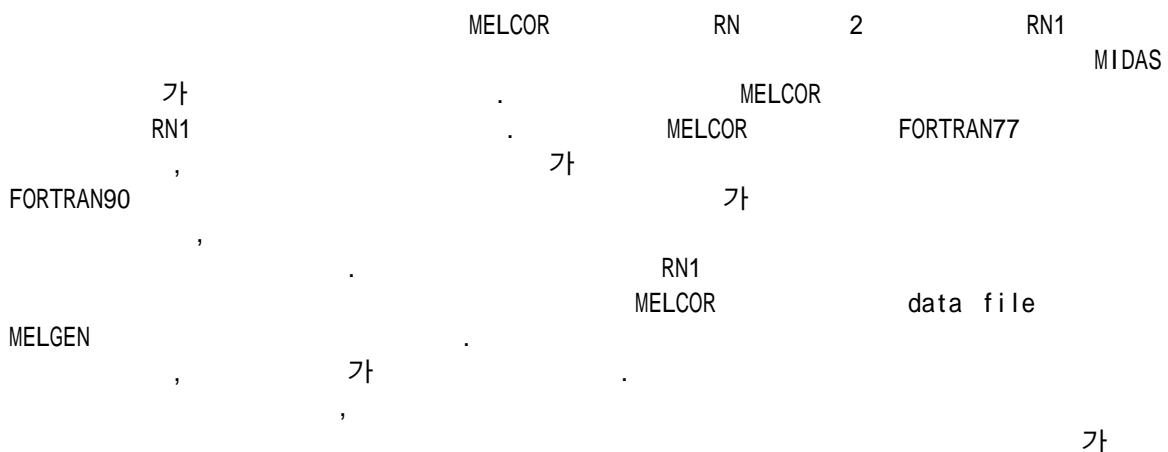


(MIDAS)

RN1

A Restructuring of RN1 Package for MIDAS Computer Code

150



Abstract

RN1 package, which is one of two fission product-related packages in MELCOR, has been restructured for the MIDAS computer code. MIDAS is being developed as an integrated severe accident analysis code with a user-friendly graphical user interface and modernized data structure. To do this, data transferring methods of current MELCOR code are modified and adopted into the RN1 package. The data structure of the current MELCOR code using FORTRAN77 causes a difficult grasping of meaning of the variables as well as waste of memory. New features of FORTRAN90 make it possible to allocate the storage dynamically and to use the user-defined data type, which lead to an efficient memory treatment and an easy understanding of the code. Restructuring of the RN1 package addressed in this paper includes module development, subroutine modification, and treats MELGEN, which generates data file, as well as MELCOR, which is processing a calculation. The verification has been done by comparing the results of the modified code with those from the existing code. As the trends are similar to each other, it hints that the same approach could be extended to the entire code package. It is expected that code restructuring will accelerate the code domestication thanks to direct understanding of each variable and easy implementation of modified or newly developed models.

1.

MELCOR
MIDAS
MELCOR
, 가
, 가
, 가
FORTRAN90
가 data type
, [1,2,3]
(readability) (DMM)
, 가 subroutine (derived type variables)
[4,5].
[6,7,8], RN1 (RN
2) , MELCOR
restart file MELGEN ,
,

2.

MELCOR code 3 , restart file
MELGEN, restart file , log file plot file
MELCOR, PLOT COR, HT, SPR, TF, RN1, RN2 20
가 , data ,
subroutine , message subroutine, code
subroutine subroutine [9].

2.1 Restart file

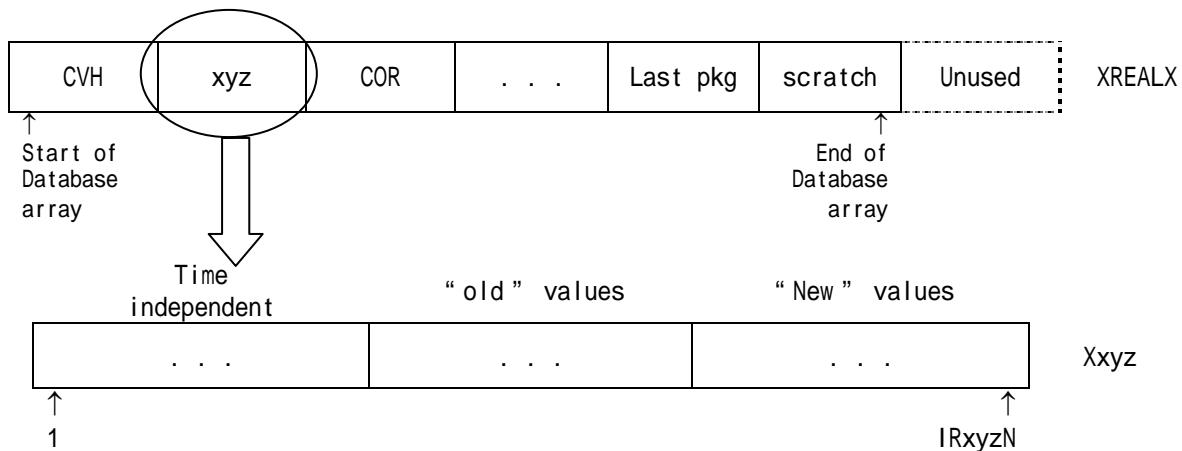
RESTART file read write data MELCOR
read write subroutine MXXRS MXXRSW ,
xyzPRS 1, 2 , subroutine ,
coefficient , subroutine xyzRIO
character 4 array real, integer, logical,
) . (xyz :
,

2.2 Database

MELCOR data
4가
- XREALX : floating point variables (500,000 array)

- INTEGE : integer variables (50,000 array)
- LOGICA : logical variables (5,000 array)
- CHARAC : character variables (30,000 array)

(1),



1.

Database array subroutine	2가	. Database array	1 argument	,
	2			

```

SUBROUTINE xyzDBC
*- INCLUDE BLANK
COMMON /DBREAL/ NEDREL, IRELCS, IRELES
COMMON /      / DREALX(NUMREL/2)
DOUBLE PRECISION DREALX C
DIMENSION XREALX(NUMREL)
EQUIVALENCE (XREALX(1), DREALX(1))
DOUBLE PRECISION VREALX(NUMREL/2)
EQUIVALENCE (VREALX(1), DREALX(1))
*- INCLUDE xyzDB
COMMON /xyzDB/  IRxyzF , IRxyzN , IIxyzF , IIxyzN ,
1           ILxyzF , ILxyzN , ICxyzF , ICxyzN
CALL xyzDB(
1 IRxyzN , XREALX(IRxyzF) ,
2 IIxyzN , INTEGE(IIxyzF) ,
3 ILxyzN , LOGICA(ILxyzF),
4 ICxyzN , CHARAC(ICxyzF), . . . )
C
RETURN
END

```

2. 1 database subroutine

Database 2
 array argument , subroutine 3

```

SUBROUTINE xyzDBD (
1 NxyzR , Rxyz ,
2 NxyzI , Ixyz ,
3 NxyzL, Lxyz,
4 NxyzC, Cxyz, . . .
C
      DIMENSION Rxyz(NxyzR), Ixyz(NxyzI), . . .
C
*- INCLUDE xyzPNT
      COMMON /xyzPNT/ Nvar1, Nvar2, . . .
C
      CALL xyzRUN (Nvar1, Rxyz(Ivar1), Nvar2,Ixyz(Ivar2), . . .
C
      RETURN
END
  
```

3. 2 database subroutine

Database argument
 subroutine 4

```

SUBROUTINE xyzRUN(
1 Nvar1, var1, Nvar2, var2, . . .)
C
      DIMENSION var1(Nvar1), . . .
C
C   FROM HERE ON, SIMPLY USE var1 AND var2.
C   FORGETTING ALL DETAILS OF WHERE AND HOW THEY ARE STORED.
C
      CALL xyz. . .
C
      RETURN
END
  
```

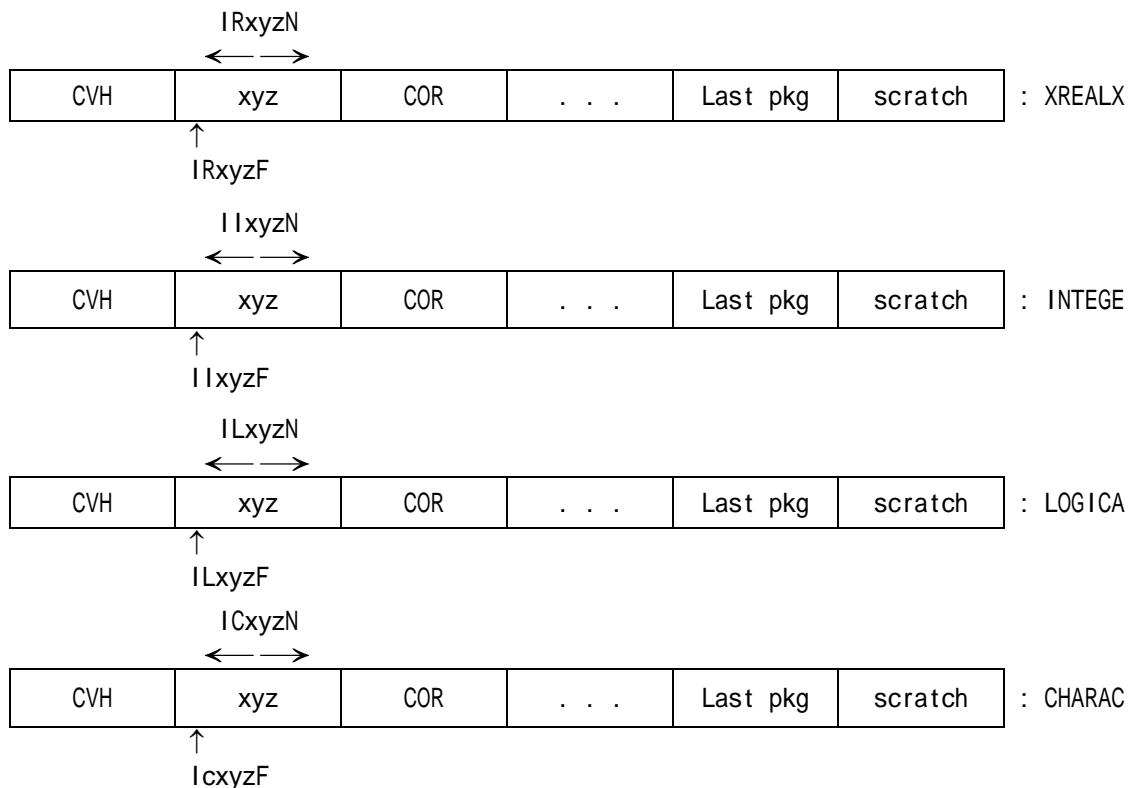
4. database subroutine

2.3

subroutine	xyzDBD	subroutines	database	comment	subroutine	xyzDBC
					pass	. RN1

(1) RN1	1					
	1				(5),	
subroutine	' RN1DB '	common block			(6), 4	data
type	2					
(2) RN1	2					
	2					
' xyzPNT '		common block				
database		7				

RN1	가	subroutine
,		RN1 data RN1
RN1		.
CVH, FL, RN1	SPR	MELCOR
RN1		가



5. 1

```
*- INCLUDE RN1DB
C
C      RN1 COMMON BLOCK FOR NUMBER OF VARIOUS DATA TYPES
C
COMMON/RN1DB/ IRRN1F, IRRN1N, IIRN1F, IIRN1N,
+           ILRN1F, ILRN1N, ICRN1F, ICRN1N
*-
```

6. RN1 1

3.

```
restart file          MELGEN      /
, restart file        MELCOR
```

```

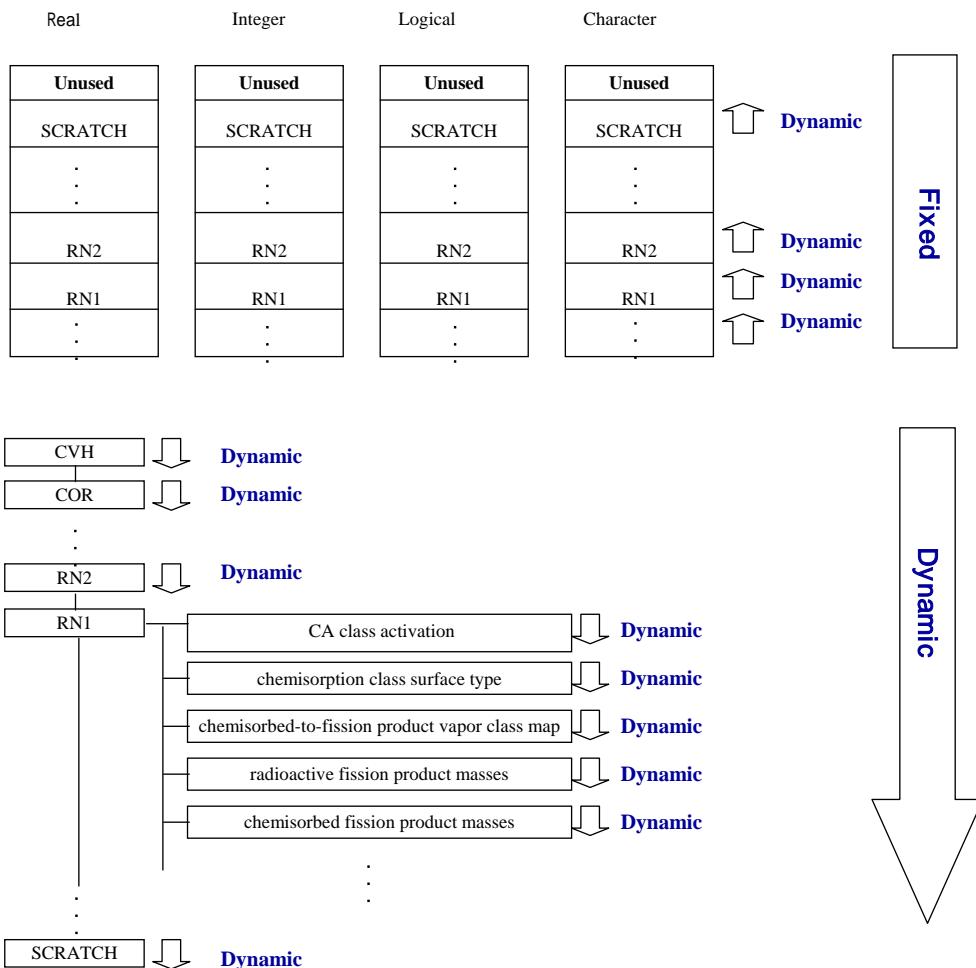
*- INCLUDE RN1PNT
C
C      RN1 DATABASE POINTERS
C
COMMON/RN1PNT/  IPMSEC,
+    IT1AGO, IT1ALO, IT1VGO, IT1VLO, ITADPO, ITVDPO,
+    IT1AGN, IT1ALN, IT1VGN, IT1VLN, ITADPN, ITVDPN,
+    IR1AGO, IR1ALO, IR1VGO, IR1VLO, IRADPO, IRVDPO,
+    IR1AGN, IR1ALN, IR1VGN, IR1VLN, IRADPN, IRVDPN,
+    IPMCRO, IPMCVO, IPMCRN, IPMCVN, IPEADO, IPEADN, IPCLCO,
+    IPRSRA, IPRSRV, IPIRSA, IPISRV, IPSRCA, IPSRCV, IPIRSP,
+    IPRRSP, IPCN1B, IPCN2A, IPCN2B, IPCN3, IPCN4, IPCDEP,
+    IPCGRW, IPIVDS, IPDSUR, IPFRCR, IPRSMO, IPRSMN, IPRCOR,
+    IPRCAV, IPRFDI, IPRMRL, IPMRLN, IPCRCL, IPCLVN, IPNCL,
+    IPMVNO, IPMVNN, IPMFDO, IPMFDN, IPMSC, IPNCCB, IPICCB,
+    IPXCCB, IORRN1, IOIRN1, NUMSEC, NUMCMP, NUMCLS, NUMSRA,
+    NUMSRV, NNSRA, NNSRV, NUMCOF, NUMSUR, NNSUR, IFLAGR,
+    NCNODE, NCMATA, NCLC, NCLCT, NNCLC, NNCLCT, NVANCL,
+    IPMCRI, ICPPTH, NAXLC, NRADC, NGAPC, KCMPC, NFMATC,
+    IXMFUC, IPPRLO, PSDTO, IPFRLN, PSDTN, IPDHAO, IPDHDO,
+    IPDHAN, IPDHDN, IPVDCO, IPRVCO, IPVDCN, IPRVCN, IPCAST,
+    IPCLCM, IPCAON, NUMCA, NNCA, IVCNDO, IVCNDN
C PARAMETERS ADDED BY R.K.COLE, JULY 1991
C POINTERS ADDED BY R.C.SMITH, ST. PATTY'S DAY 1992
C
C      POINTERS ADDED BY M.F.YOUNG FOR CHEMISORPTION
C IPVDCO = pointer for old chemisorbed fission product masses
C IPRVCO = pointer for old radioactive fission product masses
C IPVDCN = pointer for new chemisorbed fission product masses
C IPRVCN = pointer for new radioactive fission product masses
C IPCAST = pointer for chemisorption class surface type
C IPCLCM = pointer for chemisorbed-to-fission product vapor class map
C IPCAON = pointer for CA class activation
C NUMCA = number of chemisorption classes
C NNCA = MAX(1,NUMCA)
C
C      POINTERS ADDED BY R. SMITH
C IVCNDO = POINTER FOR OLD VOLUMETRIC CONDENSATION/EVAPORATION
C IVCNDN = POINTER FOR NEW VOLUMETRIC CONDENSATION/EVAPORATION
*-

```

140 subroutine RN1
 subroutine 60 , (MELtoMID)
 subroutine [4,5].

3.1

Subroutine RN1DBC	Subroutine RN1DBD	
subroutine RN1RN1, RN1RN2, RN1RN3, RN1RN5, RN1RNC		,
(local variable)		2
RN1	9	.



8.

3.2 Subroutine

Subroutine	[8] FORTRAN77	
MELCOR	FORTRAN90	,
RN1	subroutine , argument 가	가
	subroutine 60 , subroutine	,
	subroutine local variable argument	argument

dimension	array	member variable
1		

```

!!!!!!!!!!!!!! RN1 (Radio Nuclide 1) package data !!!!!!!
! IMPLICIT NONE
MODULE RN1_MDL
!
***** RadioNuclide-1 GLOBAL DATA *****
INTEGER :: IFLAGR, IRSPA, KCMPC, NCMATA, NCNODE, NFMATC, NGAPC
INTEGER :: NAXLC, NRADC, NUMCLS, NUMCMP, NUMCOF, NUMSEC, NVANCL
INTEGER :: NUMCA, NNCA, NCLC, NNCLC, NCLCT, NNCLCT
INTEGER :: NDHSUR, NNDHSR, NDHVOL, NNDHVL, NRPSTT, NNPSTT
INTEGER :: NRPVOL, NNPVOL, NRCLSF, NNRCLF, NRCLST, NNRCLT
INTEGER :: NRCT, NNRCT, NRTRN, NNRTRN, NUMSET, NNSET
INTEGER :: NUMSRA, NNSRA, NUMSRV, NNSRV, NUMSUR, NNSUR
INTEGER :: NTRCFP, NNTRFP, NTRN, NNTRN, NTRCTP, NNTRTP
INTEGER :: NTRVLP, NNTRVP, NTRSTP, NNTSTP, NTTRN, NNTTRN, NRN1_FLAG
INTEGER :: NRN1_IACTV, RN1_NNCAV, RN1_NNFDI, RN1_NFDDEP, RN1_NNVOL
!
TYPE RN1_N01 ; SEQUENCE
  INTEGER :: ICLCO, ICLVAN
  REAL :: XCORCL(8)
END TYPE
TYPE (RN1_N01), ALLOCATABLE :: RN1_NCO(:)
!
TYPE RN1_N02 ; SEQUENCE
  REAL :: ADEPO, VDEPO, RADEPO, RVDEPO, &
          ADEPN, VDEPN, RADEPN, RVDEPN
END TYPE
TYPE (RN1_N02), ALLOCATABLE :: RN1_NC1(:, :)
!
. . .
!
END MODULE RN1_MDL
!
```

9. RN1

1. Array

ADEP(NCLS, NNSUR)	RN1_NC1(NUMCLS,NNSUR)%ADEPO
VDEP(NCLS, NNSUR)	RN1_NC1(NUMCLS,NNSUR)%VDEPO
RADEP(NCLS, NNSUR)	RN1_NC1(NUMCLS,NNSUR)%RADEPO
RVDEP(NCLS, NNSUR)	RN1_NC1(NUMCLS,NNSUR)%RVDEPO
ADEPN(NCLS, NNSUR)	RN1_NC1(NUMCLS,NNSUR)%ADEPN
VDEPN(NCLS, NNSUR)	RN1_NC1(NUMCLS,NNSUR)%VDEPN
RADEPN(NCLS, NNSUR)	RN1_NC1(NUMCLS,NNSUR)%RADEPN
RVDEPN(NCLS, NNSUR)	RN1_NC1(NUMCLS,NNSUR)%RVDEPN
RGAPO(NCND, NCLS)	RN1_NC3(NCNODE,NUMCLS)%RGAPO
TGAPO(NCND, NCLS)	RN1_NC3(NCNODE,NUMCLS)%TGAPO
RGAPN(NCND, NCLS)	RN1_NC3(NCNODE,NUMCLS)%RGAPN
TGAPN(NCND, NCLS)	RN1_NC3(NCNODE,NUMCLS)%TGAPN

subroutine .

<> subroutine RN1DBD

```
SUBROUTINE RN1DBD (IRRN1, XRN1, IIRN1, IRN1, IRRN2, XRN2, IIRN2, &
IRRN2, IRCVH, XCV, IICVH, ICV, IRHS, XHS, IDHS, DHS, IIHS, IHS, &
IRSC, XSC, IIISC, ISC)
```

.

! CHEMISTRY TRANSFER PACKAGE

```
CALL RN1RN5 (NNVOL, NUMSEC, NUMCLS, NNSUR, XRN1 (IT1AGN - IR), &
XRN1 (IT1VGN - IR), XRN1 (IT1ALN - IR), XRN1 (IT1VLN - IR), &
XRN1 (IR1AGN - IR), XRN1 (IR1VGN - IR), XRN1 (IR1ALN - IR), &
XRN1 (IR1VLN - IR), XRN1 (ITADPN - IR), XRN1 (ITVDPN - IR), &
XRN1 (IRADPN - IR), XRN1 (IRVDPN - IR), XRN1 (IRAPLN - IRS), &
XRN1 (IRVPLN - IRS), XRN1 (ITAPLN - IRS), XRN1 (ITVPLN - IRS), &
TIME, DT, XCV (KCVVOO + IC), IRN1 (ITICLF), XRN1 (ITXCLF), &
IRN1 (ITPCLF), IRN1 (ITICLT), XRN1 (ITXCLT), IRN1 (ITPCLT), &
XRN1 (ITXTRN), IRN1 (ITPTRN), IRN1 (ITVOL), IRN1 (ITPVOL), &
IRN1 (ITSTTF), IRN1 (ITSTTT), IRN1 (ITSTTW), IRN1 (ITPSTT), &
IRN1 (ITCFM), IRN1 (ITCFE), IRN1 (ITNUM), NTRN, NNTRN, NNTRFP, &
NNTRTP, NNTRRN, NNTRVP, NNTSTP, IRN1 (IPDSUR), XCV (KDELE), &
NUMHS, NNUMHS, IHS (NHSNUM), XHS (NHSMLN - IH), DHS (NETOTO + &
IH + 1) / 2), XHS (NHSECN - IH), ISC (IPI8), ISC (IPI9), XSC ( &
IPS53), XSC (IPS60) )
```

.

RETURN

END SUBROUTINE RN1DBD

<> subroutine RN1DBD

```
! SUBROUTINE RN1DBD (IRRN1, XRN1, IIRN1, IRN1, IRRN2, XRN2, IIRN2, &
! IRRN2, IRCVH, XCV, IICVH, ICV, IRHS, XHS, IDHS, DHS, IIHS, IHS, &
! IRSC, XSC, IIISC, ISC)
```

!! NOTICE: Converted by MELtoMID

```
SUBROUTINE RN1DBD ( IRRN2, XRN2, IIRN2, &
IRRN2, IRCVH, XCV, IICVH, ICV, IRHS, XHS, IDHS, DHS, IIHS, IHS, &
IRSC, XSC, IIISC, ISC)
```

!

USE RN1_MDL

.

! CHEMISTRY TRANSFER PACKAGE

!! NOTICE: Converted by hand

```
! CALL RN1RN5 (NNVOL, NUMSEC, NUMCLS, NNSUR, XRN1 (IT1AGN - IR), &
! XRN1 (IT1VGN - IR), XRN1 (IT1ALN - IR), XRN1 (IT1VLN - IR), &
! XRN1 (IR1AGN - IR), XRN1 (IR1VGN - IR), XRN1 (IR1ALN - IR), &
! XRN1 (IR1VLN - IR), XRN1 (ITADPN - IR), XRN1 (ITVDPN - IR), &
! XRN1 (IRADPN - IR), XRN1 (IRVDPN - IR), XRN1 (IRAPLN - IRS), &
! XRN1 (IRVPLN - IRS), XRN1 (ITAPLN - IRS), XRN1 (ITVPLN - IRS), &
! TIME, DT, XCV (KCVVOO + IC), IRN1 (ITICLF), XRN1 (ITXCLF), &
! IRN1 (ITPCLF), IRN1 (ITICLT), XRN1 (ITXCLT), IRN1 (ITPCLT), &
! XRN1 (ITXTRN), IRN1 (ITPTRN), IRN1 (ITVOL), IRN1 (ITPVOL), &
! IRN1 (ITSTTF), IRN1 (ITSTTT), IRN1 (ITSTTW), IRN1 (ITPSTT), &
```

```

! IRN1 (ITCFM), IRN1 (ITCFE), IRN1 (ITNUM), NTRN, NNTRN, NNTRFP, &
! NNTRTP, NNTTRN, NNTRVP, NNTSTP, IRN1 (IPDSUR), XCV (KDELE), &
! NUMHS, NNUMHS, IHS (NHSNUM), XHS (NHSMLN - IH), DHS ((NETOTO + &
! IH + 1) / 2), XHS (NHSECN - IH), ISC (IPI8), ISC (IPI9), XSC (&
! IPS53), XSC (IPS60) )
!! NOTICE: Converted by MELtoMID
CALL RN1RN5 (NNVOL, &
DT, XCV (KCVVOO + IC), &
XCV (KDELE), &
NUMHS, NNUMHS, IHS (NHSNUM), XHS (NHSMLN - IH), DHS ((NETOTO + &
IH + 1) / 2), XHS (NHSECN - IH), ISC (IPI8), ISC (IPI9), XSC (&
IPS53), XSC (IPS60) )
. . . .
!
RETURN
END SUBROUTINE RN1DBD

```

<> subroutine RN1RN5

```

SUBROUTINE RN1RN5 (NVOL, NSEC, NCLS, NSUR, AER1GN, VAP1GN, AER1LN,&
VAP1LN, RDA1GN, RDV1GN, RDA1LN, RDV1LN, ADEPN, VDEPN, RADEPN, &
RVDEPN, RAPOLN, RVPOLN, TAPOLN, TVPOLN, TIME, DELT, CVOL, ITICLF, &
XTCLF, ITPCLF, ITICLT, XTCLT, ITPCLT, XTTRN, ITPTRN, ITVOL, &
ITPVOL, ITSTTF, ITSTTT, ITSTTW, ITPSTT, ITCFM, ITCFE, ITNUM, NTRN,&
NNTRN, NNTRFP, NNTRTP, NNTTRN, NNTRVP, NNTSTP, IDSUR, DELE, NUMHS,&
NNUMHS, IHSNUM, HSMULT, ETOTO, HSECMN, NHS, IERRX, HSETRN, RADF)
. . . .

IF (NX.EQ.1) THEN
  IV1 = 1
  IST1 = 1
  ICF1 = 1
  ICT1 = 1
  ITR1 = 1
ELSE
  IV1 = ITPVOL (NX - 1) + 1
  IST1 = ITPSTT (NX - 1) + 1
  ICF1 = ITPCLF (NX - 1) + 1
  ICT1 = ITPCLT (NX - 1) + 1
  ITR1 = ITPTRN (NX - 1) + 1
ENDIF
IV2 = ITPVOL (NX)
IST2 = ITPSTT (NX)
ICF2 = ITPCLF (NX)
ICT2 = ITPCLT (NX)
ITR2 = ITPTRN (NX)
NUMT = ICT2 - ICT1 + 1
!
. . . .

RETURN
END SUBROUTINE RN1RN5

```

<> subroutine RN1RN5

```
SUBROUTINE RN1RN5 (NVOL, NSEC, NCLS, NSUR, AER1GN, VAP1GN, AER1LN,&
! VAP1LN, RDA1GN, RDV1GN, RDA1LN, RDV1LN, ADEPN, VDEPN, RADEPN, &
! RVDEPN, RAPOLN, RVPOLN, TAPOLN, TVPOLN, TIME, DELT, CVOL, ITICLF, &
! XTCLF, ITPCLF, ITICLT, XTCLT, ITPCLT, XTTRN, ITPTRN, ITVOL, &
! ITPVOL, ITSTTF, ITSTTT, ITSTTW, ITPSTT, ITCFM, ITCFE, ITNUM, NTRN,&
! NNTRN, NNTRFP, NNTRTP, NNTTRN, NNTRVP, NNTSTP, IDSUR, DELE, NUMHS,&
! NNUMHS, IHSNUM, HSMULT, ETOTO, HSECMN, NHS, IERRX, HSETRN, RADF)
!! NOTICE: Converted by MELtoMID
SUBROUTINE RN1RN5 (NVOL,                               DELT, CVOL,      &
                    DELE, NUMHS,&
NNUMHS, IHSNUM, HSMULT, ETOTO, HSECMN, NHS, IERRX, HSETRN, RADF)
USE RN1_MDL
. . .

! GET INDICES
IF (NX.EQ.1) THEN
    IV1 = 1
    IST1 = 1
    ICF1 = 1
    ICT1 = 1
    ITR1 = 1
ELSE
!! NOTICE: Converted by MELtoMID
    ! IV1 = ITPVOL (NX - 1) + 1
    ! IV1 = RN1_TRO(NX - 1)%ITPVOL + 1
!! NOTICE: Converted by MELtoMID
    ! IST1 = ITPSTT (NX - 1) + 1
    ! IST1 = RN1_TRO(NX - 1)%ITPSTT + 1
!! NOTICE: Converted by MELtoMID
    ! ICF1 = ITPCLF (NX - 1) + 1
    ! ICF1 = RN1_TRO(NX - 1)%ITPCLF + 1
!! NOTICE: Converted by MELtoMID
    ! ICT1 = ITPCLT (NX - 1) + 1
    ! ICT1 = RN1_TRO(NX - 1)%ITPCLT + 1
!! NOTICE: Converted by MELtoMID
    ! ITR1 = ITPTRN (NX - 1) + 1
    ! ITR1 = RN1_TRO(NX - 1)%ITPTRN + 1
ENDIF
!! NOTICE: Converted by MELtoMID
! IV2 = ITPVOL (NX)
! IV2 = RN1_TRO(NX)%ITPVOL
!! NOTICE: Converted by MELtoMID
! IST2 = ITPSTT (NX)
! IST2 = RN1_TRO(NX)%ITPSTT
!! NOTICE: Converted by MELtoMID
! ICF2 = ITPCLF (NX)
! ICF2 = RN1_TRO(NX)%ITPCLF
!! NOTICE: Converted by MELtoMID
! ICT2 = ITPCLT (NX)
! ICT2 = RN1_TRO(NX)%ITPCLT
!! NOTICE: Converted by MELtoMID
! ITR2 = ITPTRN (NX)
! ITR2 = RN1_TRO(NX)%ITPTRN
NUMT = ICT2 - ICT1 + 1
!
. . .
RETURN
END SUBROUTINE RN1RN5
```

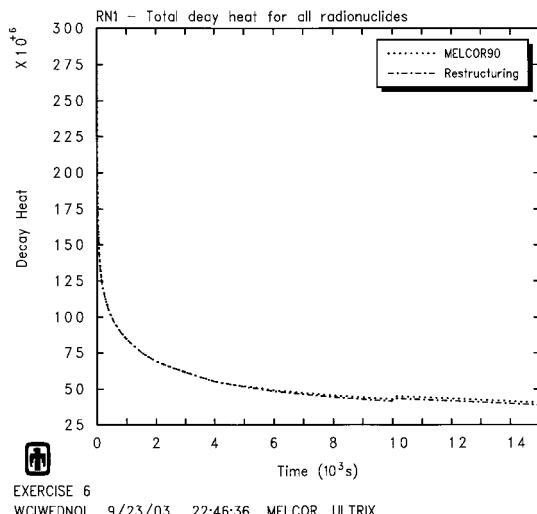
RN1 data RN1 CVH(1 subroutine), FL(1 subroutine), RN1
 (9 subroutine) SPR (3 subroutine)
 subroutine

4.

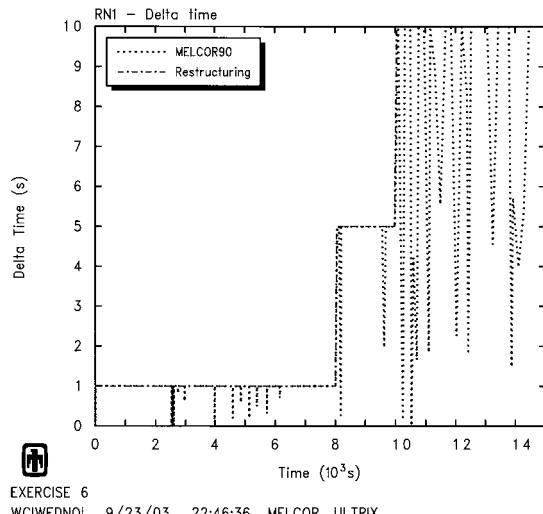
```

FORTRAN90
RN1      FORTRAN77      MELCOR      FORTRAN90
,       library execution file      ,      FORTRAN90
      MELCOR      RN1MELCOR      RN1
      RN1      pool scrubbing,      containment
failure      가      ,      flow path convection
RN1      convection switch      4300MWt      BWR type
      , RN      가      RN1000 card
15,000
      MELGEN      MELCOR      subroutine      data
file(restart file)      read/write      . MELGEN      restart file
      write 가      , MELCOR      data file(restart file)      read      ,
RN1
      Unformatted print      가      subroutine      RN1
      ,      text
      file      write      UNIX diff command      text file      data
file(restart file)      read/write
      ,      FORTRAN90      MELCOR
RN1MELCOR      RN1
      ,      10
11

```



10.



11.

(dt)

5.

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