The RFSP Direct-Access File

Benoit Arsenault, AECL

March, 2000

RFSP Data Base

- Modules communicate through direct access (database) file
- Hierarchical structure
- Up to 7 levels
- Up to 40 records and/or subindices per level
- All model data stored, minimizing input requirements

Communication with Other Codes or Platforms

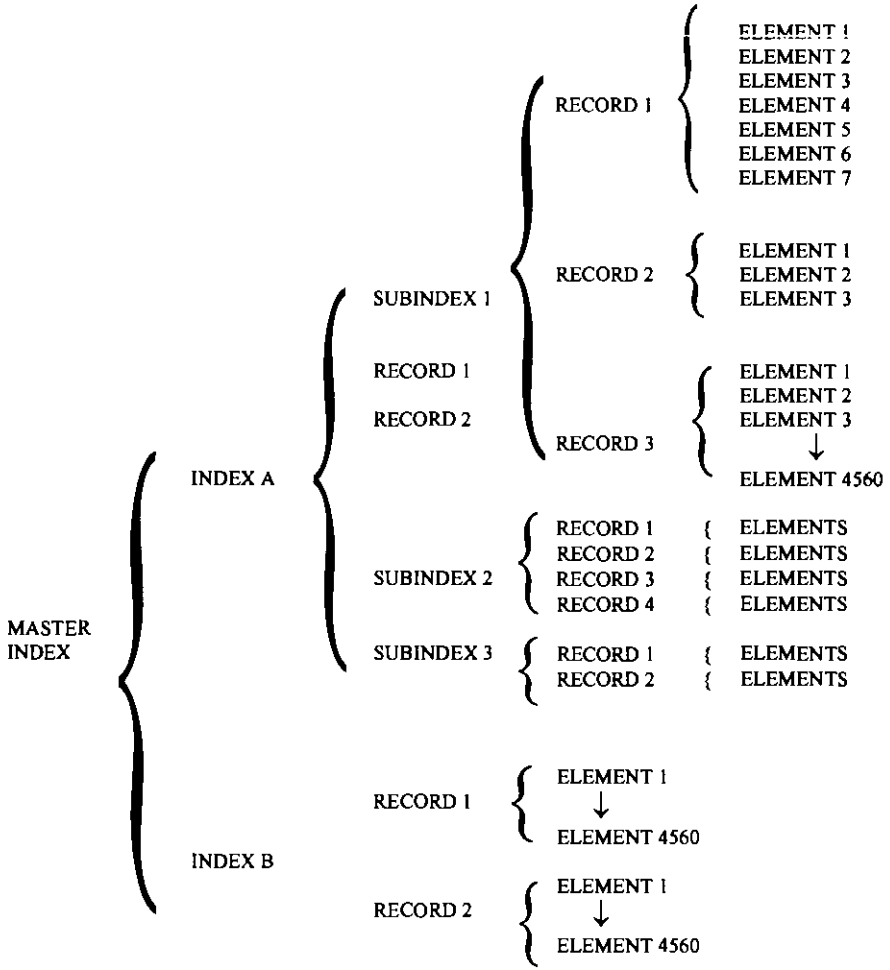
- ***RMICASCII, *WMICASCII**
  - read and write direct access file in ASCII format
- ***RNSES, *WNSES**
  - read and write direct access file to NSES ASCII format (for link to HQSIMEX)
- ***NUCIRCLNK**
  - read coolant properties from NUCIRC and write bundle powers to NUCIRC

  ***CERBERUS, *CERBRRS**
  - links to CATHENA, FIREBIRD, SOPHT, NUCIRC

RFSP Direct-Access File

- Hierarchical or tree-like organizational structure.
- Local direct-access file called "STORE".
- Composed of indices and records.
- Up to 7 levels of indices.
- Under any index may be combined total of 40 subindices and records.
- Move from lowest-level (Level-1) index to higher-and higher-level subindices.
- Not all records are at the same level.
- Records and index identified by 10-character alphanumeric name.
- Names need be unique only within an index.

Example of the Structure of a Direct-Access File



- The system of indices is used to gain access to any record by giving the proper sequence of indices, from lowest level to highest level, leading to that record.
- [Note: Since names are not necessarily unique, the user must be careful to properly identify the record desired.
- Usually the index names correspond to the module that creates them i.e.:

  *DATA GEOMETRY creates GEOMETRY index

  *DATA IRRADIATION creates IRRADIATION index

  *DATA FLUX/POWER creates FLUX/POWER index

  *SIMULATE creates SIMULDATA index
- Each index contains names, lengths, and addresses of its subindices and records.
- Also index can be used to store information, 6 words called the IDENT array, displayed by *PRINT MASS

- Modules ***DELETE** and ***STORE** can be used to delete or copy, respectively, records or whole indices (including everything under them) e.g.,:

  *STORE

  FROM FLUX/POWERPOWERS

  TO REFORM FLUX/POWERPOWERS

  *DELETE FLUX/POWERPOWERS CHANNEL

- ***PRINT** can be used to print most records (without listing the complete path) and in some cases whole indices and everything below them:

  *PRINT GEOMETRY

  *PRINT IRRADIATION

  *PRINT PHYS PARMS

  *PRINT DIMENSIONS (no need for GEOMETRY)

  Exception is *SIMULATE records:

  *PRINT RECORD SIMULDATA REACTOR ENERGY

*USE DAF/*MAKE DAF vs. *READ TAPE/RITE Tape

Advantages of *USE DAF/MAKE DAF

- RFSP data base is saved as a direct-access file
- Better than copying "STORE" file since name is shown in output file
- Faster
- Full path names can be given (70 characters available)

Disadvantages of *USE DAF/*MAKE DAF

- File size large
- *DELETE's create holes that are not filled if possible but size of file can, at best, stay the same
- For calculations where file keeps growing e.g. *SIMULATE, *CERBERUS or *CERBRRS may be unusable with limited disk space

*USE DAF/*MAKE DAF vs. *READ TAPE/RITE Tape (con't)*

Advantages of *READ TAPE/*RITE Tape

- File size is kept to minimum; *DELETE can be used to control size
- Can be used to merge models:

```
*READ TAPE file 1
*READ TAPE file 2  TEMP
*STORE
FROM TEMP GEOMETRY
TO GEOMETRY
*DELETE TEMP
```

*USE DAF/*MAKE DAF vs. *READ TAPE/RITE Tape (con't)*

Disadvantages of *READ TAPE/*RITE Tape

- Slower because direct-access file must be created each time from sequential file
- File name limited to 10 characters

*PRNT MASS (or PRINT MASS)

```
0 INDEX     MASTERINDX      256     9611081430
1 INDEX     HOLES           256     9405270925
2 RECORD    HOLES           400     ←Location of available space in the direct access file
1 INDEX     MODEL           256     9304070747
                          PLMAR9    ←Model name assigned by user, stored in index

1 INDEX     GEOMETRY        256     9611081427      ←Main Level Index (*DATA
GEOMETRY)
2 RECORD    DIMENSIONS       30     ←Data from A, B, C and P GEOMETRY trailer cards
2 RECORDS   MESH SPACE       232    ←Mesh spacing and mesh centre values as input on X, Y and
Z cards
2 RECORDS   NA ARRAY        73980   ←Indicator of material type in each mesh 0-outside, 1-inside
model
2 RECORDS   FUEL TYPES       9120  ←Bundle type - fuel tables from PPV or WIMS input on K
card
2 RECORD    CHAN NUMS        484    ←cross reference of row, column to channel number-used
internally
2 RECORD    REGIONS          760    ←channel groupings usually burnup regions input on J card
2 RECORD    ROWCOLUMNS        56    ←row, column, plane id, input on F, G, H cards
2 RECORD    SERIAL NUM     91210    ←bundle serial numbers (date and position) from L and S card
2 RECORD    MESH NUMS       1728    ←mesh numbering per plane (1 to NPTS) - used internally
2 RECORD    ILIMITS         1152    ←mesh starting and ending point for each row - used internally
2 RECORD    NOTCHRADII        10    ←radius and Z positions of calandria notch - input on M, N
cards
2 RECORD ROPEDATA             34    ←*INTREP input on F, G, and H cards to model ROP
detectors
2 RECORD    DIFF COM 1        26    ←*INTREP input on J card for difference compensation
2 RECORD    NUMDETGRPS         1    ←*INTREP input on A card - no. of detector groups
2 RECORD    GROUPSPECS        56    ←*INTREP input on B card - detector group specifications
2 RECORD DTCTRSPECS         6336    ←*INTREP input on D cards - detector positions
2       RECORD ION CHAM        8    ←*INTREP input on M and N cards - ion chamber electronics
```

Irradiation

1 INDEX IRRADIATION 256 9405271004 ←Main Level Index (*DATA IRRADIATION)
2 RECORD FUEL SCHEM 380 ←Fuelling scheme input on B and C cards
2 RECORD EXIT IRRAD 380 ←Time average exit irradiations specified on A cards
2 RECORD FUEL IRRAD 4560 ←Snapshot of fuel bundle irradiation (n/kb)
2 RECORD FUEL FLUX 4560 ←Snapshot of fuel flux
2 RECORD FUELBURNUP 4560 ←Snapshot of fuel burnup
2 RECORD DELTA RHO 4560 ←Bundle reactivity change on refuelling each channel
2 RECORD CHN BURNUP 380 ←Time average channel exit burnup (*SUMMARY)
2 RECORD K INCREASE 380 ←Reactivity change upon refuelling each channel (from *K-CHANGE)
2 RECORD LAST FUEL 380 ←Energy index for last fuelling of each channel (from *SIMULATE)
2 RECORD LASTFULCYC 380 ←Cycle indicator for multicycle scheme
2 RECORD MULTICYCLE 222 ←Definition of multicycle scheme input on E card
2 RECORD GENFULSCH 13 ←Generalized fuelling schemes as defined on D cards
2 RECORD KLINCREASE 380 ←Reactivity due to fuelling for low-Z half of core
2 RECORD KHINCREASE 380 ←Reactivity due to fuelling for high-Z half of core
2 RECORD T.A.FF*PHI 4560 ←Time average fuel flux
2 RECORD TIMAVEXITW 4560 ←Time average bundle exit irradiations at end-of-cycle
2 RECORD BOC IRRADS 9120 ←Time average beginning and end of cycle bundle irradiations
2 RECORD DWELL TIME 380 ←Time average channel dwell times (time between refuellings)
2 RECORD BUN BURNUP 4560 ←Time average bundle exit burnups at end-of-cycle (*SUMMARY)
2 RECORD BOC BURNUP 9120 ←Time average beginning and end of cycle bundle burnups (*SUMMARY)

Fuel Props

1	INDEX	FUEL PROPS	256	9405271004 ←Main Level Index (*DATA FUEL PROPS)
		ZTFU01 NAT	14	←Reference fuel type name and number of zone controllers in index
2	RECORD	FIXED PROP	20	←Reflector cross sections and any additional fixed property
2	RECORD	MOVE DEVS	4792	←Moveable device positions
2	INDEX	R000	256	←Second level index under which PPV iputs are stored
3	RECORD	R000	90	←Default PPV input - corresponding to first PPV input
3	RECORD	WSFU01 NAT	90	←PPV input for fuel type WSFU01 NAT
3	RECORD	WSFU03 NAT	90	
3	RECORD	WSFU05 NAT	90	
3	RECORD	WSFU02 DEP	90	
3	RECORD	WSFU04 DEP	90	
3	RECORD	CEFU01 NAT	90	
3	RECORD	CEFU02 NAT	90	
3	RECORD	GEFU01 NAT	90	
3	RECORD	WSCC06 NAT	90	
3	RECORD	WSFU05ANAT	90	
3	RECORD	WSFU04ADEP	90	
3	RECORD	ZTFU01 NAT	90	
2	RECORD	MOVE PROPS	642	←Moveable device types, i.e. incremental cross sections
2	RECORD	ZC NAME	28	←Moveable device names for zone controller compartments
2	RECORD	ZC LEVEL	14	←Zone controller fills from latest calculation
2	RECORD	WSFU04 DEP	493	←PPV output for fuel type WSFU04 DEP - i.e. fuel table
2	RECORD	GEFU01 NAT	493	
2	RECORD	ZTFU01 NAT	493	

Flux/Power

```
 1 INDEX     FLUX/POWER      256     9405271017      ←Main Level Index (*DATA
FLUX/POWER)

 2 INDEX     POWERS          256     ←Second level index under which powers are stored
   2061400.00  879.79  6995.86.956120  ←Index contains info from latest calculation:
               total thermal power, max bundle power, max channel power and thermal-to-fission ratio

 3 RECORD    BUNDLE          4560    ←Bundle powers
 3 RECORD    CHANNEL          380    ←Channel powers

 2 INDEX     XENON DIST      256     ←Second level index under which satrating fission product
                                       concentrations are stored for end of time step
 3 RECORD    FUEL FLUX       4560    ←fuel flux at end of time stap
 3 RECORD    IODINE          4560    ←iodine concentration at end of time stap
 3 RECORD    XENON           4560    ←xenon concentration at end of time stap
 3 RECORD    PM 149          4560
 3 RECORD    SM 149          4560
 3 RECORD    RU 105          4560
 3 RECORD    RH 105          4560
 3 RECORD    PM 151          4560
 3 RECORD    SM 151          4560
 3 RECORD    SM 155          4560
 3 RECORD    EU 155          4560
 3 RECORD    EU 157          4560
 3 RECORD    GD 157          4560
 3 RECORD    AG 113          4560
 3 RECORD    CD 113          4560
 3 RECORD    XENON META      4560
```

Flux/Power (con't)

```
2  INDEX     XENON INIT      256     ←Second level index under which saturating fission product
concentrations are stored for beginning of time step
3  RECORD    FUEL FLUX       4560
3  RECORD    IODINE          4560
3  RECORD    XENON           4560
3  RECORD    XENON META      4560
3  RECORD    PM  149         4560
3  RECORD    SM  149         4560
3  RECORD    RU  150         4560
3  RECORD    RH  105         4560
3  RECORD    PM  151         4560
3  RECORD    SM  151         4560
3  RECORD    SM  155         4560
3  RECORD    EU  155         4560
3  RECORD    EU  157         4560
3  RECORD    GD  157         4560
3  RECORD    AG  113         4560
3  RECORD    CD  113         4560

2  INDEX     OVERPOWERS      256     ←Second level index under which overpowers are stored
3  RECORD    CHNLOVPWR       380     ←Channel overpowers (*SIMULATE vs REFORM)
3  RECORD    BNDLOVPWR       4560    ←Bundle overpowers (*SIMULATE vs REFORM)

2  INDEX     FAST FLUX       256     ←Second level index containing fast flux
                                             44 36 24  2  2
3  RECORD    2               1133    ←Fast flux for z-plane 2 (NPTS)
3  RECORD    3               1133
3  RECORD    4               1133
3  RECORD    5               1133
etc, etc...
3  RECORD    23              1133
3  RECORD CELL FLXF          4560    ←lattice cell fast flux
```

Flux/Power (con't)

```
2  INDEX     SLOW FLUX        256    ←Second level index containing thermal flux
                                      44  36  24  .200E-04  1.500000  1.000359  .500E+00 1  10
300
3  RECORD    2                1133   ←Thermal flux for z-plane 2 (NPTS)
3  RECORD    3                1133
3  RECORD    4                1133
3  RECORD    5                1133
etc, etc....
3  RECORD    23               1133
3  RECORD    CELL PHI         4560   ←lattice cell thermal flux


1  INDEX     REFORM           256    9405251451      ←Main level index containing reference
power distribution
2  INDEX     FLUX/POWER       256
3  INDEX     POWERS           256
                                      2061400.00  873.84  6955.31  0.956120
4  RECORD    CHANNEL          380
4  RECORD    BUNDLE           4560

1  INDEX     AUXILDATA        256    9405251510      ←Data used by *PRTPWR
19.236000  182.3999  .900000  2061.40  14  10  30  25  20200      ←data input on A and B cards
stored in index, i.e. UBUN, TABURN, RAT, FULPOW, INTLF, INTPOL, IOLDB, INTBP, INTBU,
INTCP
2  RECORD    REGIONS          760    ←channel regions from D card
2  RECORD    AXL REGION       28     ←axial region names from E card
2  RECORD    REF FLUX         14     ←reference flux per axial zone from E card
2  RECPRD    CPPFREGION       380    ←CPPF region (0 or 1) read in by *READ CARD
2  RECORD    LIFE NPOOL       1      ←number of bundles in pool statistics, LTPOOL on A card
2  RECORD    LIFE BURN        1      ←average exit burnup for NPOOL bundles, BURNLT on B
card
2  RECORD    TA BURN          14     ←time average end-of-cycle burnup input on E card
```

PHYS PARMS

```
1  INDEX     PHYS PARMS        256    9702271432      ←Main level index for material properties

2  RECORD    BNDRPLANES          6    ←plane boundaries for modelling moderator level
2  RECORD    F FACTOR         4560    ←F  factor - ratio of thermal fuel flux to cell flux
2  RECORD    H FACTOR         4560    ←H  factor - ratio fo bundle power to cell thermal flux

2  INDEX     SIGMATRF1         256    44 36 24        ←Fast transport cross section
                                                        (index includes mesh dimensions)
3  RECORD              2      1133    ←values for Z plane 2 (NPTS)
3  RECORD              3      1133
etc, etc....
3  RECORD             23      1133

2  INDEX     SIGABSLOW         256    44 36 24 ←Thermal transport corss sectin
3  RECORD              2      1133
3  RECORD              3      1133

etc, etc...
3  RECORD             23      1133

2  INDEX     SIGABSLOW         256    44 36 24 ←Thermal absorrtion cross section
3  RECORD              2      1133
3  RECORD              3      1133
etc, etc...
3  RECORD             23      1133
```

PHYS PARMS (con't)

```
2  INDEX     SIGREMVFST      256     44  36  24 ←Fast absorption cross section
3  RECORD              2    1133
3  RECORD              3    1133
etc, etc...
3  RECORD             23    1133

2  INDEX     NUSIGFISS       256     44  36  24 ←thermal production cross section
3  RECORD              2    1133
3  RECORD              3    1133
etc, etc....
3  RECORD             23    1133
```

```
1  INDEX     PROP              256     9302021040      ←Main level index for xenon properties
from PPV or WIMS
                                       0.29E-04  0.212E-04  0.320E-17  ←index contains I and Xe
decay contants and xenon microscopic cross section
2  RECORD    WSFU04  DEP       188     ←1) ratio of I yield to I+Xe, 2) reference Xe concentration, 3)
Xe incremental absorption cross section vs irradiation
2  RECORD    GEFU01  NAT       188
2  RECORD    ZTFU01  NAT       188

                                    *SIMULATE RECORDS
1  INDEX     SIMULDATA         256     9611081430
2  INDEX     PLGSUNIT1         256
3  INDEX     147424620         256
4  INDEX     158505929         256
2061400.00  879.79  6995.86  .956120D  4560  .999919
5  RECORD    PPVABBDATA 196080
5  RECORD    SERIAL NUM      9120
5  REORD     FUEL TYPES      9120
5  RECORD    CELL    PHI     4560
5  RECORD    FUEL IRRAD      4560
5  RECORD    F    FACTOR     4560
5  RECORD    CELL   FLXF     4560
5  RECORD    LAST   FUEL      380
5  RECORD    LASTFULCYC       380
5  RECORD    H    FACTOR     4560
5  RECORD    BUNDLE          4560
5  RECORD    CHANNEL          380
5  RECORD    FUELBURNUP      4560
5  RECORD    CHNLOVPWR        380
```