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ENGINEERING PHYSICS DIVISION

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ABSTRACT

This report presents user input data requirements for certain special processors in a nuclear reactor computation system. These processors generally read data in formatted form and generate binary interface data files. Some data processing is done to convert from the user oriented form to the interface file forms. The VENTURE diffusion theory neutronics code and other computation modules in this system use the interface data files which are generated.

I. Introduction

Input data requirements for certain special processors are described here. These codes are used in a local computation system for analysis of nuclear reactors.[a] A key computation module in this system is the VENTURE finite-difference diffusion theory code.[b] Another module in this system is an input processor which generates interface files directly from free form data; it plays a separate role in generating files but lacks capability to process data in a form oriented toward problem descriptions rather than file formats. These special processors have, for the most part, been in production use for a long period of time; the user community has become intimately familiar with their use and calls for their services routinely.

These codes are honest members of the system in that they play the game of interface file management fairly under the file management service routines. Primary control is vested in these service routines to make available a reference table of file names and associated unit numbers, to update this table by extending it, and to identify revision numbers of files having the same name. A computer run is made under the direction of a control module which plays a crucial role of initialization and wrap-up. A stand-alone mode of module use was adopted in the early development effort, but this mode is no longer recommended because instructions at the control module level are overridden and destroyed.

The name of each interface data file to be generated is either in the file management tables (although a file may or may not exist in the sense of being available) or it is not. Execution of a special processor quite generally causes the generation of a new file having the same version number as the latest (highest numbered) one which appears to exist on the same logical unit, without access of the old file. Thus preassignment of file names and associated logical unit numbers may be made at

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[a] ORNL-5158

[b] ORNL-5062

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the control module level as an initialization step. If a file is to be generated which does not have its name in the file management tables, assignment is made of a new logical unit number to the file name, version 1 is assigned, and the file is generated.

Each block of user input data must start with a header card which identifies the special processor, and must terminate with an END card. No distinction is made between a zero and a blank field. Data elements are usually named herein, followed by fixed field columns of a keypunched input data card in parentheses. A non-zero default value is shown in [] after the discussion about the datum, overridden by non-zero input. Undefined data is reserved for future use. Some of the data is blocked into individual sections and three digit identifying numbers are used to head the input data for the individual sections; except where indicated, data must be supplied for each section, and in the order of increasing section number.

A reasonable amount of error checking is done to identify evident user blunders and to effect abortion to avoid wasted calculation by return of a non-zero stop number. Still, unreasonable data may be supplied inadvertantly, so careful checking of the edits from the codes and of the results is in order to avoid drawing incorrect conclusions in analysis.

A summary is presented below of the access names and path identification for the special processors covered and the names of the files generated. Files which are generated only on option have been shown in parentheses. Also shown are the names of records added to the file CONTRL; these are accessed by the computation modules for their control.

Processor Access Name	Access Path Module Number	Record Generated in file CONTRL	Files Generated
DVENTR	2	DTNINS	GEODST, NDXSRF, ZNATDN, (SEARCH)
DCRSPR	2	XCPINS	(CXSPRR)
DUTLIN	2	(optional)	-
DCMACR	2	-	See discussion
DENMAN	99	-	(ZNATDN),(QNATDN), (NDXSRF),(SEARCH)

See the Appendix for VENTURE storage requirements.

II. Processor DVENTR (VENTURE Input)

This code processes data to generate the essential files required by the VENTURE neutronics code. The files generated are consistent regarding the zone volumes which are calculated from the geometric mesh description and the nuclide cross section, concentration referencing tables. Reference data is accessed from the group ordered microscopic cross section file GRUPXS requiring that it be available.

Header card: DVENTR in columns (1-6).

(Three cards are required here in the stand-alone code access mode, not recommended. The first contains the memory to be allocated for data storage, I6 in columns 1-6, and the next two cards are for a descriptive title, 12A6/12A6.)

Section 001: General Control[a]

Card 1: 001 in Columns 1-3.

Card 2: Control Data (6E12.0).

RXX1(1-12)

RXX2(13-24) Machine central processor time limit for any eigenvalue problem (min) if > 0.

RXX3(25-36) If > 0, the restart I/O data file RSTRTR will be written (rewritten) every RXX3 minutes during the iterative calculation, and also at termination [0.0].

RXX4(37-48) Power level (watts thermal). (Normalization of the flux is to source neutrons produced lacking energy generation data with the cross sections.)

RXX5(49-60) Conversion factor, ratio of thermal energy to fission + capture energy as calculated from the data presented with the cross sections [1.0].

RXX6(61-72) Fraction of reactor considered, applied to the power level RXX4 (accounts for the actual geometry treating less than the whole core). RXX6 would be 1.0 in R-Z geometry if Z spanned the whole core, 0.5 if only half was treated; in X-Y geometry, this could be

[a] Unless noted, defaulting has been moved into VENTURE for this section of data.

the reciprocal of the Z dimension. Considering unit dimensions in untreated coordinates, this is the volume actually treated divided by the actu- core volume. Power generation in untreated regi- s requires special consideration.
Note that the flux level will be normalized to cause a fission + capture energy level of RXX4*RXX6/RXX5. (If RXX4 is perchance electrical energy, then RXX5 should contain the plant efficiency.)

Card 3: Control Data, cont. (6E12.0).

RXX7(1-12)

RXX8(13-24) Chebyshev parameter μ_2 upper bound (overrides that calculated by the code).

RXX9(25-36) Chebyshev parameter μ_1 lower bound, usually zero, (overrides that calculated by the code).

RXX10(37-48) Specified overrelaxation coefficient (overrides automated procedure).

RXX11(49-60) Convergence criterion on integral quantities (K) on outer iterations [0.000005].

RXX12(61-72) Convergence criterion on local, point quantities (maximum relative flux change) [0.00005].

Card 4: Control Data cont. (6E12.0)

RXX13(1-12) Input Buckling to override that on the GEODST interface file.

RXX14(13-24)

RXX15(25-36)

RXX16(37-48) Search k_{eff} to be satisfied. Required if ICX2=4 or 5. May be used to override search k_{eff} on search interface if ICX2=1.

Card 5: Control Options (24I3).

ICX1(1-3) Transport theory approximation to be applied [1].
1 - Finite-difference diffusion theory.
2 - Simple P_1 approximation.

ICX2(4-6) Type of problem.

0 - Determine k_{eff}.

1 - Search (requires search file be supplied, see ICX3).

2 - Fixed source (requires source file be supplied).

3 - Adjoint only (see ICX4 option to do the adjoint problem directly following a regular problem, which is generally recommended).

4 - B^2 search.

5 - 1/v search, prompt mode (requires velocity data in cross section file).

ICX3(7-9) Search data identifier, see section 028 which is required if ICX3 > 0, or if ICX2 = 1 and ICX3 $\geq$ 0

ICX4(10-12) Adjoint problem option.

0 - Not to be done.

1 - Adjoint eigenvalue problem.

2 - Adjoint fixed source problem (requires source file be supplied or generated).

ICX5(13-15) Flux initialization option.

0 - Automated procedure, recommended unless a good guess is available.

-1 - Set all values equal.

1 - Make space-energy dependent.

2 - Use data from the interface data file supplied.

ICX6(16-18)[a] Force data handling mode.

0 - Automated procedure, recommended to minimize data input/output.

1 - Core contained.

2 - Space problem contained.

3 - One row contained.

4 - Multiple planes stored.

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[a] A -1 option has recently been added to allow the user to cause termination if the amount of memory allocated is insufficient for efficient execution (cannot store space problem in two-dimensions or enough planes to avoid excess data transfer in three-dimensions).

5 - Multiple rows stored.

6 - Multi-level transfer mode (special coding for a machine having a large slow extended memory).

ICX7(19-21) If > 0, a previously written restart data file RSTRTR will be read to continue a calculation which must be supplied.

ICX8(22-24) Extrapolation options on outer iterations.

0 - Automated procedure which may do either single error or double error mode extrapolation.

-1 - Single error mode using successive iterate flux sets.

1 - Single error mode using alternate iterate flux sets.

2 - Extrapolation not allowed.

3 - Set to 0, but when single error mode extrapolation is done, successive iterate flux sets are used.

ICX9(25-27) Options for initialization procedure.

-2 - Do not solve a 1-D problem.

-1 - Do not use results from a 1-D problem for inner iterative procedure data.

0 - Automated.

1 - No Chebyshev of overrelaxation coefficients on outer iterations.

2 - Fix the number of inner iterations.

3 - Fix the number of inner iterations, no Chebyshev.

4 - Fix overrelaxation factors and the number of inner iterations.

5 - Same as 4, but no Chebyshev.

6 - Same as 4, but do not use results from a 1-D problem.

7 - Same as 5, but do not use results from a 1-D problem.

ICX10(28-30) Recalculate overrelaxation coefficients and number of inner iterations at outer iteration number ICX10.

ICX11(31-33) Number of inner iterations, leave blank and let the code decide this. (For many fast reactor problems we find 4 inner iterations are near optimum without Chebyshev acceleration; however, for some problems the code automated procedure may be superior provided adequate memory is allocated for the inner iteration process to be done efficiently.)

ICX12(34-36) Maximum number of outer iterations. If set = 969, calculation is not done, but preliminary data processing from the interface data files is a check-out procedure [50 in input processor].

ICX13(37-39) Extrapolation not allowed before ICX13 outer iterations.

If < 0, forced extrapolation is allowed.

ICX14(40-42) Outer iteration chebyshev acceleration (flux) options.

<0 - Start at iteration number |ICX14|.

0 - Use automated procedure.

1 - Start after first extrapolation.

2 - Force after initial delay.

3 - Do not allow.

100 +N - Start at iteration N > 3 with forced extrapolation to obtain the L_1 norm eigenvalue.

ICX15(43-45) Options on mesh point sweep.

-1 - Force normal ordering.

0 - Automated procedure.

1 - σ_1 ordering when data handling procedures allow it.

ICX16(46-48) Plane (or row) number of a 3-D (or 2-D) problem which is to be run as a 2-D (or 1-D) problem.

ICX17(49-51) Options on k-effective calculation.

0 - Automated procedure.

1 - Calculate k-effective by the source ratio.

ICX18(52-54) Fission spectrum option.

0 - Apply set values.

1 - Determine zone-dependent data from data for the individual nuclides, often desirable for fast reactor problem.

ICX19(55-57) Fission spectrum normalization.

0 - Not to be done.

1 - Normalize individually to unity.

ICX20(58-60)

ICX21(61-63) This order (1, 2, or 3) of the coordinate direction dependent cross section data in the library is to be used for the first dimension.

ICX22(64-66) Ditto, second dimension.

ICX23(67-69) Ditto, third dimension.

ICX24(70-72) Force data transfer of the region assignments in processing (only used to check procedures).

Card 6: Edit options and instruction to generate interface data files (2413).

Note: Indicated action generally to be taken if the value is $\neq 0$, no action if 0.

IXE1(1-3) Print overall neutron balance, highly recommended.

IXE2(4-6) Print neutron balance by zone (macroscopic composition).

IXE3(7-9) Print space-energy point flux values which is recommended only when really essential.

IXE4(10-12) Print space point map of power density, not usually needed, especially when zone peaks are edited.

IXE5(13-15) Print power density traverse through peak along each coordinate.

IXE6(16-18) Print space point map of neutron density requiring velocity data with the cross sections, useful only in some situations (ϕ/v is 1/v response).

IXE7(19-21) Print neutron density traverse through peak along each coordinate.

IXE8(22-24) Print space-energy point adjoint flux values (when calculated), seldom needed.

IXE9(25-27) Print zone average flux values by energy group (already available if the zone neutron balance is obtained by option IXE2); if >1, also print zone average adjoint flux values if the adjoint problem is solved.

IXE10(28-30) Print information about the iterative progress.

-1 - No

0,1 - One line of iteration edit per outer iteration.

2 - Also inner iteration data.

3 - Also more inner iteration data.

IXE11(31-33) Print principal macroscopic cross sections and other data, useful for checking data.

1 - Only macroscopic cross sections.

2 - Also boundary conditions and buckling, and overrelaxation coefficients.

3 - Also extensive information about initialization and recalculation of overrelaxation coefficients.

IXE12(34-36) Print scattering macroscopic cross sections.

IXE13(37-39) A plane number for which the zone and group bucklings are to be calculated.

IXE14(40-42) A second plane number for the buckling calculation.

IXE15(43-45) Write regular total flux interface data file RTFLUX.

1 - Replace old file; if none exists, create one.

2 - Write a new file.

IXE16(46-48) Write adjoint total flux (if calculated) interface data file ATFLUX.

1 - Replace old file; if none exists, create one.

2 - Write a new file.

IXE17(49-51) Write regular zone flux interface data file RZFLUX.

1 - Replace old file; if none exists, create one.

2 - Write a new file.

IXE18(52-54) Write power density interface data file PWDINT.

1 - Replace old file; if none exists, create one.

2 - Write a new file.

IXE19(55-57) Write fission source interface data file FISSOR.
1 - Replace old file; if none exists, create one.
2 - Write a new file.

IXE20(58-60) Print option when input data is processed.
1 - Edit interface data files NDXSRF and ZNATDN.
2 - Also edit interface data file GEODST.

IXE21(61-63) Additional print option when data is processed.
-1 - No mesh point zone number edit.
0 - Edit zone number at each mesh interval only after overlay input Section 006.
1 - Edit zone number at each mesh interval after input Sections 005 and 006.

IXE22(64-66)[a] Perturbation edits. Positive values for this number indicate that the neutronics regular-flux or adjoint-flux or both regular followed by adjoint calculations are to be run prior to the perturbation calculation to write the interface data files RTFLUX and ATFLUX which must be available for perturbation calculations. Negative values indicate that these two interface data files already exist and no neutronics calculation will be done.
|1| - Edit basic integrals.
|2| - Also edit transport integrals.
|3| - Also edit absorption cross-section space point importance map.
|4| - Also edit production and production-absorption cross-section space point importance maps.
|5| - Also edit 1/v space point importance map.

IXE23(67-69) Write perturbation interface data file PERTUB (IXE22 not zero).
1 - Replace old file; if none exists create one.
2 - Write a new file.

IXE24(70-72) Save results as formatted data (see Section 704, of the VENTURE report) at the end of a case.

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[a] A new option |6| allows file PERTUB to be written with edit suppressed.

1 - Yes.

2 - Also print this data.

Section 002: Optional General Control

This section of input is optional.

Card 1: 002 in columns 1-3.

Card 2: Control options (24I3).

IXCN1(1-3) Identifies secondary search data in the SEARCH interface file to be used if the constraints of the first set are not satisfied, and a second search is to be done (see SEARCH file specifications).

IXCN2(4-6) Option to use local implementation of system data transfer routines (requires about 600 words additional memory for data but reduces buffer space.)

IXCN3(7-9) Option for testing to prevent default of files to memory.

Card 3: Control options (cont.) (24I3).

IXEN1(1-3) Calculate and edit perturbation results for a 100 percent change in macroscopic cross sections and uncertainty (sensitivity) information if IXE22 (Section 001) is not zero.

IXEN2(4-6) Option to write point flux values (used for auxiliary exposure calculations), if IXE17>0.

>0 - write flux data for this zone.

-1 - write data for only the point where the power density is a maximum for the initial neutronics problem.

-2 - write flux data for points in the zone where the power density is a maximum for the initial neutronics problem.

-3 - write flux data for the point where the first group flux is a maximum for the initial neutronics problem.

-4- write flux data for the points in the zone where the first group flux is a maximum for the initial neutronics problem.

<-4 - write flux data for this mesh point count in the mesh.

IXEN3(7-9) A second zone number for the same purpose, only >0 allowed.

IXEN4(10-12) Option to calculate a fixed source and write a new interface file FIXSRC from the results of this forward eigenvalue problem: $F(\text{zone, group}) = \frac{\Sigma_c}{C} - \frac{\Sigma_a}{A}$, Σ_c is the fertile macroscopic capture cross section, Σ_a is the fuel macroscopic absorption cross section, and C and A are integrated fertile capture and fuel absorption (C/A = primitive conversion ratio). If < 0 write two fixed source files: $\frac{\Sigma_c}{C}$, $\frac{\Sigma_a}{A}$.

IXEN5(13-15)
IXEN6(16-18)
IXEN7(19-21)
IXEN8(22-24)
IXEN9(25-27)

IXEN10(28-30) Option to calculate and edit the relative change in conversion ratio for a 100% change in the macroscopic fertile capture cross section and finite absorption cross section.

IXEN11(31-33)

IXEN12(34-36) Write zone power density file ZNPOWD.
1 - Replace old file; if none exists, create one.
2 - Write a new file.

IXEN13(37-39) Write a point fixed source file as $DB^2\phi$.
1 - Replace old file; if none exists, create one.
2 - Write a new file.

IXEN14(40-42) Write the adjoint zone average flux file AZFLUX.
1 - Replace old file; if none exists, create one.
2 - Write a new file.

Card 4: Control options (cont.) (2413).

IXNU1(1-3)

Card 5: Control Data (6E12.0).

RXXN1(1-12) Limiting value of the diffusion coefficient[a] (100 cm)

Card 6: Control Data (cont.) (6E12.0).

RXXN7(1-12)

[a] If a larger value is calculated, the limiting value is used (essential to avoid poor convergence characteristics), defaulted in VENTURE proper.

Section 003: Geometric Description

Card 1: 003 in Columns 1-3.

Card 2: Data (13I3)

IGOM(1-3) Reference Geometry.

1 - Slab (X) one-dimensional.
2 - Cylinder (R).
3 - Sphere (S).
6 - X-Y, two-dimensional.
7 - R-Z.
8 - θ-R.
9 - T (equilateral triangle).
10 - H (equilateral hexagon).
14 - X-Y-Z, three dimensional.
15 - θ-R-Z.
17 - T-Z.
18 - H-Z.

IMBL(4-6) Boundary at start of rows (left).

0 - Zero flux.
1 - Reflected.
2 - Extrapolated.
3 - Repeating with opposite end.

IMBR(7-9)[a] Boundary at end of rows (right).

0 - Zero flux.
1 - Reflected.
2 - Extrapolated.
3 - Automatically if IMBL=3.
4 - Repeating with next adjacent face (rotational symmetry with boundary JMBB).
5 - Inverted repeating this face (180° rotational symmetry).

[a]Note interchange of IMBR and JMBT from old ORNL codes; only those boundaries required for the geometry need values.

JMBT(10-12) Boundary at start of columns (top).

0, 1, 2, options above.

JMBB(13-15) Boundary at end of columns (bottom)

0, 1, 2 options above (set = 4 if IMBR = 4).

KMBF(16-18) Boundary face of planes (front)

0, 1, 2 options above.

KMBR(19-21) Boundary back of planes (back)

0, 1, 2 options above.

NBS(22-24) Number of buckling specifications: remember that buckling is normally only to approximate leakage in those coordinate directions untreated, and not for S, R-Z and three-dimensional problems.

0 - None, code uses $B_1^2 = 0.0$.

1 - Single value of B_1^2 applies everywhere.

= NZONE ≡ number of zones, zone dependent.

= N*NZONE, data is given over all zones for the first energy group, then for the next group, and so on through N groups. If there are more than N groups, data for group N is used for the other groups. If NBS > 0, additional data will be required.

NBCS(25-27) Number of constants for external boundaries non-return boundary constants, applied only where the "extrapolated" boundary condition is specified.

0 - Default value of C = 0.4692 is used;

$$C = -\frac{D}{\phi}\frac{\partial \phi}{\partial x}\bigg|_b .$$

1 - Single value to be used everywhere.

6 - Individual values for each of the faces of a 3-D problem (left, right, top, bottom, front, back).

N*6 - Values for the six faces are given for the first energy group, then the next, through N groups; data for group N is used for any additional groups. If NBCS > 0, additional data will be required.

NIBCS(28-30) Number of constants for internal extrapolated boundaries.

0 - None, default value C = 0.4692.

1 - Single value given will be used.

N - Values given in increasing group number order, last value used for any additional groups. If NIBCS > 0, additional data will be required.

NZWBB(31-33) Number of zones which are black absorbers (no return current from these).

If NZWBB > 0, additional data will be required.

NTRIAG(34-36) Orientation of triangular geometry.

0 - 120° between X and Y axes (required for 120° rotational symmetry which is about opposite corner from 0,0).

1 - 60° between X and Y axes (required for 60° rotational symmetry which is about opposite corner from 0.0).

NRASS(37-39)

Card(s) 3: NBS values of buckling required (6E12.0).

Card(s) 4: NBCS values of boundary constants required (6E12.0).

Card(s) 5: NIBCS values of internal boundary constants required (6E12.0).

Card(s) 6: NZWBB identifiers of black zones required (24I3).

Section 004: Geometric Mesh Description

Card 1: 004 in Columns 1-3.

Card(s) 2: (6(I3,E9.0)).

Specify the number of mesh points and the region width for each vertical region going from left to right. For a two-dimensional problem next specify the number of mesh points and the region width for each horizontal region going from the top to bottom starting with a new card. For a three-dimensional problem then specify the number of mesh points and the region width for each region going from front to back starting with a new card. In referring to the geometric mesh, rows of mesh points go from top to bottom, columns of mesh points go from left to

right, and planes of mesh points go from front to back. In R and R-Z geometry, a row is a radial traverse. In θ-R and θ-R-Z geometries, columns radiate downward from a center at the top and a row has constant radius. In hexagonal geometry, the X and Y axes are assumed to be at 60° (upper left-hand corner), and dimensions are on external boundaries. In triagonal geometry, the X and Y axes are located at 120° (except 60° when NTRIAG in Section 003 is made 1). Distances are given along these coordinates (not at 90° for the special orientations). Data must be ended for each traverse by a blank entry; if the last cart of data is filled for any traverse, another card is required (blank).

Section 005: Zone Placement

Card 1: 005 in Columns 1-3.

Card(s) 2: (24I3).

Specify the zone identification numbers (i.e., location of uniform composition) of each region of a traverse along the first horizontal row of regions going from left to right, one number for each interval entry in Section 004. Beginning with a new card, specify the zone numbers of each region in the second horizontal row of regions. Continue these specifications going from top to bottom. For a one-dimensional problem, the zone numbers are specified for only one traverse. For a three-dimensional problem, give the two-dimensional grid for the front plane of regions and continue these to map the material through to the back plane. The cross section set later to be associated with the zone numbered 1 will be used as a reference, so zone 1 might be located within a core rather than in a blanket or reflector. Also it will prove convenient to number consecutively zones which will contain the same material (will have the same nuclides and use the same microscopic cross-section tape). Note that each specification in this block of data is for a traverse along a row and requires the same number of entries.

Section 006: Mesh Overlay (Optional)

New zones may be superimposed within a mesh already described with this data.

Card 1: 006 in Columns 1-3.

Card 2: (I4).

Specify a zone number in the first field; data is read to a blank zone number.

Card(s) 3: (3(6I4)).

Specify blocks of points by left column number and then right column number to give limits along rows, top and bottom row numbers for column limits, and front and back plane numbers for depth limits in that order. If only one row is involved, for example, then that row number is repeated. Only 4 entries are needed for each specification in 2-D geometry. Data is read to blank left column entry. The entry 000600060005001500020002 places the new material along column 6 from row 5 through 15 and on only plane 2. Remember that each mesh point has an associated volume around it - mesh points do not lie on material interfaces; specifying a single mesh point here, say 000600060005000500020002 does involve the associated volume.

Section 012: Assignment of Nuclide Name Sets to Zones

This data is used to block the nuclide concentrations.

Card 1: 012 in Columns 1-3.

Card 2: Number of subzones in Columns 1-3, NSZ.

Card 3: Referencing data (4I3,E12.0).

M1(1-3)	First zone number of a consecutively numbered set of zones.
M2(4-6)	Last zone number of the set.
NS(7-9)	Nuclide set reference number (out of the integers from 1 to the number of sets).
NC(10-12)	Zone classification number.
VF(13-24)	Volume fraction associated with zone concentrations in these zones. [1.0]
	Cards 3 are read until a blank or zero M1 number is encountered.

Card(s) 4: Subzone data (4.3,E12.0,I3) required if NSZ > 0.

MM1(1-3)	First subzone number of a consecutively numbered set of subzones.
MM2(4-6)	Last subzone number of the set.
MMS(7-9)	Nuclide set reference number.
MMC(10-12)	Zone number containing these subzones.
VMC(13-24)	Fraction of the zone volume applying to each of these subzones.
	Cards 4 are read to a blank (zero MM1).
MMCOPT(25-27)	If = 1, the first subzone is assigned to zone MMC, the next subzone is assigned to the next zone, etc., indexing upward through the subzone set, one subzone assigned to a zone.

Section 013: Nuclide Names in Sets

This data is necessary to relate concentration assignments by nuclide name.

Card 1: 013 in Columns 1-3.

Card 2: NNS maximum number of nuclides in any set in Columns 1-3.

Card 3: NDXS number of nuclides in this set in Columns 1-3.

Card(s) 4: Names of nuclides (alphanumeric characters) in the set which must correspond with user identification names (not absolute labels) in the cross-section library, NDXS six-character names (12A6) required.

Cards 3 and 4 are repeated for each set specified in Section 012 through the maximum set number.

Section 020: Nuclide Concentration Assignments

In this assignment of nuclide concentrations for some initial condition, overlay is permitted; that is the last assignment to a zone overrides any previous ones.

Card 1: (I3, 3X, 2I3, E12.0) Section Card.

Columns (1-3)	Must contain the section identification 020.
NDØ (7-9)	Option that no concentrations are supplied if <0 which assumes that the file ZNATDN exists and is not to be written, and no more cards are supplied in this section.

MCN (10-12) Cycle reference (count) for documentation.

TIME (13-24) Reference time (days) for documentation.

Card 2: Zone set (3I3).

MZ1(1-3) First zone number of a consecutively numbered set.

MZ2(4-6) Last zone number of the set.

MZI(7-9)[a] Reserved

Card(s) 3: Concentration assignments 4(A6,E12.0).

Specify a six character alphanumeric name of a nuclide and then its concentration, and continue with sets of these to a blank name.

Cards 2 and 3 are read until a blank card (zero MZ1) is encountered.

Note: Names must correspond precisely with those given in Section 013 and with those in the cross-section library.

Card(s) 4: Subzone set (3I3), required if NSZ > 0.

MSZ1(1-3) First subzone number of a consecutively numbered set of subzones.

MSZ2(4-6) Last subzone number of the set.

MSZI(7-9)[a] Option on input.

0 - Input concentrations.

+1 - Use the concentrations from the corresponding zone (the nuclide set for the zone and subzone must be the same for this option).

Card(s) 5: Subzone concentrations 4(A6,E12.0), required if MSZI = $\leq$0.

Cards 4 and 5 are read until a blank card (zero MSZ1) is encountered.

Section 028: Criticality Search Data for Search Problems (Required if ICX3 > 0 or if ICX2 = 1 and ICX3 $\geq$ 0)

Card 1: (I3) 028 in Columns (1-3).

Card 2: (I3)

NSP(1-3) Search set identifier, set equal to ICX3 in DVENTR.

Card 3: (6E12.0) Search specifications.

XSH1(1-12) Desired multiplication factor (1.0).

[a]For processing with the special processor DENMAN, a -1 here causes the nuclide densities in these locations to be set to zero before the additions are made.

XSH2(13-24) Multiplication factor slope, $\partial k/\partial \lambda$ where λ is the search problem eigenvalue.

XSH3(25-36) Convergence criterion to be met by k, $\varepsilon_n = (k_n - k_{n-1})/k_n$ where u refers to iteration [5.0E-5].

XSH4(37-48) Convergence criterion to be met by eigenvalue of the search problem [1.0E-3].

XSH5(49-60) Modifier applied to nuclide concentration varied specially (for NSH1 = 7 only).

XSH6(61-72)

Card 4: (24I3) Search specifications.

NSH1(1-3) Type of search.

0 - Not defined.

1 - Buckling.

2 - 1/V.

5 - Dimension.

7 - Nuclide concentration search by proportional adjustments of selected initial concentration.

9 - Nuclide concentration search by adding weighted eigenvalue adjustments to selected initial concentration.

NSH2(4-6) Subzone option when NSH1 = 7 or 9.

0 - Search data by zone.

1 - Search data by subzone.

NSH3(7-9) Maximum number of neutronic eigenvalue problems allowed for the search (a zero specifies a direct search).

NSH4(10-12) Number of first dimension coarse mesh intervals (data required only for a dimension search, NSH1 = 5).

NSH5(13-15) Number of second dimension coarse mesh intervals.

NSH6(16-18) Number of third dimension coarse mesh intervals.

NSH7(19-21) Maximum number of isotopes or nuclides defined in a set for a concentration search (NSH1 = 7 or 9 only).

NSH8(22-24) Number of sets specified for concentration search (NSH1 = 7 or 9 only).

NSH9(25-27) Search problem eigenvalue range allowed for an acceptable solution.

-1 - $\lambda > 0$.

0 - No restriction.

1 - $0 < \lambda < 1$.

2 - $\lambda < 1$.

NSH10(28-30) State of the iterative procedure allowed for an acceptable solution.

0 - No restraint.

1 - Convergence criteria not met.

2 - Convergence criteria not met and problem not converging.

NSH11(31-33) Conditions allowed in the solution for it to be acceptable.

0 - All N > 0 during calculation.

1 - All N > 0 at solution.

2 - Allow N < 0.

NSH12(34-36) If > 0, update the macroscopic cross sections during a direct nuclide search (NSH3 = 0).

Additional input is required if NSH1 = 5 or 7 or 9.

For NSH1 = 5

Card(s) 5: (6E12.0)

SRHDJ(J) NSH4 values to be used as first dimension coarse mesh modifiers; coarse mesh intervals are adjusted in proportion to these modifiers.

Card(s) 6: (6E12.0)

SRHDI(I) NSH5 values to be used as second dimension coarse mesh modifiers.

Card(s) 7: (6E12.0)

SRHDK(K) NSH6 values to be used as third dimension coarse mesh modifiers.

For NSH1 = 7. There must be NSH8 sets of Card 5 and Card(s) 6.

Card 5: (2I3)

NSHZ1(1-3) First number of a consecutively numbered set of zones (or subzones).

NSHZ2(4-6) Second number of a consecutively numbered set of zones (or subzones).

Card(s) 6: (12(A6))

HNNAMS(N) NSH7 nuclide names whose concentrations are to be adjusted proportionately in the specified zones (subzones); blanks are allowed.
Concentrations are adjusted by the equation $C_2 = \lambda C_1$ where λ is a common multiplier.

Card 7: (10(A6))

HNSHN(N) The names of up to 10 nuclides to have concentrations adjusted inversely (concentration changes are of opposite sign to those of the other nuclides) in all search zones $C_2 = C_1 + C_1*(1-\lambda)*XSH5$.

For NSH1 = 9

Card 5: (2I3)

NSHZ1(1-3) (See above)

NSHZ2(4-6)

Card(s) 6: [4(A6,E12.0)]

(HNNAMS(N), CHZDN(N)) NSH7 pairs of nuclide names and relative concentration changes to be made in the specified zones (subzones). Concentrations are adjusted by the equation $C_2 = C_1 + \lambda*\Delta C$.

III. Processor DCRSPR (Cross Section Processor Input)

This code processes data for the cross section processor code. Since a number of tasks have been programmed in the latter, the necessary instructions and data must be supplied as required by the various options. A primary role is the conversion from a nuclide ordered cross section file ISOTXS, as usually available from cross section preparation codes, to a group ordered GRUPXS file required by many of the computation modules in this system. Also, extraneous data in an ISOTXS file may be eliminated, such as the higher moments of scattering and data for nuclides not of interest, important to hold down the computer memory and possibly the data transfer requirements for a calculation.

Header card: DCRSPR in columns (1-6)

(In stand-alone code execution, not recommended, another card is required here giving the memory alloction for data storage, I6, in columns (1-6).

Card 1: Control Options (24I3)

ICD1(1-3)

ICD2(4-6)

ICD3(7-9) Option on input cross-section file processing
- 0 - No processing required.
- 1 - Generate a new nuclide-ordered file. (ISOTXS) from the file or files having format ICD5 (requires additional input data)

ICD4(10-12) Option to generate a new group-ordered file (GRUPXS) from a nuclide-ordered file.
- 0 - No.
- 1 - Yes.

ICD5(13-15) Format of input cross section for ICD3=1.
- 0 - Nuclide-ordered file (ISOTXS)
- 1 - CITATION cross-section sets.
- 2 - Merge two nuclide-ordered files (ISOTXS); the file control parameters NGROUP, MAXORD, ICHIST, NSCMAX, and NSBLOK must be the same for both files.

ICD6(16-18) Option on principal cross-section data for ICD4=1.

0 - Retain all data.

1 - Redefine (n,γ) cross section to be the capture cross section = (n,γ) + (n,α) + (n,p) + (n,d) + (n,t) - (n,2n).

ICD7(19-21) Option on scattering data for ICD4=1.

0 - Retain all data.

1 - Retain the total scattering only.

ICD8(22-24) Option on scattering order for ICD4=1.

0 - Retain all data.

N - Retain orders up to (N-1) only.

ICD9(25-27) Option on scattering record blocking factor for ICD4=1.

0 - NSBLOK=1.

N - NSBLOK=N, if (NISO/N)*N=NISO, otherwise NSBLOK=NISO where NISO is the number of nuclides.

ICD10(28-30) Option to compute the total scattering matrix from the components for ICD4=1: TOTAL=ELASTIC + INELASTIC + N2N (This must be done if the GRUPXS file is to be used by VENTURE and there is no total scattering data present).

0 - No.

1 - Yes.

2 - Yes, but multiply N2N by 2.0.

ICD11(31-33) Option to create isotope mixtures after processing specified by ICD3 and ICD5, if any. A new nuclide-ordered file (ISOTXS) will be written.

0 - No.

1 - Yes (requires additional input data).

ICD12(34-36)

ICD13(37-39)

ICD14(40-42)

ICD15(43-45)

ICD16(46-48)

ICD17(49-51)

ICD18(52-54)

ICD19(55-57)

ICD20(58-60)

ICD21(61-63)

ICD22(64-66)

ICD23(67-69) Option to edit latest nuclide-ordered file (ISOTXS)

0 - No.

1 - Yes.

ICD24(70-72) Option to edit group-ordered file (GRUPXS).

0 - No.

1 - Yes.

If ICD3 ≤ 0 and ICD11 ≤ 0, no additional input is required.

Card 2: (24I3) Control instructions (required if ICD3=1 or ICD11=1).

NOP1(1-3) Number of CITATION cross-section sets to process (if NOP1=0 and ICD3=1 and ICD5=1, set one will be processed). If NOP1>0, card(s) 3 required.

NOP2(4-6) Scattering blocking factor for nuclide-ordered file created from CITATION cross sections.

0 - NSBLOK=1.

N - NSBLOK=N, if (NGROUP/N)*N=NGROUP, otherwise NSBLOK=1.

NOP3(7-9) Option to input a neutron energy spectrum for weighting in mixture calculation.

0 - No.

N - Yes (N should be equal to the number of energy groups on the cross section file). If NOP3>0 card(s) 4 required.

NOP4(10-12) Option to create pseudo direction dependent transport data.

0 - No.

1 - Yes, if NOP4>0, card 5 required.

NOP5(13-15) Option to input override data for isotopes.

0 - NO.

N - Yes (N is the number of card(s) 6).

NOP6(16-18) Number of mixtures (required if ICD11=1).
Card(s) 7, 8, and 9 are required if NOP6>0.

NOP7(19-21) Maximum number of isotopes in any mixture (required if ICD11=1).

NOP8(22-24)

NOP9(25-27)

NOP10(28-30) Option on use of the override data for isotopes when NOP5>0 (applicable only when ICD3=1 and ICD5=0).
0 - Data corresponds with the order of isotopes in the file.
1 - Data identifies isotopes to be selected by unique isotope label.

NOP11(31-33)

NOP12(34-36)

NOP13(37-39)

NOP14(40-42)

NOP15(43-45)

NOP16(46-48)

NOP17(49-51)

NOP18(52-54)

NOP19(55-57)

NOP20(58-60)

NOP21(61-63)

NOP22(64-66)

NOP23(67-69)

NOP24(70-72) Option on edit during CITATION cross section processing.
0 - No.
1 - Yes.

Note: Any subsequent data causes file CXSPRR to be generated.

Card(s) 3: (24I3) CITATION set numbers to process (required if NOP. 0).

(ISET(I),I=1,NOP1) Set numbers in ascending order of appearance in library.

Card(s) 4: (6E12.0) Neutron energy spectrum (required if NOP3>0).

(WGT(I),I=1,NOP3) Spectrum for weighting in mixture calculation.

Card 5: (3E12.0) Multipliers for transport cross section (required if NOP4>0).

(TRMOD(I),I=1,3) Multiplier for each coordinate direction STRPD(I)=TRMOD(I)*STRPL(1) for each energy.

Card 6: (3A6,6X,3E12.0,4I3) Isotope override data, required if NOP5>0 and there must be NOP5 card(s) 6.

HISONM(1-6)	Hollerith isotope label (unique).
HABSID(7-12)	Hollerith isotope label (absolute).
HMAT(13-18)	Hollerith isotope label (reference).
AMASS(25-36)	Gram atomic weight.
EFISS(37-48)	Total thermal energy yield/fission (watt-sec/fission).
ECAPT(49-60)	Total thermal energy yield/capture (n,γ) (watt-sec/capture).
KBR(61-63)	Isotope classification.
IDP1(64-66)	
IDP2(67-69)	
IDP3(70-72)	

When NOP10=0 and ICD3=1, the contents of these cards control the processing of the cross sections. The order of these cards must be one-to-one with the order of the isotopes in the old data file(s). One card is read for each isotope. If for the label HISONM the word 'DELETE' is specified, the data for this isotope are not written on the new nuclide-ordered file; otherwise, the data will be included and non-blank names and non-zero data on the card will replace the old data. The new file is completed when NOP5 isotopes have been processed (copied or deleted) which may be less than the number on the old file.

When NOP10=1 and ICD3=1 and ICD5=0, this data may be used to control the content of the new ISOTXS file. The order of the cards is not specified since the unique label (HISONM) is used to identify isotopes to be copied to the new file. Non-blank or non-zero values for the rest of the data will be put on the new file. The unique label may not be changed when using this option. If NOP5=0, data for all isotopes in the old file will be copied to the new file.

Card(s) 7 and 8 are required for creating mixtures if MOP6>0.

Card 7: (2I3)

M1(1-3) First mixture number of a consecutive set of mixtures.[a]

M2(4-6) Last mixture of a consecutive set of mixtures.

Card(s) 8: 4(A6,E12.0)

Specify sets of a character unique isotope label and the concentration (Atoms/bn-cm). A blank label ends this data for these mixtures. Any isotope appearing in a mixture will be deleted from the new file.

Sets of card(s) 7 and 8 are read until a M1=0 is encountered.

Card(s) 9: (3A6,6X,3E12.0,4I3)

Reference data for the mixtures, required if MOP6>0 and there must be MOP6 card(s). Card format is the same as Card 6. Non-blank data should be supplied for labels and non-zero data for KBR. AMASS, EFISS, and ECAPT are calculated for the mixture, but are replaced by non-zero entries.

---

[a] Normally M1 is a mixture number, running from 1 up, and M2 is left blank.

IV. Processor DUTLIN (Module Control Input)

This special input processor is used to add or replace records on the interface file CONTRL which is initially created by the control module. For example, the Reaction Rate module reads the record RRTINS to obtain the instructions for calculating reaction rates, the exposure module reads the record EXPINS for the instructions for exposure and shutdown calculations. This processor may be used to add the RRTINS and EXPINS and other records to the CONTROL file.

Each record of the file CONTRL consists of a REAL*8 six character identifier, 100 REAL*8 words and 100 INTEGER*4 words. The 100 REAL*8 words may contain Hollerith information, but the Hollerith will always be in the first locations and each Hollerith word will consist of six characters.

Header card: DUTLIN in columns (1-6).

Card 1: (A6,6X,4I3).

HXCTL(1-6)	Record identifier.
NH(13-15)	Number of REAL*8 six-character Hollerith words to be input in (12A6) format.
NR(16-18)	Number of REAL*8 floating point numbers to be input in (6E12.0) format.
NI6(19-21)	Number of integers to be input in (12I6) format.
NI3(22-24)	Number of integers to be input in (24I3) format.
IPR(25-27)	Edit data if > 0.

Note: NH + NR ≤ 100, and NI6 + NI3 ≤ 100.

Card(s) 2: (12A6) Required if NH > 0.

(XCD(I),I=1,NH) REAL*8 Hollerith data.

Card(s) 3: (6E12.0) Required if NR > 0.

(XCD(NH+I),I=1,NR) REAL*8 floating point data.

Card(s) 4: (12I6) Required if NI6 > 0.

(IXD(I),I=1,NI6) Integer data.

Card(s) 5: (24I3) Required if NI3 > 0.

(IXD(NI6+I),I=1,NI3) Integer data.

Note: Unassigned values of XCD or IXD will be zero.

Data for additional records will be processed until HXCTL on card 1 equals 6H_____ or 6HBLANK_ (or end-of-file is read).

V. Processor DCMACR (CITATION Macroscopic Data)

This code reads macroscopic cross section data in the section 008 format of the CITATION code[a] and writes a pseudo CITATION format microscopic cross section file on logical unit 8. This file may then be converted to the standard interface file GRUPXS by the cross section processor code in this system.

Header card: DCMACR in columns (1-6).

Card 1: (I3)

MVX(1-3)	The number of zones (pseudo nuclides) in the CITATION format macroscopic data below.

Card 2: (12A6)

TITLE(1-72)	Descriptive title.

Card(s) 3: The data for a complete CITATION input section 008 including the 008 card.

[a] ORNL/TM-2496; note that certain assumptions are made in converting the data to pseudo microscopic including values of the fission cross section, and the full capability implied in the specifications for file ISOTXS or GRUPXS is of course not possible.

VI. Processor DENMAN (Nuclide Concentrations and Related Matters)

This code is accessed by a module number 99 in the calculational path instruction to the control module. On option, the user may,

(1) Change the cross section reference
   (a) change zone and/or subzone nuclide set reference
   (b) change nuclide set definition
(2) Change (overlay) the nuclide concentrations in file ZNATDN (or QNATDN)
(3) Produce a deck of nuclide concentrations in the Section 020 format of the special processor DVENTR
(4) Edit the contents of file ZNATDN (or QNATDN)
(5) Create file SEARCH with multiple sets of search data

The interface file NDXSRF, which contains referencing information, is always required.

If no data is specified (the code finds an end-of-file or the first card after the header card contains a 999 in Columns 1-3) the default task of option NOPN2=1 below is performed (a deck of nuclide concentrations in the Section 020 format is produced).

Header card: DENMAN in Columns 1-6.

Section 010: Nuclide Set Reference Instructions (optional)

Card 1: 010 in Columns 1-3.

Card 2: Instructions (24I3)

JOPN1(1-3) Option to change nuclide set reference
- 0 - no change
- 1 - change nuclide set number assigned to zone and/or subzone (requires additional input in form of Section 012)
- 2 - change nuclide set definitions (requires additional input in form of Section 013)

JOPN2(4-6) Reserved

JOPN3(7-9) Reserved

JOPN4(10-12) Reserved

JOPN5(13-15) Reserved

JOPN6(16-18) Option on the version of the referencing file NDXSRF to be written

0 - rewrite old version

1 - write new version

JOPN7-JOPN24 Reserved

Note: When nuclide sets are changed the absolute nuclide name associated with each position in the old set and the new set must agree. Also a change in nuclide sets may require redefining the file SEARCH.

Section 012: Assignment of Nuclide Sets to Zones and/or Subzones
(Conditional - Required if JOPN1 = 1)

Card 1: 012 in columns 1-3.

Card 2: NSZ(1-3) Number of subzones (not used but is obtained from file NDXSRF)

Cards 3: Zone referencing data (4I3, E12.0)

M1(1-3) First zone number of a consecutively numbered set of zones

M2(4-6) Last zone number of the set

NS(7-9) Nuclide set reference number (out of the integers from 1 to the number of sets defined in file NDXSRF, zero is allowed if the zone contains subzones)

NC(10-12) Not used

VF(13-24) Not used

Cards 3 are read until a blank or zero M1 number is encountered

Cards 4: Subzone referencing data (4I3, E12.0, I3) (required if subzones are present)

MM1(1-3) First subzone number of a consecutively numbered set of subzones

MM2(4-6) Last subzone number of the set

NMS(7-9) Nuclide set reference number (out of the integers from 1 to the number of sets define in file NDXSRF)

NMC(10-12) Not used

VMC(13-24) Not used

NMCOPT(25-27) Not used

Cards 4 are read until a blank or zero NMI is encountered

Section 013: Nuclide Set Definition (Conditional – Required if JOPN1 = 2)

Card 1: 013 in Columns 1-3

Card 2: NNS(1-3) Maximum number of nuclides in any set (not used but is obtained from file NDXSRF)

Card 3: NDXS(1-3) Number of nuclides in this set (enter zero if no change in this set)

Cards 4: Names of nuclides (alphanumeric characters) in the replacement set which must correspond with user identification (unique) names (not absolute names) in the cross section library, there must be NDXS six-character names (12A6).

Cards 3 and 4 are repeated for each nuclide set specified in NDXSRF file.

Section 018: Nuclide Concentration Instructions (Optional)

Card 1: 018 in Columns 1-3

Card 2: Instructions (24I3)

NOPN1(1-3) Option to change (overlay) the nuclide concentrations in the latest version interface file

0 - No

1 - Yes (requires additional input in form of Section 020)

NOPN2(4-6) Option to produce a deck of the nuclide concentrations in the format of Section 020 of the DVENTR special input processor from the latest version interface file. The deck is written on unit 7 and may be punched or saved on an external device according to the job control instructions.

0 - No

1 - Yes

NOPN3(7-9) Option to edit the nuclide concentrations from the latest version interface file

0 - No

1 - Yes

NOPN4(10-12) Option on nuclide concentration interface file name

-1 - Read QNATDN, write QNATDN

0 - Read ZNATDN, write ZNATDN

1 - Read QNATDN, write ZNATDN

Note: A file is written only when NOPN1 = 1

NOPN5(13-15) Reserved

NOPN6(16-18) Option on version of nuclide concentration file to be written

0 - rewrite old version

1 - write new version

NOPN7-NOPN24 Reserved

Section 020: Nuclide Concentrations (Conditional - Required if NOPN1 = 1)

The form of the data is as described for Section 020 of the DVENTR special input processor except that NDO on Card 1 has no affect. Note that existing concentrations are not altered unless new concentrations are assigned. If a zero concentration is desired for a nuclide in one or more zones where it is non-zero in the file, then such must be specified. There is provision to set nuclide densities to zero by option before adding new values. Following the identification of a series of zones (MZ1, MZ2), MZI Col. 7-9 set to -1 causes all nuclide densities in zones MZ1 through MZ2 to be set to zero, and for a set of subzones (MSZ1, MSZ2), MSZI Col. 7-9 set to -1 effects the same for this set of subzones. Full overlay capability of data by blocks of zones or subzones is implemented allowing redundant specifications; the last assignment in such event overrides any earlier ones. Note: If nuclide sets have been changed, reference to nuclides must be made with the new unique names.

Section 026: Search Data Instructions (Optional)

Card 1: 026 in Columns 1-3

Card 2: Instructions (24I3)

LOPN1(1-3) Option to create a search interface file

0 - No

1 - Yes (requires additional input in form of Section 028)

LOPN2(4-6) Reserved

LOPN3(7-9) Reserved

LOPN4(10-12) Reserved

LOPN5(13-15) Reserved

LOPN6(16-18) Option on the version of the search file SEARCH to be written

0 - rewrite old version

1 - write new version

LOPN7-LOPN24 Reserved

Section 028: Criticality Search Data (Conditional – Required if LOPN1 = 1)

The form of the data is as described for Section 028 of the DVENTR special input processor except that multiple sets of search data may be input. Data is processed until NSP on Card 2 is less than or equal to zero.

Section 999: Terminator

A card containing 999 in Columns 1-3 is recommended for termination of this data.

END Card

The block of data for this processor requires a final card with END in Columns 1-3.

VII. Regarding the Interface Data Files

The following comments are offered about the data contents of specific interface data files regarding file processing and data use.[a]

IS$\emptyset$TXS

1) NSBL$\emptyset$K - the scattering blocking factor must be evenly divisible into NGR$\emptyset$UP.
2) JBAND - the scattering band width must be greater than 0.
3) IJJ - the scattering in-group term must fall within the band. Combinations of JBAND and IJJ which cause fictituous transfers for a given group are not allowed.
4) LTRN - must be greater than 0 and $\leq$ MAXORD + 1.
5) LT$\emptyset$T - must be greater than 0 and $\leq$ MAXORD + 1 for the P_1 calculation.
6) Group-to-group fission spectra are not allowed.

GRUPXS

1) NSBL$\emptyset$K - the scattering blocking factor must be evenly divisible into NIS$\emptyset$.
2) JBAND - same as IS$\emptyset$TXS.
3) IJJ - same as IS$\emptyset$TXS.
4) Group-to-group fission spectra are not allowed.
5) The total scattering arrays must be present.

GE$\emptyset$DST

1) IG$\emptyset$M - the following geometries are not implemented.
   0 - point.
   11 - Rθ
   12 - RθZ

---

[a] For Version III standard interface data file specifications, refer to: G. E. Bosler, et al., "LASIP-III, A Generalized Processor for Standard Interface Files," ERDA Report, LA-6280-MS (April 1976).

13 - RθZ

16 - θRZ

Triagonal geometry options assume equilateral triangles.

Hexagonal geometry options assume regular hexagons.

2) Boundary indicators for repeating conditions.

IMB1 = 3 first boundary of dimension 1 may repeat with second boundary of dimension 1.

IMB2 = 4 second boundary of dimension 1 may repeat with second boundary of dimension 2 (XY,XYZ,T,TZ only - mesh must be consistent for rotation).

IMB2 = 5 second boundary of dimension 1 may repeat with itself inverted (XY,XYZ,T,TZ only - mesh must be consistent for rotation).

3) Boundary constants

Default constants:

0.4692 for extrapolated and internal.

1.0 + 30 for zero flux.

0.0 for reflected.

If boundary constants are supplied, no check is made to assure consistency with boundary indicators.

4) NTRIAG - triagonal geometry options 2, 3, and 4 are not implemented.

5) VØLR - the region volumes are not required except for use in the reaction rate module.

NDXSRF

1) NØN, HNNAME, HANAME and NCLN must be the same as NISØ, HISØNM, HABSID and KBR, respectively, on GRUPXS.

2) NZØNE - must be the same as NZØNE and GEØDST.

3) VØLZ - the zone volumes are not required except for use in the reaction rate module. However, a case having subzones must have both the zone volumes and subzone volumes defined.

4) ATWT - is not used, atomic weights are always obtained from GRUPXS.

ZNATDN

1) NTZSZ - must be the same as NZ$NE + NSZ on NDXSRF.
2) NBLKAD - the density blocking factor must be evenly divisible into NTZSZ.

SEARCH

1) For concentration searches - nuclide names in search data not appearing in GRUPXS (NDXSRF) or are not assigned to the zone(s) specified will be eliminated from the calculation.
2) For dimension searches - NCINTI, NCINTJ, and NCINTK must have the same values as the same parameters on GE$DST.

FIXSRC

1) Distributed sources for IDIST.EQ.1 and NDC$MP.GT.1 will cause termination.
2) Surface sources capability has not been used.

APPENDIX

VENTURE STORAGE REQUIREMENTS

The equations that determine the memory and scratch data file storage requirements for a VENTURE neutronics problem as dependent on the mode of calculation have been programmed to produce specific information. This program is being distributed with the code for use at other installations. It is available for use on the ORNL IBM-360/91 computer. Documentation of local use is shown by requirements in Table A-1 and edit in Table A-2.

For large problems we strongly recommend that the data storage be determined. Usually for three-dimensional problems the multi-plane stored mode must be used, and usually enough memory allocated to store as many planes of data as the maximum number of inner iterations to minimize data transfer. The requirements depend on the number of inner iterations which should be determined by the code (unless known), see VENTURE option, special input processor section 001, ICX11 = 0, ICX12 = 969 for a special run to determine the number of inners (and also storage); or the DTNINS record of the CONTRL file, IX(20) = 969, IX(21) = 0.

The authors do believe that documentation for a code should present the information required by users to determine storage requirements. When a code attempts to cover a very broad range of problem type and provides great flexibility in data handling to balance storage and transfer, the equations become extremely involved and not practical to use routinely. A Fortran listing of the code used to calculate storage could be included here, but the 2,000 lines would waste many pages and serve little utility. We recommend using this calculator, using the VENTURE code proper, and relying on past experience. A Fortran source deck can be made available for this calculator or a listing if really needed.

TABLE A-1. CONTROL INSTRUCTIONS, INPUT DESCRIPTION, AND SAMPLE INPUT FOR THE CALCULATION OF VENTURE STORAGE REQUIREMENTS.

JOB CONTROL INSTRUCTIONS

```
//USERID   JOB (CHARG),'USER ADDRESS        ',MSGLEVEL=(1,1)
//*CLASS CPU91=10S,IO=1,REGION=270K,LINES=1,CARDS=0
//STEP EXEC LINKEGO,
// REGION.GO=270K
//LKED.VENTSTOR DD UNIT=3330,VOLUME=SER=ZX1111,DISP=SHR,
// DSNAME=I.IBP14650.VENTSTOR
//LKED.SYSIN DD *
 INCLUDE VENTSTOR
/*
//GO.FT05P001 DD *
/*
//
```

INPUT DESCRIPTION

```
C-------------------------------------------------------------------------C
C       INPUT FORMAT IS N1((18A4)/4(12I6)/N2(I6)). N1 AND N2 ARE        C
C       VARIABLES.                                                       C
C                                                                        C
C        CARD 1 - HOLLERITH TITLE.                                       C
C                                                                        C
C        CARDS 2-5 ARE INTEGERS IN THE STANDARD INTERFACES               C
C                  GEODST, GRUPIS, NDISRP, AND SEARCH (EXCEPT THE        C
C                  LAST THREE INTEGERS). THE FIRST SEVEN NUMBERS         C
C                  (IGOM THRU NGROUP) ARE NECESSARY TO COMPUTE           C
C                  REQUIREMENTS FOR THE ITERATIVE PROCEDURE. IF THE      C
C                  REST OF THE NUMBERS ARE INPUT ZERO, THE REQUIREMENTS  C
C                  FOR THE MACRO., CMSTS., AND INITIALIZION PROCEDURES   C
C                  WILL BE INCORRECT.                                    C
C                                                                        C
C             COLUMNS   NAME      INTERFACE                              C
C             -------   ----      ---------                              C
C   CARD 2 - ( 1- 6)    IGOM       (GEODST)                              C
C            ( 7-12)    NZONE      (GEODST)                              C
C            (13-18)    NINTI      (GEODST)                              C
C            (19-24)    NINTJ      (GEODST)                              C
C            (25-30)    NINTK      (GEODST)                              C
C            (31-36)    NZNBB      (GEODST)                              C
C            (37-42)    NGROUP     (GRUPIS)                              C
C            (43-48)    NISO       (GRUPIS)                              C
C            (49-54)    MAXUP      (GRUPIS)                              C
C            (55-60)    MAXDN      (GRUPIS)                              C
C            (61-66)    MAXORD     (GRUPIS)                              C
C            (67-72)    NPSCS      (GRUPIS)                              C
C   CARD 3 - ( 1- 6)    NSTRPD     (GRUPIS)                              C
C            ( 7-12)    NSCMAX     (GRUPIS)                              C
C            (13-18)    NSBLOK     (GRUPIS)                              C
C            (19-24)    NREG       (GEODST)                              C
C            (25-30)    NCINTI     (GEODST)                              C
C            (31-36)    NCINTJ     (GEODST)                              C
C            (37-42)    NCINTK     (GEODST)                              C
C            (43-48)    INB1       (GEODST)                              C
```

(CONT)

```
C              (49-54)   IMB2       (GEODST)                                C
C              (55-60)   JMB1       (GEODST)                                C
C              (60-66)   JMB2       (GEODST)                                C
C              (67-72)   KMB1       (GEODST)                                C
C   CARD 4 -   ( 1- 6)   KMB2       (GEODST)                                C
C              ( 7-12)   MBS        (GEODST)                                C
C              (13-18)   MBCS       (GEODST)                                C
C              (19-24)   MIBCS      (GEODST)                                C
C              (25-30)   MTHIAG     (GEODST)                                C
C              (31-36)   MBASS      (GEODST)                                C
C              (37-42)   NSN        (NDISRF)                                C
C              (43-48)   NNS        (NDISRF)                                C
C              (49-54)   NAN        (NDISRF)                                C
C              (55-60)   NSZ        (NDISRF)                                C
C              (61-66)   ISRCH      (SEARCH)                                C
C              (67-72)   MBAINP     (SEARCH)                                C
C   CARD 5 -   ( 1- 6)   MISOSR     (SEARCH)                                C
C              ( 7-12)   NSETS      (SEARCH)                                C
C              (13-18)   NPS        GT.0 FOR FIXED SOURCE PROBLEMS.         C
C              (19-24)   NP1        GT.0 FOR CONSISTANT P1 PROBLEMS.        C
C              (25-30)   NADJ       GT.0 FOR ADJOINT AND/OR PERTURBATIONS.  C
C              (31-36)   NPRIT      GT.0 FOR WRITING RTFLUX OR ATFLUX.      C
C              (37-42)   NPRIT      GT.0 FOR WRITING PWDINT.                C
C              (43-48)   UNDEFINED.                                         C
C              (49-54)   UNDEFINED.                                         C
C              (55-60)   UNDEFINED.                                         C
C              (61-66)   UNDEFINED.                                         C
C              (67-72)   UNDEFINED.                                         C
C                                                                           C
C   THE NEXT INPUT CARDS GIVE THE DATA ARRAY SIZE (COLUMNS 1-6) FOR         C
C   AS MANY DIFFERENT ARRAY SIZES AS DESIRED, ENDING WITH A BLANK CARD.     C
C   THE CODE THEN LOOPS TO READ A NEW TITLE CARD. A BLANK TITLE CARD        C
C   ENDS THE RUN.                                                           C
C-----------------------------------------------------------------------C
```

SAMPLE INPUT

```
 PROBLEM TITLE
    17     8     50     25     20      1     21     10      0     21      0      0
     0
     0
     0
 60000
 72000
     0
COMMENT - A BLANK CARD OR NEW PROBLEM TITLE CARD GOES HERE.
```

Table A-2. Edit for a sample calculation of VENTURE storage requirements.

```
                                                TOTAL                          A          B          C          D
                                              MINIMUM    MAXIMUM
STORAGE AVAILABLE                               60000
MACRO CALCULATION                                 653
EQUATION CONSTANTS CALCULATION
         CORE CONTAINED OR SPACE STORED        133022     154272
         PLANE STORED                           15347      36597
         ROW STORED                              5271      26521
         MULTI-LEVEL PLANE STORED               16571      37821
INITIAL FLUX
         CORE CONTAINED OR SPACE STORED         54652      78402
         OTHER MODES                             4652      28402
ITERATIVE PROCESS
         CORE CONTAINED                       4017663                3882752       2454       4706     127751
         SPACE STORED                          330743                 327751       2454        538          0
       3 PLANES STORED                          55720                  52720       2454        538          0
       1 PLANE STORED                           25568                  22576       2454        538          0
      25 ROWS STORED                            19592                  16600       2454        538          0
       1 ROW STORED                              2992                      0       2454        538          0
       2 MULTI-LEVEL PLANES STORED              40092                   7500       2454        538      37600
PERTURBATION CALCULATION                         8340

DATA WILL BE STORED FOR 1 GROUP,    3 PLANES

MEMORY LOCATIONS RESERVED FOR DATA STORAGE---    60000
MAX MEMORY LOCATIONS REQUIRED FOR THIS PROB--    55720
MEMORY LOCATIONS NOT USED------------------      4280

     SPECIAL SCRATCH DATASET REQUIREMENTS
     MAXIMUM PHYSICAL RECORD IS      7200 WORDS
DIRECT ACCESS FILE 24  REQUIRES    420 RECORDS     2500 WORDS IN LENGTH
DIRECT ACCESS FILE 27  REQUIRES    420 RECORDS     2500 WORDS IN LENGTH
DIRECT ACCESS FILE 28  REQUIRES    420 RECORDS     2500 WORDS IN LENGTH
DIRECT ACCESS FILE 40  REQUIRES    420 RECORDS    10075 WORDS IN LENGTH

DD PARAMETERS FOLLOW FOR  B1 = 3520  AND  B2 =  32000
N2=1326  N3=  10  N4=   1  N5= 584  N6=  10  N7=   7  N8=   7  N9=  64  N10=  64  N11=  79  N12=   1  N13=   1  N14=   1  N15=  10
N16=   1   (NOTE THAT IF THE FLUXES ARE TO BE EXPANDED FROM EXISTING RTFLUX, N10=1326)

REQUIRED DISK STORAGE SPACE FOR FLUX(UNITS 24,27,28) IS    4667520 BYTES.
                           FOR CONSTANTS(UNIT 40) IS--   18888000 BYTES.
                           FOR CONSTANTS(UNIT 23) IS--      35200 BYTES.
REQUIRED TOTAL DISK STORAGE SPACE IS------------------   44222720 BYTES.

FOR THE ASSIGNED DATA STORAGE, THE REQUIRED REGION SIZE IS APPROXIMATELY  570K BYTES
```

Table A-2. (Cont'd.)

```
                                          TOTAL                          A          B          C          D
                                       MINIMUM    MAXIMUM
STORAGE AVAILABLE                        72000
MACRO CALCULATION                          653
EQUATION CONSTANTS CALCULATION
          CORE CONTAINED OR SPACE STORED  133022     154272
          PLANE STORED                     15347      36597
          ROW STORED                        5271      26521
          MULTI-LEVEL PLANE STORED         16571      37821
INITIAL FLUX
          CORE CONTAINED OR SPACE STORED   54652      78402
          OTHER NODES                       4652      28402
ITERATIVE PROCESS
          CORE CONTAINED                4017663            3882752       2454       4706     127751
          SPACE STORED                   330743             327751       2454        538          0
        4 PLANES STORED                   70796              67804       2454        538          0
        1 PLANE STORED                    25568              22576       2454        538          0
       25 ROWS STORED                     19592              16600       2454        538          0
        1 ROW STORED                       2992                  0       2454        538          0
        3 MULTI-LEVEL PLANES STORED       64392               7500       2454        538      53900
PERTURBATION CALCULATION                   8340

DATA WILL BE STORED FOR 1 GROUP,     4 PLANES

MEMORY LOCATIONS RESERVED FOR DATA STORAGE---    72000
MAX MEMORY LOCATIONS REQUIRED FOR THIS PROB--    70796
MEMORY LOCATIONS NOT USED------------------      1204

     SPECIAL SCRATCH DATASET REQUIREMENTS
     MAXIMUM PHYSICAL RECORD IS      7200 WORDS
DIRECT ACCESS FILE 24  REQUIRES    420 RECORDS      2500 WORDS IN LENGTH
DIRECT ACCESS FILE 27  REQUIRES    420 RECORDS      2500 WORDS IN LENGTH
DIRECT ACCESS FILE 28  REQUIRES    420 RECORDS      2500 WORDS IN LENGTH
DIRECT ACCESS FILE 40  REQUIRES    420 RECORDS     10075 WORDS IN LENGTH

DD PARAMETERS FOLLOW FOR  B1 = 3520  AND  B2 =  32000
N2=1326  N3=  10  N4=   1  N5= 504  N6=  10  N7=   7  N8=   7  N9=  64  N10=  64  N11=  79  N12=   1  N13=   1  N14=   1  N15=  10
N16=   1   (NOTE THAT IF THE FLUXES ARE TO BE EXPANDED FROM EXISTING RTFLUX, N10=1326)

REQUIRED DISK STORAGE SPACE FOR FLUX(UNITS 24,27,28) IS    4667520 BYTES.
                           FOR CONSTANTS(UNIT 40) IS--   18688000 BYTES.
                           FOR CONSTANTS(UNIT 23) IS--      35200 BYTES.
REQUIRED TOTAL DISK STORAGE SPACE IS------------------   44222720 BYTES.

FOR THE ASSIGNED DATA STORAGE, THE REQUIRED REGION SIZE IS APPROXIMATELY  618K BYTES

IRC002I STOP      0
```

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