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MASTER

A USERS MANUAL FOR ANISN

A One Dimensional Discrete Ordinates Transport Code With Anisotropic Scattering

AUTHOR:

Ward W. Engle, Jr.

UNION CARBIDE

UNION CARBIDE CORPORATION
NUCLEAR DIVISION

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ABSTRACT

ANISN is a FORTRAN IV, version 13 program which solves the one dimensional Boltzmann transport equation for slab, cylindrical or spherical geometry. As a secondary calculation, the detailed flux generated as the solution to the Boltzmann equation may be used to perform a group reduction of the cross sections.

The users manual describes in detail the format of the input data required to execute the many options available in the ANISN program. As an aid to understanding the data, the input and output of a sample problem are presented with comments.

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I. Introduction

ANISN[1] is a one dimensional S_n transport code with general anisotropic scattering written in FORTRAN IV. The major differences between ANISN and its predecessor, DTF-II[2], are as follows:

1. ANISN allows general anisotropic scattering (i.e. an L<u>th</u> order (P_L) Legendre expansion of the scattering cross sections). DTF-II allowed a P_1 expansion.

2. ANISN will permit a white boundary condition (isotropic reflection) at either boundary. Coupled with the white boundary condition is an albedo for each group which returns only a specified fraction of the out-going flux.

3. The shell source option has been extended to allow complete angular description for either one interval or all intervals.

4. The activity option has been extended to allow activity prints for materials which do not appear either explicitly or as components of a mixture in the "material by zone" specifications. The interval activities may be multiplied by 1.0, $2\pi r$, or $4\pi r^2$ depending on the geometry specified.

5. ANISN will, if necessary, store cross sections, fixed sources, fluxes, and currents on tape. The number of items stored on tape is determined by the code and depends on the storage requirements of the particular problem.

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[1] Engle, W. W., Jr., F. R. Mynatt, "ANISN, A One Dimensional Discrete Ordinates Transport Code with Anisotropic Scattering", To be published.

[2] Engle, W. W., Jr., M. A. Boling, B. W. Colston, "DTF-II, A One Dimensional Multigroup Neutron Transport Program", NAA-SR-10951, March 25, 1966.

6. The group skipping option in DTF-II has been eliminated.

7. The error procedure in DTF-II has been extended so that ANISN edits all input data. If an error is detected in the data, ANISN searches for and attempts to execute another problem.

8. If an ANISN problem is terminated by iteration count or sense switch settings, the code prints complete output as if the problem had converged.

9. The variable dimensioning technique introduced to FORTRAN S_n codes in DTF-II has been extended to take advantage of the variable dimensioning allowed by FORTRAN IV in subroutines.

II. Input Format

All numerical data is written in the same format. Each data card consists of six twelve-column data fields. Each data field consists of three subfields of two, one, and nine columns respectively. The contents of the first two subfields define the operation to be performed on the data contained in the third subfield. The second subfield may contain either a blank or one of the following characters: $,*,R,I,T, S,F,A,+,-. The first subfield may contain either a blank or an integer from 1 to 99.

$ indicates the beginning of an integer array. The first subfield identifies the array.

* indicates the beginning of a floating point array. The first subfield identifies the array.

R indicates that the data contained in the third subfield is to be entered several times in succession. The first subfield defines the number of successive entries or Repeats.

I indicates linear Interpolation between the data in the associated third subfield and the following third subfield. The first subfield defines the number of interpolations between the two data entries.

T indicates Termination of data reading. All following data and data in the associated first and third subfields is ignored.

S indicates Skip. The first subfield defines the number of entries to be skipped. The third subfield may contain the first entry following the skips.

F indicates that the remainder of the present array is to be Filled with the data entry in the third subfield. Any entry in the first subfield is ignored.

A indicates Address modification. The next non-blank data entry is entered in the Nth location of the present array where N is an integer entry in the third subfield associated with the A. Any entry in the first subfield is ignored.

+ or - indicates exponentiation. The data entry in the third subfield is multiplied by $10^{\pm N}$ where N is the entry in the first subfield. This option allows more significant digits if necessary.

Integer data in the third subfield must be right justified. Floating point data may be written with or without an exponent and with or without a decimal point. If the decimal point is not included, it is assumed to be immediately to the left of the exponent field. If there is no exponent, the decimal point is assumed to be at the extreme right of the nine column subfield.

The following restrictions must be observed when writing data for ANISN:

1) Floating point zeroes must be written as 0. or 0.0. A .0 is read as a blank.

2) Blanks are ignored.

3) If an I is specified in any data field, the next data field may not be either blank or an A entry.

4) The third subfield of a data field containing a $ or a * may contain any integer, N. The next data entry is assumed to be the (N+1)<u>th</u> member of the array. Normally this third subfield is blank and is interpreted as zero.

The sample data sheet which follows illustrates the format and flexibility of the input. Note that the sample data sheet is for illustrative purposes only and is not meant to be a continuous set of meaningful data.

Name ______ Charge ______ Date ______ Page ______

Col.			IDENTIFICATION	REMARKS (DO NOT PUNCH)
1	24$			Begin 24$ array
13	F	1		Fill 24$ array with ones
25	2*			Begin 2* array
37	10R	1.0		enter 1.0 ten times - (Repeat)
49	A	20	73 … 80	Enter next data in 20th position
61	10R	1.0		Enter 1.0 in positions 20 through 29
1	10S	1.0		Skip positions 30-39 and enter 1.0
13	4*			Begin 4* array
25	4I	0.0		Enter 0.0, 1.0, 2.0, 3.0, 4.0
37		5.0		and 5.0 in successive locations
49	1*		73 … 80	Begin 1* array
61	16R			Enter zero 16 times (note exception to
1				restriction 2)
13				
25	25*	10		Begin 25* array with 11th
37				member of that array
49	T		73 … 80	Terminate
61				
1		1.234		Enter 1.234 in all cases
13		.1234 +1		
25		123.4E-2		
37		1234 -5		
49		12.34E-01	73 … 80	
61	1+	.1234		

R - REPEAT I - INTERPOLATE S - SKIP T - TERMINATE

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III. Data Description

This section is intended to be used as a guide in preparing problems for ANISN. The following section presents a more detailed description of the data. The quantity in brackets is the array dimension and the expression in braces is the condition requiring that array or set of arrays. Arrays or sets of arrays which are not required should not be entered. If no condition is specified the array is required. Note that a T must follow each of the five sets of arrays if that set is entered.

A. LIM1 card - format (6X, I6) This card contains the number of locations available for ANISN data. (See section X.)

B. Title card - format (12A6)

C. Parameters

15$ Integer parameters [36]

1. ID problem ID number
2. ITH 0 - forward solution
   1 - adjoint solution
3. ISCT maximum order of scatter found in any zone
4. ISN order of angular quadrature
5. IGE 1 - slab; 2 - cylinder; 3 - sphere
6. IBL left boundary condition
   0 - vacuum (no reflection)
   1 - reflection
   2 - periodic
   3 - white/albedo

7.	IBR	right boundary condition, same options as IBL
8.	IZM	number of zones or regions
9.	IM	number of mesh intervals
10.	IEVT	eigenvalue type
		0 - fixed source
		1 - k calculation
		2 - α calculation
		3 - concentration search
		4 - zone width search
		5 - outer radius search
		6 - buckling search
11.	IGM	number of energy groups
12.	IHT	position of σ_{total} in cross section table
13.	IHS	position of σ_{gg} (self-scatter) in cross section table
14.	IHM	length of cross section table
15.	MS	cross section mixing table length (10$, 11$, 12*)
16.	MCR	number of cross section sets to be read from cards (14*)
17.	MTP	number of cross section sets to be read from tape (13$)
18.	MT	total number of cross section sets (elements + mixtures)
19.	IDFM	0 - density factors (21*) not used
		1 - density factors used
20.	IPVT	0 - no effect
		1 - enter k_o as PV (16*)
		2 - enter α_o as PV

21. IQM 0 - no effect

1 - enter distributed source (17*)

22. IPM 0 - no effect

1 - enter shell source by group and angle (18*)

IM - enter shell source by interval, group, and angle

23. IPP interval number which contains shell source if IPM = 1; 0 otherwise

24. IIM inner iteration maximum

25. ID1 0 - no effect

1 - print angular flux

2 - punch scalar flux

3 - both 1 and 2

26. ID2 0 - no effect

1 - use specially prepared group independent cross section tape (contains MTP materials)

2 - use cross sections and fixed source from previous problem

27. ID3 0 - no effect

N - compute N activities by zone where N is any positive integer

28. ID4 0 - no effect

1 - compute N activities by interval where N refers to ID3

29. ICM outer iteration maximum

30. IDAT1 0 - all data in core

1 - cross sections and fixed sources stored on tape

2 - fluxes and currents on tape also

31. IDAT2 0 - no effect

1 - execute diffusion solution for specified groups (24$)

32. IFG 0 - no effect

1 - flux weight cross sections (27$ and 28$)

33. IFLU 0 - step model used when linear extrapolation yields negative flux (mixed mode)

1 - use linear model only

2 - use step model only

34. IFN 0 - enter fission guess (2*)

1 - enter flux guess (3*)

2 - use fluxes from previous case

35. IPRT 0 - print cross sections

1 - do not print cross sections

36. IXTR 0 - calculate P_L scattering constants (Legendre coefficients)

1 - read P_L constants from cards (34*)

16* Floating point parameters [14]

1. EV first guess for eigenvalue
2. EVM eigenvalue modifier
3. EPS epsilon - accuracy desired
4. BF buckling factor, normally 1.420892
5. DY cylinder or plane height for buckling correction

6. DZ plane depth for buckling correction

7. DFM1 transverse dimension for void streaming correction

8. XNF normalization factor

9. PV 0.0, k_o, or α_o according to IPVT = 0, 1, or 2

10. RYF λ_2 relaxation factor, normally 0.5

11. XLAL point flux convergence criterion if entered greater than zero

12. XLAH upper limit for $|1.0 - \lambda_1|$ used in linear search

13. EQL eigenvalue change epsilon

14. XNPM new parameter modifier

NOTE: The above data is followed by a T.

D. Cross Sections {ID2 = 0}

13$ Library ID numbers [MTP] {MTP > 0}

14* Cross sections [MCR x IGM x IHM] {MCR > 0}

NOTE: If entered, the above data is followed by a T.

E. Fixed Source {IEVT = 0 and ID2 < 2}

17* Distributed source [IGM x IM] {IQM = 1}

18* Shell source [IGM x IPM x MM] {IPM > 0}

NOTE: If entered, the above data is followed by a T.

F. Flux or Fission Guess {IFN < 2}

2* Fission density [IM] {IFN = 0}

3* Flux guess [IGM x IM] {IFN = 1}

NOTE: If entered, the above data is followed by a T.

G. Remainder of Data

1* Fission spectrum [IGM]

4* Radii by interval boundary [IM + 1]

5* Velocities [IGM]

6* Angular quadrature weights [MM][3]

7* Angular quadrature cosines [MM]

8$ Zone numbers by interval [IM]

9$ Material numbers by zone [IZM]

10$ Mixture numbers in mixing table [MS] {MS > 0}

11$ Component numbers in mixing table [MS] {MS > 0}

12* Number densities in mixing table [MS] {MS > 0}

19$ Order of scatter by zone [IZM] {ISCT > 0}

20* Radius modifiers by zone [IZM] {IEVT = 4}

21* Density factors by interval [IM] {IDFM = 1}

22$ Material numbers for activities [ID3] {ID3 > 0}

23$ Cross section table position for activities [ID3] {ID3 > 0}

24$ Diffusion calculation markers [IGM] {IDAT2 = 1}

25* Albedo by group - right boundary [IGM] {IBR = 3}

26* Albedo by group - left boundary [IGM] {IBL = 3}

27$ Few group parameters [5] {IFG = 1}

1. ICON
   - 0 - no effect
   - 1 - micro cross sections desired
   - 2 - macro cross sections desired (minus implies cell weighting)

---

[3] MM = ISN + 1 for plane or sphere
MM = (ISN x (ISN + 4))/4 for cylinder

2. IHTF position of σ_{total} in weighted cross sections

3. IHSF position of $\sigma_{g \to g}$ in weighted cross sections (minus implies upscatter removal)

4. IHMF table length of weighted cross sections

5. IPUN 0 - no effect

1 - punch weighted cross sections

28$ Few group number for each multigroup [IGM] {IFG = 1}

34* P_L scatter constants [JT x MM][4] {IXTR = 1}

NOTE: The above data is followed by a T.

---

[4] JT = ISCT for plane or sphere
JT = (ISCT x (ISCT + 4))/4 for cylinder
NOTE: JT is truncated to the next lower integer for cylinders when ISCT is odd.

IV. Detailed Data Notes

This section presents a more detailed definition of selected parameters and arrays. Some comments derived from experience are also included.

A. Boundary conditions - IBL, IBR, 25*, 26*

The white boundary condition causes the entering flux at the specified boundary to be isotropic. This is accomplished by summing the flux leaving the system and returning an average flux in all directions. The albedo for each group specifies the fraction of the flux leaving to be returned. If the albedo is not specified it is assumed to be 1.0. The white boundary is recommended for the outer boundary of spherical and cylindrical cells.

B. Cross section mixing table - MS, 10$, 11$, 12*

The cross section mixing table is used to combine elements into macroscopic mixtures and to specify the method of the concentration search. Experience will reveal that only the imagination limits its flexibility. The following table illustrates the three types of operations performed by the mixing table.

	10$	11$	12*
1.	M	O	X
2.	M	N	X
3.	M	M	0.0

1. Multiply all cross sections in material M by X.
2. Multiply all cross sections in material N by X and add to corresponding cross sections in material M.

3. Multiply all cross sections in material M by EV, the eigenvalue. (concentration search)

C. Cross sections - 13$, 14*

ANISN expects a table of cross sections for each group, g, of each material in the following format:

Position	Cross section type	
1	activity	
.	"	
.		
.	"	
IHT-2	absorption	
IHT-1	nu x fission	
IHT	total	
IHT+1	$\sigma_{g+NUS\to g}$	upscatter[5]
.	.	
.	.	
.	.	
IHS-1	$\sigma_{g+1\to g}$	
IHS	$\sigma_{g\to g}$	
IHS+1	$\sigma_{g-1\to g}$	downscatter[5]
.	.	
.	.	
.	.	
IHM	$\sigma_{g-NDS\to g}$	

[5]NUS is the number of groups of upscatter.
NDS is the number of groups of downscatter.

Thus the parameters IHT, IHS, and IHM completely describe the format of the cross sections. If there are no activity cross sections, IHT = 3. If there is no upscatter IHS = IHT + 1. If there is no downscatter IHM = IHS (i.e. a one group problem). If there is upscatter ANISN will compute a total upscatter cross section for each group of each material and place that cross section in position IHM + 1. The activity cross sections are used only for activities (22$, 23$).

The P_L cross section tables must correspond in format to the P_o tables even though the transfer coefficients are the only numbers used. Note that the P_L cross sections must contain a (2L + 1) term. Previous S_n codes supplied this term internally. (e.g. DTF-II multiplied the P_1 cross sections by 3.0) This factor may be included externally or internally via the mixing table.

D. Material numbers - 10$, 11$, 9$, 22$

All cross section sets, whether elements or mixtures, are referred to by a continuous set of material numbers. In particular, the materials supplied in card form (14*) become materials 1 through MCR, the materials read from a library tape become MCR + 1 through MCR + MTP, and any number greater than MCR + MTP but less than or equal to MT refers to a mixture.

When the order of scatter for any zone (19$) is greater than zero, ANISN expects the P_1 cross sections to be material M + 1, the P_2 cross sections to be M + 2, etc. where M is the P_o material number specified in the 9$ array.

E. Density factors - IDFM, 21*

All cross sections appropriate to an interval are multiplied by the density factor for that interval. Thus one may easily and efficiently describe a void or a density variation by interval.

F. IPVT and PV - used in search

If IPVT = 1, ANISN will search for the parameter which results in a multiplication factor of PV. If IPVT = 2, ANISN will search for the parameter which results in a multiplication factor of 1.0 when α = PV. If IPVT = 0, ANISN will search for a multiplication factor of 1.0 with $\alpha = 0.0$.

G. Distributed source - IQM, 17*

The distributed source is entered by group and interval as follows: group 1, interval 1 through IM; group 2, etc.

H. Shell source - IPM, IPP, 18*

If IPM = 1, the shell source is entered by group and angle for interval IPP as follows: group 1, angle 1 through angle MM; group 2, etc.

If IPM = IM, the shell source is entered by group, interval and angle as follows: group 1, interval 1, angle 1 through angle MM; interval 2, etc.

I. Special cross section tape - ID2 = 1

A special purpose program is available which will prepare a group independent cross section tape for ANISN. This tape is required if the complete input cross section matrix [(MCR + MTP) x IGM x IHM] is larger than the number of data locations available.

J. Activities - ID3, ID4, 22$, 23$

Activities may be computed by zone and interval as specified in ID3 and ID4. The zone activity is a total reaction rate and the interval activity is per unit volume. The following table illustrates the use of activity specifications.

	22$	23$
1.	1	3
2.	-5	1
3.	7	-1
4.	-3	-1

1. Compute activity for material 1, cross section position 3 in the intervals and/or zones in which material 1 appears.
2. Compute activity for material 5, cross section position 1 in all intervals and/or zones.
3. Compute activity for material 7, position 1 in appropriate intervals and/or zones and multiply interval activities by 1.0, $2\pi r$, or $4\pi r^2$ for slab, cylinder, or sphere respectively.
4. Compute activity for material 3, position 1 in all intervals and/or zones and multiply interval activities by geometry factor.

K. Auxiliary tape storage - IDAT1

If IDAT1 is specified as zero, ANISN will use the most efficient tape storage possible and modify IDAT1 accordingly. IDAT1 may be specified as 1 or 2 if cross section and/or flux tapes are available from a previous problem or if ID2 = 1.

L. Diffusion theory solution - IDAT2, 24$

If IDAT2 = 1 the 24$ array must be entered. A zero implies a transport solution and a one implies a diffusion solution for the corresponding group. If IFN = 0, ANISN will use diffusion theory on the first outer iteration.

M. Weighted cross sections - IFG, 27$, 28$

When microscopic weighted cross sections are requested (ICON = 1), a set of cross sections is produced for each component of each material in each zone. When macroscopic cross sections are requested (ICON = 2), a set of cross sections is produced for each material in each zone. The cross sections are weighted by the flux or current in the zone in which the material appears. Since the mixing table is used to determine the components of a material, MS should not be zero when ICON = 1.

If the cross section structure specified for the weighted cross sections will not accommodate the complete multigroup scattering matrix, the "extra" transfer coefficients are placed such that they transfer as far down (or up) as possible.

If complete removal of the upscatter is desired, IHSF should be minus. |IHSF| should be the position of the self scatter cross section before the upscatter is removed. IHMF should be the final table length. After the upscatter is removed, IHSF will be IHTF + 1. The upscatter is removed by subtracting the reaction rate due to $\sigma_{j\to i}$ from the reaction rate due to $\sigma_{i\to j}$ where $j > i$. Thus the net transfer rate between groups j and i is preserved.

N. Starting guess - IFN, 2*, 3*

If IFN is specified as zero, ANISN will execute a diffusion solution for the first outer iteration. Since this is undesirable for fixed source calculations where one normally desires a zero flux guess one may set IFN = 1 and enter no guess. Simply enter a card with a T in column three for that section of data.

P. EV and EVM guesses

IEVT	EV	EVM
0	0.0	0.0
1	0.0	0.0
2	best guess for α[6]	0.0
3	1.0	-0.1
4	0.0	-0.1
5	outer radius	-(10% of outer radius)
6	1.0	-0.1

When IEVT = 0 there is no eigenvalue (EV).

When IEVT = 1 the multiplication factor (k) is the eigenvalue.

When IEVT = 2 α is the eigenvalue.

When IEVT = 3 the eigenvalue is defined by its use in the mixing table.

When IEVT = 4 the eigenvalue is used as follows:

$$\Delta R_I = \Delta R_I^{\circ} (1.0 + EV \times RM_Z)$$

where ΔR_I° is the initial ΔR

RM_Z is the radius modifier (20*)

---

[6]Zero is the best guess unless one is reasonably sure that his guess is close to the answer.

When IEVT = 5 the outer radius is the eigenvalue.

When IEVT = 6, EV = DY/DY° = DZ/DZ°

where DY° and DZ° are input.

R. Convergence - EPS, XLAL, RYF

The inner or flux iterations are considered converged when both the integral self-scatter error and the integral removal error are less than EPG or when the maximum flux deviation is less than EPS. EPG is related to EPS by a normalization factor, the total source divided by IGM. Since the integral tests are sometimes easily satisfied, a point flux convergence may be specified. If XLAL is greater than zero, the inner iterations are not considered converged until the maximum flux deviation is less than XLAL.

The outer or power iteration is considered converged when the total source ratio between successive iterations differs from 1.0 by less than EPS, the total scatter ratio differs from 1.0 by less than EPS/RYF and the upscatter ratio differs from 1.0 by less than EPS/RYF.

S. Buckling correction - BF, DY, DZ

ANISN computes a correction factor of the DB^2 form for finite transverse dimensions. The correction is applicable only with "transport corrected" P_o cross sections where position IHT is occupied by the transport cross section.

T. Void streaming correction - DFM1

Since the DB^2 term is not applicable to a void region, ANISN computes a simple correction[7] which effectively removes the transverse component of each angular flux in the void region. This correction term is not included in the calculation of the absorption reaction rate as are the DB^2 losses. This omission causes the neutron balance to differ from 1.0. If DFM1 is zero, no correction is computed for the void regions.

U. Normalization

When IEVT is greater than zero the total fission source is normalized to XNF. When IEVT is equal to zero the total fixed source is normalized to XNF and the fission source, if any, is unnormalized. If XNF = 0.0 there is no normalization.

V. Searches - XLAH, EQL, XNPM

When the absolute value of the difference between two successive lambdas (λ_1) is less than EQL, the eigenvalue, EV, is changed. The first EV change is the result of adding or subtracting the eigenvalue modifier, EVM. The second EV change is the result of a linear extrapolation. To prevent large changes early in the calculation, the absolute value of the difference between 1.0 and λ_1 is not allowed to exceed XLAH. To prevent oscillations when using the linear search, the extrapolation is limited by XNPM. The third EV change is the result of the quadratic search. The quadratic search is used until the absolute value of 1.0 - λ_1 is less than EQL. At this point, the

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[7] Olsen, T., "Void Streaming in S_N Calculations," NUCLEAR SCIENCE AND ENGINEERING, 21, p. 271, (1965).

linear search is used to complete the problem. XLAH is normally 0.05 and XNPM is normally 0.75. EQL should be the larger of 0.001 and three times EPS. In cases where EPS is quite small, EQL may be less.

W. Multiple cases

The ANISN data arrays are stored in core in the order in which they are numbered. For example the fission density (2*) follows the fission spectrum (1*). No data is destroyed between cases. If problem dimensions change, the repositioned arrays are simply read into core over the previous data. The result is that all arrays following and including the first array to be repositioned must be respecified. It should be noted that the 15$ and 16* parameter arrays are exceptions to the above discussion and are never destroyed. Multiple cases in which IDAT1 changes will not retain data properly. If IDAT1 = 1, multiple cases will retain data properly only if ID2 = 2 in all cases following case 1. If IDAT1 = 2, multiple cases will retain data properly only if ID2 = 2 and IFN = 2 in all cases following case 1. If there is upscatter, multiple cases will retain data properly only if ID2 = 2 or if the complete cross section matrix is read in all cases.

In cases where the data in a particular section remains the same in multiple cases, one may enter a card containing only a T in any of the six appropriate columns for that section of data (e.g. the 15$, 16* section).

If any case is preceded by an adjoint solution, the following arrays must be respecified if they are required for the next case: 14*, 17*, 18*, 3*, 1*, 5*, 24$, 25*, 26*.

If multiple cases are completely independent of each other (i.e. all data is specified in each case) the data of each case may be terminated with a T in the third column of two successive fields on the same card. This "double T" is used in lieu of the normal single T. If ANISN terminates a case for any reason, the code will search for the "double T" and attempt to execute the following problem. This option may also be used for independent sets of multiple cases.

X. Sense Switches

Depressing SS-3 will cause the monitor line to be printed on line for each iteration.

Depressing SS-5 will cause the problem to be terminated with complete output at the end of the next complete outer iteration.

V. Problem Size

(240)	[240]	(IM)(IDFM)	[0]
(IGM+1)(2)	[8]	(IM)(IGM) if IDAT1 < 2	[105]
(IGM)(5)	[15]	(IM) if IDAT1 = 2	[0]
(IM)(11)	[385]	(IHP)(IGM)(MT)[8] if IDAT1 = 0	[216]
(IM+1)(4)	[144]	(IHP)(MT) if IDAT1 > 0	[0]
(MM)(5)	[25]	(IM)(IGM)(IQM) if IDAT1 = 0	[0]
(IZM)(3)	[9]	(IM)(IQM) if IDAT1 > 0	[0]
(MS)(3)	[36]	(IPM)(MM)(IGM) if IDAT1 = 0	[0]
(MTP)	[0]	(IPM)(MM) if IDAT1 > 0	[0]
(ID3)(2)	[12]	(IGM) if IBR = 3	[0]
(IFG)(5)	[5]	(IGM) if IBL = 3	[0]
(IFG)(IGM)	[3]	(MM)(JT) if ISCT > 0	[15]
(IM)(ISCT)	[105]	(IM)(JT)(IGM) if ISCT > 0 and IDAT1 < 2	[315]
(IM+1)(MM)(5)	[900]	(IM)(JT) if ISCT > 0 and IDAT1 = 2	[0]
(IM)(JT)(2)	[210]	(MM)(IGM) if IDAT1 < 2	[15]
(IM)(JT) + 1	[106]	(MM) if IDAT1 = 2	[0]
(IGM)(IDAT2)	[0]	TOTAL	[2869]

To determine the number of data locations required for a given problem, each of the above expressions should be evaluated and summed. The numbers in the brackets apply to the sample problem.

---

[8]IHP = IHM if there is no upscatter
IHP = IHM + 1 if there is upscatter

VI. Sample Problem Input

The following pages contain the required input for a three group ANISN problem. The output for this problem is reproduced in section IX.

Name ________ Charge ________ Date ________ Page ________

Col.	Data	IDENTIFICATION (73–80)	REMARKS (DO NOT PUNCH)
1	AN ISN SAMPL		Title card
13	E PRØBLEM 3		
25	GRP. S4 P3		
37	SPHERE		
49			
61		1	
1	15$		Integer parameters
13	1		ID
25	0		ITH
37	3		ISCT
49	4		ISN
61	3	2	IGE
1	1		IBL
13	0		IBR
25	3		IZM
37	35		IM
49	1		IEVT
61	2R 3	3	IGM, IHT
1	4		IHS
13	6		IHM
25	2R 12		MS, MCR
37	0		MTP
49	12		MT
61	5R 0	4	IDFM, IPVT, IQM, IPM, IPP

R - REPEAT I - INTERPOLATE S - SKIP T - TERMINATE

UCN-5748
(6 5-65)

Name______________________ Charge__________ Date__________ Page__________

			IDENTIFICATION	REMARKS (DO NOT PUNCH)
1		1 0		IIM
13		1		ID1
25		0		ID2
37		6		ID3
49		1	73 80	ID4
61		3 0	5	ICM
1	2 R	0		IDAT1, IDAT2
13		1		IFG
25	4 R	0		IFLU, IFN, IPRT, IXTR
37				blanks ignored
49	1 6 *		73 80	Floating parameters
61	2 R	0 . 0	6	EV, EVM
1		0 . 0 0 0 1		EPS
13	4 R	0 . 0		BF, DY, DZ, DFM1
25		1 . 0		XNF
37		0 . 0		PV
49		0 . 5	73 80	RYF
61		0 . 0 0 1	7	XLAL
1	3 R	0 . 0		XLAH, EQL, XNPM
13	T			End of parameters
25				
37				
49			73 80	
61			8	

R - REPEAT   I - INTERPOLATE   S - SKIP   T - TERMINATE

UCN-5748
(6 5-65)

Name ______ Charge ______ Date ______ Page ______

Col.			IDENTIFICATION	REMARKS (DO NOT PUNCH)
1	1 4 *			Cross sections
13		.0013792		mat'l. 1, grp. 1 (P_0)
25		.0024645		
37		.49223		
49		.44107	73 80	
61	2 R	0.0	9	
1		.019753		grp. 2
13		.026816		
25		1.2648		
37		1.1946		
49		.049779	73 80	
61		0.0	10	
1		.17713		grp. 3
13		.30205		
25		1.686		
37		1.5089		
49		.050405	73 80	
61		1.3637 -6	11	
1	3 R	0.0		mat'l. 2, grp. 1 (P_1)
13		.65001		
25	5 R	0.0		grp. 2
37		1.8407		
49		.034195	73 80	
61	5 R	0.0	12	grp. 3

R - REPEAT   I - INTERPOLATE   S - SKIP   T - TERMINATE

UCN-5748
(6 5-65)

Name ______________ Charge ______________ Date ______________ Page ______________

Col.			IDENTIFICATION	REMARKS (DO NOT PUNCH)
1		.050124		
13		4.9522 -9		
25	3 R	0.0		mat'l. 3 (P_2)
37		.53976		
49	5 R	0.0	73 80	
61		1.2118	13	
1		-.015334		
13	5 R	0.0		
25		-.047187		
37		-7.782 -7		
49	3 R	0.0	73 80	mat'l. 4 (P_3)
61		.17246	14	
1	5 R	0.0		
13		.098833		
25		-.082968		
37	5 R	0.0		
49		-.082467	73 80	
61		-2.1059 -8	15	
1		4.5227 -4		mat'l. 5 (P_o)
13		0.0		
25		3.2087 -1		
37		3.2015E-1		
49	2 R	0.0	73 80	
61		6.6839 -3	16	

R - REPEAT. I - INTERPOLATE S - SKIP T - TERMINATE

UCN-5748
(6 5-65)

Name ______ Charge ______ Date ______ Page ______

Col.			IDENTIFICATION	REMARKS (DO NOT PUNCH)
1		0.0		
13		.78553		
25		.77793		
37		2.679 -4		
49		0.0		
61		.077168	17	
1		0.0		
13		.98114		
25		.90397		
37		.0009081		
49		0.0		
61	3R	0.0	18	mat'l. 6 (P_1)
1		.18971		
13	5R	0.0		
25		.089185		
37		-1.073 -4		
49	5R	0.0		
61		-4.8303 -4	19	
1		0.0		
13	3R	0.0		mat'l. 7 (P_2)
25		.3179		
37	5R	0.0		
49		.048595		
61		-1.338 -6	20	

R - REPEAT   I - INTERPOLATE   S - SKIP   T - TERMINATE

UCN-5743
(6 5-65)

Name__________ Charge__________ Date__________ Page__________

Col.			IDENTIFICATION	REMARKS (DO NOT PUNCH)
1	5 R	0 . 0		
13		- 1 . 4 3 1 6 - 5		
25		0 . 0		
37	3 R	0 . 0		mat'l. 8 (P_3)
49		. 1 3 6 2	73 80	
61	5 R	0 . 0	2 1	
1		. 0 2 7 7 4 8		
13		1 . 7 3 4 2 - 6		
25	5 R	0 . 0		
37		3 . 9 8 3 9 - 6		
49		0 . 0	73 80	
61		1 . 8 2 7 4 - 4	2 2	mat'l. 9 (P_o)
1		0 . 0		
13		. 6 0 9 5		
25		. 5 2 3 0 6		
37	2 R	0 . 0		
49		7 . 6 9 8 2 - 4	73 80	
61		0 . 0	2 3	
1		1 . 4 6 5 4		
13		1 . 3 7 0 9		
25		. 0 8 6 2 5 1		
37		0 . 0		
49		8 . 6 9 4 4 - 3	73 80	
61		0 . 0	2 4	

R - REPEAT I - INTERPOLATE S - SKIP T - TERMINATE

UCN-5748
(6 5-65)

Name ____________ Charge ________ Date ________ Page ________

Col.			IDENTIFICATION	REMARKS (DO NOT PUNCH)
1		1.7937		
13		1.785		
25		.0936634		
37		2.3664 -6		
49	3 R	0.0	73 80	mat'l. 10 (P_1)
61		.89753	25	
1	5 R	0.0		
13		2.5966		
25		.055036		
37	5 R	0.0		
49		.095594	73 80	
61		7.9635 -9	26	
1	3 R	0.0		mat'l. 11 (P_2)
13		.67262		
25	5 R	0.0		
37		1.7216		
49		-.02761	73 80	
61	5 R	0.0	27	
1		-.046302		
13		-1.3477 -6		
25	3 R	0.0		mat'l. 12 (P_3)
37		.3191		
49	5 R	0.0	73 80	
61		.158	28	

R - REPEAT I - INTERPOLATE S - SKIP T - TERMINATE

UCN-5748
(6 3-65)

Name________ Charge________ Date________ Page________

Col.			IDENTIFICATION	REMARKS (DO NOT PUNCH)
1		-4.3936-2		
13	5R	0.0		
25		-.14892		
37		-1.0918-8		
49	T		73 / 80	End of cross sections
61			29	
1	2*			Fission density guess
13	20R	1.0		
25	15R	0.0		
37	T			End of fission guess
49			73 / 80	
61			30	
1	1*			Fission spectrum
13		1.0		
25	2R	0.0		
37	4*			Radii
49	19I	0.0	73 / 80	
61	2I	18.273	31	
1	11I	19.633		
13		32.143		
25				
37	5*			Velocities
49	3R	1.0	73 / 80	
61			32	

R - REPEAT I - INTERPOLATE S - SKIP T - TERMINATE

UCN-5748
(6 5-65)

Name____________________ Charge__________ Date__________ Page__________

Col.			IDENTIFICATION	REMARKS (DO NOT PUNCH)
1	6 *			S_n weights
13		0.0		
25		.1666667		
37	2 R	.3333333		
49		.1666667	73 – 80	
61			33	
1	7 *			S_n cosines
13		-1.0		
25		-.8819171		
37		-.3333333		
49		+.3333333	73 – 80	
61		+.8819171	34	
1	8 $			Zone numbers by interval
13	20 R	1		
25	3 R	2		
37	12 R	3		
49			73 – 80	
61	9 $		35	
1		1		mat'l. numbers by zone
13		5		
25		9		
37	19 $			Order of scatter by zone
49	3 R	3	73 – 80	
61			36	

R - REPEAT I - INTERPOLATE S - SKIP T - TERMINATE

UCN-5748 (6 5-65)

Name__________ Charge__________ Date__________ Page__________

Col.			IDENTIFICATION	REMARKS (DO NOT PUNCH)
1	1 0 $			mixture numbers
13		1		
25		2		
37		3		
49		4	73 … 80	
61		5	3 7	
1		6		
13		7		
25		8		
37		9		
49		1 0	73 … 80	
61		1 1	3 8	
1		1 2		
13	1 1 $			component numbers
25	1 2 R	0		
37	1 2 *			number densitys
49	1 2 R	1 . 0	73 … 80	
61			3 9	
1	2 2 $			material numbers for activities
13	2 R	1		
25	2 R	5		
37	2 R	9		
49			73 … 80	
61			4 0	

R - REPEAT I - INTERPOLATE S - SKIP T - TERMINATE

UCN-5748
(6 5-65)

Name ______ Charge ______ Date ______ Page ______

			IDENTIFICATION (73–80)	REMARKS (DO NOT PUNCH)
1	2 3 $			cross section position for activities
13		1		
25		3		
37		1		
49		3		
61		1	4 1	
1		3		
13				
25	2 7 $			Few group parameters
37		2		ICON
49		3		IHTF
61		4	4 2	IHSF
1		4		IHMF
13		0		IPUN
25	2 8 $			Few group nos. by multigroup
37	3 R	1		
49	T			End of all data
61	T		4 3	
1				
13				
25				
37				
49				
61				

R - REPEAT I - INTERPOLATE S - SKIP T - TERMINATE

UCN-5748
(6 5-55)

VII. ANISN Output

The first output section is a brief edit of the input data consisting of the array identification and the number of entries found in that array. If the number of entries is incorrect the entire array is printed. T's are printed when encountered. Several self-explanatory error messages may be printed in this section. If any data errors are found the problem is terminated after this section is printed.

The next section is a list of the 15$ and 16* array with a short explanation. The following page lists the zone numbers by interval (8$), the radii (4*), the areas and volumes (computed), the fission density guess (2*), and the density factors (21*) if any. The next page contains the fission spectrum (1*), velocities (5*), right boundary albedo (25*), left boundary albedo (26*), diffusion calculation markers (24$), material numbers by zone (9$), order of scattering by zone (19$), and the radius modifiers (20*) used in zone width searches. Note that the right albedo, left albedo and diffusion markers are printed only when they are used.

The following section contains the cross section mixing table (10$, 11$, 12*) and the quadrature constants including the direction cosines (7*), the weights (6*), the reflected direction indices (computed) and the product of the cosines and weights. If ISCT is greater than one, the Legendre coefficients used in the anisotropic scattering source are printed.

Next the cross sections for MT materials as read in and computed or modified via the mixing table are printed. This section of printing may be omitted by specifying IPRT = 1.

The iteration monitor follows and includes the outer iteration counter, the inner iteration counter, balance (gains/losses), upscatter ratio, eigenvalue, lambda1 (source ratio), and lambda2 (scatter ratio). Immediately preceding the final iteration monitor the number of inner iterations and the maximum flux deviation for each group are printed.

Following the iteration monitor, the zone numbers, radii, interval midpoints, areas, volumes, and computed fission density are printed. The fission density units are source neutrons -cm^{-3}-sec^{-1}.

If ID3 is not zero activities comprise the next section of output. First the activity number, material number (22$) and position (23$) are printed. The activities by zone are printed in units of reactions per second. If ID4 is not zero, the interval activities (reactions -cm^{-3}-sec^{-1}) are printed.

The total flux (neutrons-(or photons, etc.) cm^{-2}-sec^{-1}) by group and interval midpoint follows. If IEVT is zero, the normalized fixed source is printed next. The distributed source, specified by group and interval midpoint, has units of neutrons -cm^{-3}-sec. The shell source units are neutrons -cm^{-2}-sec^{-1}-unit weight^{-1}.

If ID1 is 1 or 3 the angular flux (neutron-cm^{-2}-sec^{-1}-unit weight^{-1}) is printed for each group, angle, and interval boundary.

Note that the shell source, if any, is not included in the angular flux. To convert to flux per steradian, one must divide by 4π.

Summary tables are printed for each zone and the entire system. All reaction rates have units of reactions per second. Balance is computed as the ratio of sources to losses. The right boundary flux is the scalar flux (neutrons-cm^{-2}-sec^{-1}) at the right boundary of the zone or system. The total flux is the sum over the appropriate intervals of the product of the scalar flux and the interval volume. Density is the total flux divided by the group velocity.

If IFG is not zero, cross section weighting data follows. The parameters (27$) are printed with a brief explanation. An interpretation of the 28$ array which indicates the few group structure is printed. If the multigroup structure is unaltered a message to that effect is printed. Next a table of materials to be weighted is printed. The weighted cross sections follow. If cell weighting is specified, a message is printed indicating that the cell weighting has been accomplished. Note that the cell weighted cross sections have been multiplied by a volume integrated flux ratio. In order to produce a set of homogenized cell cross sections, one should add all P(0) materials together, all P(1) materials, etc. The final table consists of the few group integrated flux, average flux, the zone to cell ratio of the two, and the volume fraction of each zone. All values listed for zone IZM + 1 refer to the complete cell or system.

It should be noted that the output which is a function of energy group in an adjoint calculation has been reversed with respect to group number. In particular the following one dimensional arrays are reversed with respect to group number before they are printed: fission spectrum (1*), velocities (5*), right boundary albedo (25*), left boundary albedo (26*), diffusion calculation markers (24$). The fluxes (angular and scalar) and fixed source, if any, are also reversed with respect to group number. That is, any information printed by interval and/or angle for group 1 actually refers to group IGM. Group 2 refers to group IGM-1, etc. The angle dependent information (angular fluxes and shell source) must be interpreted as if it were reflected through the origin. For example, an angular flux printed for any angle μ should be interpreted as the angular flux for the angle $-\mu$.

The cross sections are also reversed with respect to group number. The transfer coefficients are also reversed with respect to the direction of transfer. Therefore $\sigma_{1\to 2}$ in the forward case first becomes $\sigma_{2\to 1}$ (reversal with respect to transfer direction) and then $\sigma_{IGM-1\to IGM}$ (reversal with respect to group number) in the adjoint case.

The fission source in an adjoint calculation is computed as the integral over volume and energy of the product of chi and the flux, and this source is distributed according to $\nu\Sigma_f$ in energy and space. Therefore the fission density array contains the sum over groups of chi times flux for each interval and in the summary tables the fission rate is the sum over intervals of chi times flux times volume and the fission source is the total fission source times $\nu\Sigma_f$ for each group.

VIII. ANISN Error Messages

CORE	N	insufficient storage, N = required storage
DATA	N	there are N data errors
SNCORE	N	insufficient storage to compute P_L (Legendre) coefficients. N = required storage; highly unlikely
S804-1	N	$\mu(N) = 0.0$
S804-2	0	S_n weights do not sum to 1.0 or S_n constants are not symmetric about $\mu = 0$.
VELOC	N	velocity in group N is zero and IEVT = 2.
SOURCE	-0	IEVT = 0 and total fixed source is ≤ 0.
S810-1	N	radius (N) ≤ 0
S810-2	N	$r(N-1) \geq r(N)$
S810-3	N	zone N dimensions have become negative in zone width search
S822-2	0	IEVT > 0 and total fission source is ≤ 0.
FGCORE	N	insufficient storage to flux weight cross sections. N = required storage.

IX. Sample Problem Output

The following pages present the ANISN output for the sample problem described in section VI.

```
ANISN SAMPLE PROBLEM  3 GRP. S4 P3 SPHERE
 15$ ARRAY     35 ENTRIES READ
 16* ARRAY     14 ENTRIES READ
   T
2869 LOCATIONS WILL BE USED FOR THIS PROBLEM
 14* ARRAY    216 ENTRIES READ
   T
  2* ARRAY     35 ENTRIES READ
   T
  1* ARRAY      3 ENTRIES READ
  4* ARRAY     36 ENTRIES READ
  5* ARRAY      3 ENTRIES READ
  6* ARRAY      5 ENTRIES READ
  7* ARRAY      5 ENTRIES READ
  8$ ARRAY     35 ENTRIES READ
  9$ ARRAY      3 ENTRIES READ
 19$ ARRAY      3 ENTRIES READ
 10$ ARRAY     12 ENTRIES READ
 11$ ARRAY     12 ENTRIES READ
 12* ARRAY     12 ENTRIES READ
 22$ ARRAY      6 ENTRIES READ
 23$ ARRAY      6 ENTRIES READ
 27$ ARRAY      5 ENTRIES READ
 28$ ARRAY      3 ENTRIES READ
   T
```

ANISN SAMPLE PROBLEM 3 GRP. S4 P3 SPHERE

ID	PROBLEM ID NO.	1	ITH	0/1 = REG./ADJ.	0
ISCT	ORDER OF SCATTERING	3	ISN	QUADRATURE ORDER	4
IGE	1/2/3 = PLA/CYL/SPH	3	IBL	0/1/2/3 = NO REFL/REFL/PER/WHITE	1
IBR	RT. B.C. SAME AS LEFT B.C.,IBL	0	IZM	NO. OF ZONES	3
IM	NO. OF INTERVALS	35	IEVT	0/1/2/3/4/5/6=Q/K/ALPHA/C/Z/R/H	1
IGM	NO. OF GROUPS	3	IHT	POS. OF SIGMA T	3
IHS	POS. OF SIGMA GG	4	IHM	TABLE LENGTH	6
MS	MIXING TABLE LENGTH	12	MCR	NO. MATLS. FROM CARDS	12
MTP	NO. MATLS. FROM LIB TAPE	0	MT	NO. OF MATLS.	12
IDFM	0/1=NONE/DENSITY FACTORS(21*)	0	IPVT	0/1/2=NONE/K/ALPHA	0
IQM	0/1=NONE/DIST. SOURCE	0	IPM	0/1/IM=NONE/S(MM,IPP)/S(MM,IM)	0
IPP	INTERVAL OF SHELL SOURCE	0	IIM	INNER ITER. MAX.	10
ID1	0/1/2/3=NO/PRNT ND/PNCH N/BOTH	1	ID2	0/1/2=NO/X-SEC TAPE/PREV	0
ID3	0/N=NO/N ACT. BY ZONE	6	ID4	0/1=NO/N ACT. BY INT.	1
ICM	OUTER ITER. MAX.	30	IDAT1	0/1/2=NO/MIN/MAX TAPE	0
IDAT2	0/1=NO/DIFFUSION(24$)	0	IFG	0/1=NO/FEW GRP.	1
IFLU	0/1/2=BOTH/LINEAR/STEP	0	IFN	0/1/2=INPUT 2*/3*/PREV. CASE	0
IPRT	0/1 = PRINT X-SEC/DO NOT	0	IXTR	0/1=CALC/READ P-L CONSTANTS	0

EV	EIGENVALUE GUESS	0.	EVM	EIGENVALUE MODIFIER	0.
EPS	PRECISION DESIRED	1.00000E-04	BF	BUCKLING FACTOR	0.
DY	CYL OR PLA HEIGHT	0.	DZ	PLANE DEPTH	0.
DFM1	HT. FOR VOID CORR.	0.	XNF	NORM. FACTOR	1.00000E 00
PV	IPVT=1/2 - K/ALPHA	0.	RYF	LAMBDA2 RELAXATION	5.00000E-01
XLAL	PT CNVRG EPS. IF .NE.0	1.00000E-03	XLAH	1-LAMBDA MAX.-SEARCH	0.
EQL	EV CHANGE EPS.-SEARCH	0.	XNPM	NEW PARAM. MOD.-SEARCH	0.

ANISN SAMPLE PROBLEM 3 GRP. S4 P3 SPHERE

INT.	ZONE NUMBER	RADIUS	AREA	VOLUME	FISS DENS	DENS FACTOR
1	1	0	0	3.19469E 00	1.00000E 00	
2	1	9.13650E-01	1.04899E 01	2.23628E 01	1.00000E 00	
3	1	1.82730E 00	4.19594E 01	6.06990E 01	1.00000E 00	
4	1	2.74095E 00	9.44087E 01	1.18203E 02	1.00000E 00	
5	1	3.65460E 00	1.67838E 02	1.94876E 02	1.00000E 00	
6	1	4.56825E 00	2.62246E 02	2.90716E 02	1.00000E 00	
7	1	5.48190E 00	3.77635E 02	4.05725E 02	1.00000E 00	
8	1	6.39555E 00	5.14003E 02	5.39902E 02	1.00000E 00	
9	1	7.30920E 00	6.71351E 02	6.93247E 02	1.00000E 00	
10	1	8.22285E 00	8.49678E 02	8.65760E 02	1.00000E 00	
11	1	9.13650E 00	1.04899E 03	1.05744E 03	1.00000E 00	
12	1	1.00501E 01	1.26927E 03	1.26829E 03	1.00000E 00	
13	1	1.09638E 01	1.51054E 03	1.49831E 03	1.00000E 00	
14	1	1.18774E 01	1.77279E 03	1.74749E 03	1.00000E 00	
15	1	1.27911E 01	2.05601E 03	2.01585E 03	1.00000E 00	
16	1	1.37047E 01	2.36022E 03	2.30337E 03	1.00000E 00	
17	1	1.46184E 01	2.68540E 03	2.61006E 03	1.00000E 00	
18	1	1.55320E 01	3.03157E 03	2.93592E 03	1.00000E 00	
19	1	1.64457E 01	3.39871E 03	3.28094E 03	1.00000E 00	
20	1	1.73593E 01	3.78684E 03	3.64514E 03	1.00000E 00	
21	2	1.82730E 01	4.19594E 03	1.94974E 03	0	
22	2	1.87263E 01	4.40672E 03	2.04646E 03	0	
23	2	1.91797E 01	4.62266E 03	2.14553E 03	0	
24	3	1.96330E 01	4.84377E 03	5.32250E 03	0	
25	3	2.06755E 01	5.37183E 03	5.88724E 03	0	
26	3	2.17180E 01	5.92720E 03	6.48046E 03	0	
27	3	2.27605E 01	6.50989E 03	7.10215E 03	0	
28	3	2.38030E 01	7.11989E 03	7.75231E 03	0	
29	3	2.48455E 01	7.75721E 03	8.43095E 03	0	
30	3	2.58880E 01	8.42184E 03	9.13807E 03	0	
31	3	2.69305E 01	9.11378E 03	9.87366E 03	0	
32	3	2.79730E 01	9.83304E 03	1.06377E 04	0	
33	3	2.90155E 01	1.05796E 04	1.14303E 04	0	
34	3	3.00580E 01	1.13535E 04	1.22513E 04	0	
35	3	3.11005E 01	1.21547E 04	1.31008E 04	0	
36		3.21430E 01	1.29832E 04			

ANISN SAMPLE PROBLEM 3 GRP. S4 P3 SPHERE

	FISS SPEC	VELOCITY	RT ALBEDO	LFT ALBEDO	DIFF MARKER	MAT'L/ZONE	L OF P(L)	RADIUS MOD
1	1.00000E 00	1.00000E 00				1	3	0
2	0	1.00000E 00				5	3	0
3	0	1.00000E 00				9	3	0

ANISN SAMPLE PROBLEM 3 GRP. S4 P3 SPHERE

CROSS SECTION MIXING TABLE

	MIXTURE	COMPONENT	NO. DENSITY
1	1	0	1.00000E 00
2	2	0	1.00000E 00
3	3	0	1.00000E 00
4	4	0	1.00000E 00
5	5	0	1.00000E 00
6	6	0	1.00000E 00
7	7	0	1.00000E 00
8	8	0	1.00000E 00
9	9	0	1.00000E 00
10	10	0	1.00000E 00
11	11	0	1.00000E 00
12	12	0	1.00000E 00

CONSTANTS FOR P(3) SCATTERING

ANGLE	SET NO 1	SET NO 2	SET NO 3
1	-1.00000E 00	1.00000E 00	-1.00000E 00
2	-8.81917E-01	6.66667E-01	-3.91963E-01
3	-3.33333E-01	-3.33333E-01	4.07407E-01
4	3.33333E-01	-3.33333E-01	-4.07407E-01
5	8.81917E-01	6.66667E-01	3.91963E-01

ANGULAR QUADRATURE CONSTANTS

COSINE (MU)	WEIGHT	REFL DIRECT	WT. X COS.
-1.00000E 00	0	5	-0
-8.81917E-01	1.66667E-01	5	-1.46986E-01
-3.33333E-01	3.33333E-01	4	-1.11111E-01
3.33333E-01	3.33333E-01	3	1.11111E-01
8.81917E-01	1.66667E-01	2	1.46986E-01

CROSS SECTIONS

MAT NO 1

POS.	GROUP 1	GROUP 2	GROUP 3
1	1.37920E-03	1.97530E-02	1.77130E-01
2	2.46450E-03	2.68160E-02	3.02050E-01
3	4.92230E-01	1.26480E 00	1.68600E 00
4	4.41070E-01	1.19460E 00	1.50890E 00
5	0.	4.97790E-02	5.04050E-02
6	0.	0.	1.36370E-06

MAT NO 2

POS.	GROUP 1	GROUP 2	GROUP 3
1	0.	0.	0.
2	0.	0.	0.
3	0.	0.	0.
4	6.50010E-01	1.84070E 00	0.
5	0.	3.41950E-02	5.01240E-02
6	0.	0.	4.95220E-09

MAT NO 3

POS.	GROUP 1	GROUP 2	GROUP 3
1	0.	0.	0.
2	0.	0.	0.
3	0.	0.	0.
4	5.39760E-01	1.21180E 00	0.
5	0.	-1.53340E-02	-4.71870E-02
6	0.	0.	-7.78200E-07

MAT NO 4

POS.	GROUP 1	GROUP 2	GROUP 3
1	0.	0.	0.
2	0.	0.	0.
3	0.	0.	0.
4	1.72460E-01	9.88330E-02	0.
5	0.	-8.29680E-02	-8.24670E-02
6	0.	0.	-2.10590E-08

MAT NO 5

POS.	GROUP 1	GROUP 2	GROUP 3
1	4.52270E-04	6.68390E-03	7.71680E-02
2	0.	0.	0.
3	3.20870E-01	7.85530E-01	9.88140E-01
4	3.20150E-01	7.77930E-01	9.03970E-01
5	0.	2.67900E-04	9.08100E-04
6	0.	0.	0.

MAT NO 6

POS.	GROUP 1	GROUP 2	GROUP 3
1	0.	0.	0.
2	0.	0.	0.
3	0.	0.	0.
4	1.89710E-01	8.91850E-02	0.
5	0.	-1.07300E-04	-4.83030E-04
6	0.	0.	0.

MAT NO 7

POS.	GROUP 1	GROUP 2	GROUP 3
1	0.	0.	0.
2	0.	0.	0.
3	0.	0.	0.
4	3.17900E-01	4.85950E-02	0.
5	0.	-1.33800E-06	-1.43160E-05
6	0.	0.	0.

MAT NO 8

POS.	GROUP 1	GROUP 2	GROUP 3
1	0.	0.	0.
2	0.	0.	0.
3	0.	0.	0.
4	1.36200E-01	2.77480E-02	0.
5	0.	1.73420E-06	3.98390E-06
6	0.	0.	0.

MAT NO 9

POS.	GROUP 1	GROUP 2	GROUP 3
1	1.82740E-04	7.69820E-04	8.69440E-03
2	0.	0.	0.
3	6.09500E-01	1.46540E 00	1.79370E 00
4	5.23060E-01	1.37090E 00	1.78500E 00
5	0.	8.62510E-02	9.36340E-02
6	0.	0.	2.36640E-06

MAT NO 10

POS.	GROUP 1	GROUP 2	GROUP 3
1	0.	0.	0.
2	0.	0.	0.
3	0.	0.	0.
4	8.97530E-01	2.59660E 00	0.
5	0.	5.50360E-02	9.55940E-02
6	0.	0.	7.96350E-09

MAT NO 11

POS.	GROUP 1	GROUP 2	GROUP 3
1	0.	0.	0.
2	0.	0.	0.
3	0.	0.	0.

4	6.72620E-01	1.72160E 00	0.
5	0.	-2.76100E-02	-4.63020E-02
6	0.	0.	-1.34770E-06

MAT NO 12

POS.	GROUP 1	GROUP 2	GROUP 3
1	0.	0.	0.
2	0.	0.	0.
3	0.	0.	0.
4	3.19100E-01	1.58000E-01	0.
5	0.	-4.39360E-02	-1.48920E-01
6	0.	0.	-1.09180E-08

OUTER	INNER	NEUT BAL	UPSCATTER RATIO	EIGENVALUE	LAMBDA1	LAMBDA2	
0	0	0.	0.	0.	0.	0.	
1	0	1.0000004E 00	0.	9.8753346E-01	9.8753345E-01	0.	
2	30	1.0000016E 00	0.	9.9614769E-01	1.0087230E 00	9.9444325E-01	
3	60	1.0000020E 00	0.	1.0049931E 00	1.0088796E 00	9.9946036E-01	
4	90	1.0000018E 00	0.	1.0130129E 00	1.0079800E 00	9.9951030E-01	
5	120	1.0000017E 00	0.	1.0195381E 00	1.0064414E 00	9.9966002E-01	
6	150	1.0000020E 00	0.	1.0246106E 00	1.0049753E 00	9.9977446E-01	
7	180	1.0000015E 00	0.	1.0284648E 00	1.0037616E 00	9.9984748E-01	
8	210	1.0000020E 00	0.	1.0313604E 00	1.0028155E 00	9.9989226E-01	
9	240	1.0000020E 00	0.	1.0335221E 00	1.0020959E 00	9.9992468E-01	
10	270	1.0000015E 00	0.	1.0351291E 00	1.0015549E 00	9.9994749E-01	
11	299	1.0000022E 00	0.	1.0363132E 00	1.0011439E 00	9.9996068E-01	
12	326	1.0000016E 00	0.	1.0371769E 00	1.0008335E 00	9.9997414E-01	
13	352	1.0000019E 00	0.	1.0378088E 00	1.0006092E 00	9.9998102E-01	
14	372	1.0000018E 00	0.	1.0382279E 00	1.0004038E 00	9.9999477E-01	
15	388	1.0000019E 00	0.	1.0384741E 00	1.0002371E 00	9.9999586E-01	
16	393	1.0000018E 00	0.	1.0385257E 00	1.0000498E 00	1.0000000E 00	
GROUP	1	INNER ITERATIONS 1	MAX FLUX DEVIATION 7.96036E-05				
GROUP	2	INNER ITERATIONS 1	MAX FLUX DEVIATION 9.66848E-05				
GROUP	3.	INNER ITERATIONS 1	MAX FLUX DEVIATION 9.94798E-05				
17	396	1.0000018E 00	0.	1.0385518E 00	1.0000250E 00	9.9999917E-01	FINAL MONITOR

ANISN SAMPLE PROBLEM 3 GRP. S4 P3 SPHERE

INT.	ZONE NUMBER	RADIUS	INT. MIDPOINT	AREA	VOLUME	FISSION DENS
1	1	0.	4.56825E-01	0.	3.19469E 00	6.67854E-05
2	1	9.13650E-01	1.37047E 00	1.04899E 01	2.23628E 01	6.65683E-05
3	1	1.82730E 00	2.28412E 00	4.19594E 01	6.06990E 01	6.60236E-05
4	1	2.74095E 00	3.19777E 00	9.44087E 01	1.18203E 02	6.51854E-05
5	1	3.65460E 00	4.11142E 00	1.67838E 02	1.94876E 02	6.40593E-05
6	1	4.56825E 00	5.02507E 00	2.62246E 02	2.90716E 02	6.26580E-05
7	1	5.48190E 00	5.93872E 00	3.77635E 02	4.05725E 02	6.09911E-05
8	1	6.39555E 00	6.85237E 00	5.14003E 02	5.39902E 02	5.90721E-05
9	1	7.30920E 00	7.76602E 00	6.71351E 02	6.93247E 02	5.69157E-05
10	1	8.22285E 00	8.67967E 00	8.49678E 02	8.65760E 02	5.45391E-05
11	1	9.13650E 00	9.59332E 00	1.04899E 03	1.05744E 03	5.19620E-05
12	1	1.00501E 01	1.05070E 01	1.26927E 03	1.26829E 03	4.92072E-05
13	1	1.09638E 01	1.14206E 01	1.51054E 03	1.49831E 03	4.63031E-05
14	1	1.18774E 01	1.23343E 01	1.77279E 03	1.74749E 03	4.32884E-05
15	1	1.27911E 01	1.32479E 01	2.05601E 03	2.01585E 03	4.02235E-05
16	1	1.37047E 01	1.41616E 01	2.36022E 03	2.30337E 03	3.72156E-05
17	1	1.46184E 01	1.50752E 01	2.68540E 03	2.61006E 03	3.44805E-05
18	1	1.55320E 01	1.59889E 01	3.03157E 03	2.93592E 03	3.24713E-05
19	1	1.64457E 01	1.69025E 01	3.39871E 03	3.28094E 03	3.22099E-05
20	1	1.73593E 01	1.78162E 01	3.78684E 03	3.64514E 03	3.59198E-05
21	2	1.82730E 01	1.84997E 01	4.19594E 03	1.94974E 03	0.
22	2	1.87263E 01	1.89530E 01	4.40672E 03	2.04646E 03	0.
23	2	1.91797E 01	1.94063E 01	4.62266E 03	2.14553E 03	0.
24	3	1.96330E 01	2.01542E 01	4.84377E 03	5.32250E 03	0.
25	3	2.06755E 01	2.11967E 01	5.37183E 03	5.83724E 03	0.
26	3	2.17180E 01	2.22392E 01	5.92720E 03	6.48046E 03	0.
27	3	2.27605E 01	2.32817E 01	6.50989E 03	7.10215E 03	0.
28	3	2.38030E 01	2.43242E 01	7.11989E 03	7.75231E 03	0.
29	3	2.48455E 01	2.53667E 01	7.75721E 03	8.43095E 03	0.
30	3	2.58880E 01	2.64092E 01	8.42184E 03	9.13807E 03	0.
31	3	2.69305E 01	2.74518E 01	9.11378E 03	9.87366E 03	0.
32	3	2.79730E 01	2.84942E 01	9.83304E 03	1.06377E 04	0.
33	3	2.90155E 01	2.95368E 01	1.05796E 04	1.14303E 04	0.
34	3	3.00580E 01	3.05792E 01	1.13535E 04	1.22513E 04	0.
35	3	3.11005E 01	3.16217E 01	1.21547E 04	1.31008E 04	0.
36		3.21430E 01		1.29832E 04		

ANISN SAMPLE PROBLEM 3 GRP. S4 P3 SPHERE

ACTIVITY	MATERIAL	POSITION
1	1	1
2	1	3
3	5	1
4	5	3
5	9	1
6	9	3

ACTIVITIES BY ZONE INCLUDING SUM OVER ALL ZONES IN LINE 4

ZONE	ACT. 1	ACT. 2	ACT. 3	ACT. 4	ACT. 5	ACT. 6
1	6.41775E-01	2.14538E 01	0.	0.	0.	0.
2	0.	0.	7.25550E-02	2.04618E 00	0.	0.
3	0.	0.	0.	0.	1.66783E-01	4.12206E 01
4	6.41775E-01	2.14538E 01	7.25550E-02	2.04618E 00	1.66783E-01	4.12206E 01

ACTIVITIES BY INTERVAL

INT.	ACT. 1	ACT. 2	ACT. 3	ACT. 4	ACT. 5	ACT. 6
1	4.14420E-05	1.45974E-03	0.	0.	0.	0.
2	4.13079E-05	1.45581E-03	0.	0.	0.	0.
3	4.09700E-05	1.44394E-03	0.	0.	0.	0.
4	4.04500E-05	1.42570E-03	0.	0.	0.	0.
5	3.97513E-05	1.40112E-03	0.	0.	0.	0.
6	3.88817E-05	1.37052E-03	0.	0.	0.	0.
7	3.78474E-05	1.33411E-03	0.	0.	0.	0.
8	3.66566E-05	1.29216E-03	0.	0.	0.	0.
9	3.53184E-05	1.24502E-03	0.	0.	0.	0.
10	3.38436E-05	1.19303E-03	0.	0.	0.	0.
11	3.22442E-05	1.13660E-03	0.	0.	0.	0.
12	3.05343E-05	1.07620E-03	0.	0.	0.	0.
13	2.87314E-05	1.01233E-03	0.	0.	0.	0.
14	2.68588E-05	9.45590E-04	0.	0.	0.	0.
15	2.49526E-05	8.76714E-04	0.	0.	0.	0.
16	2.30765E-05	8.06734E-04	0.	0.	0.	0.
17	2.13578E-05	7.37286E-04	0.	0.	0.	0.
18	2.00626E-05	6.71173E-04	0.	0.	0.	0.
19	1.97908E-05	6.13537E-04	0.	0.	0.	0.
20	2.18451E-05	5.71907E-04	0.	0.	0.	0.
21	0.	0.	1.03629E-05	3.36901E-04	0.	0.
22	0.	0.	1.15324E-05	3.29472E-04	0.	0.
23	0.	0.	1.33997E-05	3.33280E-04	0.	0.
24	0.	0.	0.	0.	2.09894E-06	6.82238E-04
25	0.	0.	0.	0.	2.67309E-06	7.42976E-04
26	0.	0.	0.	0.	2.82097E-06	7.27802E-04
27	0.	0.	0.	0.	2.73839E-06	6.75502E-04
28	0.	0.	0.	0.	2.50772E-06	6.00542E-04
29	0.	0.	0.	0.	2.20194E-06	5.16467E-04
30	0.	0.	0.	0.	1.86240E-06	4.30406E-04
31	0.	0.	0.	0.	1.51585E-06	3.46731E-04
32	0.	0.	0.	0.	1.17726E-06	2.67589E-04
33	0.	0.	0.	0.	8.51909E-07	1.93306E-04
34	0.	0.	0.	0.	5.46451E-07	1.24712E-04
35	0.	0.	0.	0.	2.44098E-07	5.73155E-05

ANISN SAMPLE PROBLEM 3 GRP. S4 P3 SPHERE

TOTAL FLUX

INT.	GROUP 1	GROUP 2	GROUP 3
1	9.18778E-04	5.80514E-04	1.62073E-04
2	9.17059E-04	5.78817E-04	1.61518E-04
3	9.09601E-04	5.74098E-04	1.60195E-04
4	8.98182E-04	5.66839E-04	1.58157E-04
5	8.82731E-04	5.57058E-04	1.55424E-04
6	8.63500E-04	5.44884E-04	1.52022E-04
7	8.40607E-04	5.30396E-04	1.47977E-04
8	8.14227E-04	5.13710E-04	1.43320E-04
9	7.84559E-04	4.94953E-04	1.38088E-04
10	7.51833E-04	4.74268E-04	1.32323E-04
11	7.16307E-04	4.51814E-04	1.26074E-04
12	6.78266E-04	4.27760E-04	1.19400E-04
13	6.38021E-04	4.02290E-04	1.12375E-04
14	5.95920E-04	3.75592E-04	1.05108E-04
15	5.52359E-04	3.47859E-04	9.77785E-05
16	5.07791E-04	3.19282E-04	9.07211E-05
17	4.62711E-04	2.90037E-04	8.46302E-05
18	4.17374E-04	2.60260E-04	8.09916E-05
19	3.70352E-04	2.30059E-04	8.31912E-05
20	3.12471E-04	1.98992E-04	9.87041E-05
21	2.61573E-04	1.73996E-04	1.17686E-04
22	2.28562E-04	1.56846E-04	1.34521E-04
23	1.98202E-04	1.41793E-04	1.60200E-04
24	1.53155E-04	1.23714E-04	2.27240E-04
25	1.04817E-04	1.00696E-04	2.96331E-04
26	7.46234E-05	7.89473E-05	3.15900E-04
27	5.36855E-05	6.11215E-05	3.08420E-04
28	3.87629E-05	4.67040E-05	2.83479E-04
29	2.80326E-05	3.53340E-05	2.49541E-04
30	2.02789E-05	2.64726E-05	2.11436E-04
31	1.46507E-05	1.96125E-05	1.72304E-04
32	1.05420E-05	1.43026E-05	1.33916E-04
33	7.51413E-06	1.01453E-05	9.69275E-05
34	5.22917E-06	6.87737E-06	6.21321E-05
35	3.33137E-06	3.86656E-06	2.76629E-05

FLUX BY ANGLE AND POINT FOR GROUP 1

POINT	ANGLE 1	ANGLE 2	ANGLE 3	ANGLE 4	ANGLE 5
1	9.15508E-04	9.16177E-04	9.18439E-04	9.18439E-04	9.16177E-04
2	9.03392E-04	9.05551E-04	9.13931E-04	9.27295E-04	9.31224E-04
3	8.83305E-04	8.87237E-04	9.03026E-04	9.25363E-04	9.41454E-04
4	8.58929E-04	8.64615E-04	8.88041E-04	9.22085E-04	9.44861E-04
5	8.30887E-04	8.38246E-04	8.69139E-04	9.13658E-04	9.44617E-04
6	7.99511E-04	8.08449E-04	8.46563E-04	9.01363E-04	9.40009E-04
7	7.65072E-04	7.75479E-04	8.20456E-04	8.85016E-04	9.31271E-04
8	7.27846E-04	7.39602E-04	7.91007E-04	8.64760E-04	9.18457E-04
9	6.88122E-04	7.01098E-04	7.58435E-04	8.40745E-04	9.01669E-04
10	6.46201E-04	6.60263E-04	7.22985E-04	8.13157E-04	8.81033E-04
11	6.02393E-04	6.17409E-04	6.84932E-04	7.82219E-04	8.56710E-04
12	5.57015E-04	5.72855E-04	6.44578E-04	7.48185E-04	8.28888E-04
13	5.10376E-04	5.26925E-04	6.02255E-04	7.11347E-04	7.97789E-04
14	4.62767E-04	4.79927E-04	5.58328E-04	6.72041E-04	7.63666E-04
15	4.14436E-04	4.32130E-04	5.13210E-04	6.30674E-04	7.26814E-04
16	3.65537E-04	3.83697E-04	4.67384E-04	5.87769E-04	6.87586E-04
17	3.16059E-04	3.34567E-04	4.21397E-04	5.44054E-04	6.46435E-04
18	2.65684E-04	2.84218E-04	3.75647E-04	5.00555E-04	6.04009E-04
19	2.13633E-04	2.31326E-04	3.29165E-04	4.58414E-04	5.61369E-04
20	1.58670E-04	1.73621E-04	2.74003E-04	4.17131E-04	5.20484E-04
21	1.00552E-04	1.10023E-04	1.73296E-04	3.65731E-04	4.85203E-04
22	8.10549E-05	8.94048E-05	1.45679E-04	3.13586E-04	4.57663E-04
23	6.30274E-05	7.03157E-05	1.19330E-04	2.70149E-04	4.27869E-04
24	4.63782E-05	5.26598E-05	9.33664E-05	2.32334E-04	3.97222E-04
25	3.23601E-05	3.66275E-05	6.30279E-05	1.39405E-04	2.95080E-04
26	2.31952E-05	2.62461E-05	4.48883E-05	9.62065E-05	2.12800E-04
27	1.67226E-05	1.89353E-05	3.23929E-05	6.88102E-05	1.52904E-04
28	1.20530E-05	1.36686E-05	2.34594E-05	4.96891E-05	1.10015E-04
29	8.65265E-06	9.83950E-06	1.70009E-05	3.60021E-05	7.93288E-05
30	6.15591E-06	7.03390E-06	1.23047E-05	2.61256E-05	5.73220E-05
31	4.30322E-06	4.95752E-06	8.87071E-06	1.89685E-05	4.14940E-05
32	2.90868E-06	3.39780E-06	6.33965E-06	1.37625E-05	3.00761E-05
33	1.84044E-06	2.20001E-06	4.44788E-06	9.95803E-06	2.18136E-05
34	1.01049E-06	1.25342E-06	2.98534E-06	7.15365E-06	1.58128E-05
35	3.78741E-07	4.96438E-07	1.71043E-06	5.02783E-06	1.14328E-05
36	0.	0.	0.	3.18373E-06	8.20320E-06

FLUX BY ANGLE AND POINT FOR GROUP 2

POINT	ANGLE 1	ANGLE 2	ANGLE 3	ANGLE 4	ANGLE 5
1	5.79903E-04	5.80081E-04	5.80656E-04	5.80656E-04	5.80081E-04
2	5.75873E-04	5.76474E-04	5.78908E-04	5.82620E-04	5.83855E-04
3	5.68127E-04	5.69227E-04	5.73876E-04	5.80274E-04	5.84889E-04
4	5.57732E-04	5.59344E-04	5.66334E-04	5.76087E-04	5.82572E-04
5	5.44889E-04	5.46992E-04	5.56260E-04	5.68966E-04	5.77871E-04
6	5.29735E-04	5.32313E-04	5.43808E-04	5.59456E-04	5.70547E-04
7	5.12394E-04	5.15421E-04	5.29046E-04	5.47473E-04	5.60765E-04
8	4.93002E-04	4.96450E-04	5.12094E-04	5.33159E-04	5.48572E-04
9	4.71709E-04	4.75546E-04	4.93077E-04	5.16614E-04	5.34065E-04
10	4.48677E-04	4.52871E-04	4.72142E-04	4.97967E-04	5.17351E-04
11	4.24084E-04	4.28596E-04	4.49448E-04	4.77364E-04	4.98556E-04
12	3.98113E-04	4.02906E-04	4.25167E-04	4.54963E-04	4.77822E-04
13	3.70957E-04	3.75992E-04	3.99483E-04	4.30936E-04	4.55307E-04
14	3.42810E-04	3.48048E-04	3.72587E-04	4.05468E-04	4.31183E-04
15	3.13864E-04	3.19268E-04	3.44677E-04	3.78752E-04	4.05632E-04
16	2.84293E-04	2.89830E-04	3.15946E-04	3.50989E-04	3.78849E-04
17	2.54250E-04	2.59887E-04	2.86574E-04	3.22381E-04	3.51038E-04
18	2.23859E-04	2.29553E-04	2.56707E-04	2.93122E-04	3.22403E-04
19	1.93311E-04	1.98947E-04	2.26381E-04	2.63335E-04	2.93129E-04
20	1.63222E-04	1.68428E-04	1.95703E-04	2.33028E-04	2.63310E-04
21	1.36651E-04	1.41027E-04	1.62112E-04	2.00461E-04	2.32528E-04
22	1.21973E-04	1.26255E-04	1.46224E-04	1.79083E-04	2.12382E-04
23	1.08237E-04	1.12532E-04	1.32388E-04	1.61246E-04	1.93103E-04
24	9.49651E-05	9.93591E-05	1.21066E-04	1.45984E-04	1.75156E-04
25	7.34664E-05	7.72589E-05	9.69737E-05	1.27473E-04	1.49805E-04
26	5.61645E-05	5.91622E-05	7.49807E-05	9.96515E-05	1.23975E-04
27	4.26108E-05	4.49817E-05	5.76331E-05	7.80420E-05	9.86348E-05
28	3.20416E-05	3.38858E-05	4.37891E-05	5.99886E-05	7.70498E-05
29	2.38816E-05	2.53075E-05	3.29893E-05	4.56778E-05	5.93148E-05
30	1.76014E-05	1.87021E-05	2.46307E-05	3.44582E-05	4.51716E-05
31	1.27551E-05	1.36099E-05	1.81930E-05	2.57694E-05	3.40850E-05
32	8.97222E-06	9.64720E-06	1.32229E-05	1.90732E-05	2.54906E-05
33	5.94403E-06	6.49127E-06	9.35864E-06	1.39140E-05	1.88644E-05
34	3.43438E-06	3.90321E-06	6.21474E-06	9.88074E-06	1.37480E-05
35	1.21790E-06	1.51996E-06	3.91341E-06	6.78204E-06	9.77548E-06
36	0.	0.	0.	3.60701E-06	6.49832E-06

FLUX BY ANGLE AND POINT FOR GROUP 3

POINT	ANGLE 1	ANGLE 2	ANGLE 3	ANGLE 4	ANGLE 5
1	1.62090E-04	1.62107E-04	1.62161E-04	1.62161E-04	1.62107E-04
2	1.61498E-04	1.61562E-04	1.61824E-04	1.62218E-04	1.62369E-04
3	1.60054E-04	1.60171E-04	1.60683E-04	1.61387E-04	1.61897E-04
4	1.57882E-04	1.58055E-04	1.58826E-04	1.59900E-04	1.60623E-04
5	1.55012E-04	1.55238E-04	1.56264E-04	1.57665E-04	1.58663E-04
6	1.51476E-04	1.51754E-04	1.53028E-04	1.54759E-04	1.55999E-04
7	1.47300E-04	1.47627E-04	1.49140E-04	1.51181E-04	1.52668E-04
8	1.42518E-04	1.42892E-04	1.44632E-04	1.46968E-04	1.48690E-04
9	1.37167E-04	1.37584E-04	1.39538E-04	1.42151E-04	1.44097E-04
10	1.31291E-04	1.31748E-04	1.33897E-04	1.36767E-04	1.38924E-04
11	1.24941E-04	1.25432E-04	1.27758E-04	1.30860E-04	1.33212E-04
12	1.18176E-04	1.18696E-04	1.21174E-04	1.24481E-04	1.27009E-04
13	1.11075E-04	1.11615E-04	1.14211E-04	1.17689E-04	1.20372E-04
14	1.03752E-04	1.04298E-04	1.06961E-04	1.10562E-04	1.13371E-04
15	9.63998E-05	9.69238E-05	9.95626E-05	1.03212E-04	1.06109E-04
16	8.93818E-05	8.98265E-05	9.22640E-05	9.58283E-05	9.87477E-05
17	8.34558E-05	8.36966E-05	8.55451E-05	8.87608E-05	9.15858E-05
18	8.02585E-05	8.00167E-05	8.04620E-05	8.27476E-05	8.52319E-05
19	8.34603E-05	8.21359E-05	7.92063E-05	7.93483E-05	8.09862E-05
20	1.00998E-04	9.74353E-05	8.72285E-05	8.21951E-05	8.17807E-05
21	1.49331E-04	1.43304E-04	1.15495E-04	9.89611E-05	9.41708E-05
22	1.73286E-04	1.67055E-04	1.33576E-04	1.05823E-04	9.99952E-05
23	2.02190E-04	1.96522E-04	1.60830E-04	1.20360E-04	1.09501E-04
24	2.34225E-04	2.30143E-04	2.05699E-04	1.44142E-04	1.24169E-04
25	3.00099E-04	2.99011E-04	2.91248E-04	2.77354E-04	2.36667E-04
26	3.17618E-04	3.18140E-04	3.18762E-04	3.12001E-04	3.03423E-04
27	3.08753E-04	3.10324E-04	3.16743E-04	3.22183E-04	3.19531E-04
28	2.82979E-04	2.85080E-04	2.94476E-04	3.04528E-04	3.10249E-04
29	2.48557E-04	2.50904E-04	2.61783E-04	2.74987E-04	2.83964E-04
30	2.10210E-04	2.12614E-04	2.23917E-04	2.38197E-04	2.49248E-04
31	1.70989E-04	1.73345E-04	1.84560E-04	1.99002E-04	2.10677E-04
32	1.32600E-04	1.34868E-04	1.45533E-04	1.59625E-04	1.71315E-04
33	9.56765E-05	9.78081E-05	1.08338E-04	1.21588E-04	1.32830E-04
34	6.09193E-05	6.30330E-05	7.18643E-05	8.50104E-05	9.58560E-05
35	2.67218E-05	2.84400E-05	4.05206E-05	5.12042E-05	6.10577E-05
36	0.	0.	0.	1.61226E-05	2.67624E-05

SUMMARY FOR ZONE 1 BY GROUP INCLUDING SUM FOR ALL GROUPS IN LINE 4

GRP.	FIX SOURCE	FISS SOURCE	IN SCATTER	SLF SCATTER	OUT SCATTER	ABSORPTION	LEAKAGE	BALANCE
1	0.	1.00000E 00	0.	5.85239E 00	6.60523E-01	1.83001E-02	3.21107E-01	1.00004E 00
2	0.	0.	6.60499E-01	9.97157E 00	4.21091E-01	1.64882E-01	7.43119E-02	1.00016E 00
3	0.	0.	4.20759E-01	3.90657E 00	-7.76350E-05	4.58593E-01	-3.80111E-02	1.00030E 00
4	0.	1.00000E 00	1.08126E 00	1.97305E 01	1.08154E 00	6.41775E-01	3.57408E-01	1.00013E 00

GRP.	RT BDY FLUX	RT BDY J+	RT BDY J	RT LEAKAGE	LFT LEAKAGE	FISS RATE	TOTAL FLUX	DENSITY
1	2.78880E-04	1.11955E-04	7.65280E-05	3.21107E-01	0.	3.27005E-02	1.32686E 01	1.32686E 01
2	1.83117E-04	5.64519E-05	1.77104E-05	7.43119E-02	0.	2.23839E-01	8.34721E 00	8.34721E 00
3	1.11064E-04	2.48375E-05	-9.05901E-06	-3.80111E-02	0.	7.82013E-01	2.58902E 00	2.58902E 00
4	5.73061E-04	1.93244E-04	8.51794E-05	3.57408E-01	0.	1.03855E 00	2.42049E 01	2.42049E 01

SUMMARY FOR ZONE 2 BY GROUP INCLUDING SUM FOR ALL GROUPS IN LINE 4

GRP.	FIX SOURCE	FISS SOURCE	IN SCATTER	SLF SCATTER	OUT SCATTER	ABSORPTION	LEAKAGE	BALANCE
1	0.	0.	0.	4.49168E-01	3.75621E-04	6.34531E-04	-9.98486E-04	-0.
2	0.	0.	3.75861E-04	7.50273E-01	8.83535E-04	5.44628E-03	-6.93643E-03	9.77226E-01
3	0.	0.	8.75815E-04	7.66986E-01	5.94094E-03	5.54742E-02	-7.05686E-02	1.01697E 00
4	0.	0.	1.25168E-03	1.96643E 00	7.20009E-03	7.25550E-02	-7.85035E-02	1.00002E 00

GRP.	RT BDY FLUX	RT BDY J+	RT BDY J	RT LEAKAGE	LFT LEAKAGE	FISS RATE	TOTAL FLUX	DENSITY
1	1.83547E-04	8.42010E-05	6.60867E-05	3.20108E-01	3.21107E-01	0.	1.40299E 00	1.40299E 00
2	1.34769E-04	4.19659E-05	1.39097E-05	6.73754E-02	7.43119E-02	0.	9.64448E-01	9.64448E-01
3	1.75666E-04	3.42669E-05	-2.24164E-05	-1.08580E-01	-3.80111E-02	0.	8.48464E-01	8.48464E-01
4	4.93982E-04	1.60434E-04	5.75800E-05	2.78904E-01	3.57408E-01	0.	3.21590E 00	3.21590E 00

SUMMARY FOR ZONE 3 BY GROUP INCLUDING SUM FOR ALL GROUPS IN LINE 4

GRP.	FIX SOURCE	FISS SOURCE	IN SCATTER	SLF SCATTER	OUT SCATTER	ABSORPTION	LEAKAGE	BALANCE
1	0.	0.	0.	1.81485E 00	2.99285E-01	6.34048E-04	-2.99861E-01	-0.
2	0.	0.	2.99263E-01	5.06622E 00	3.46384E-01	2.84490E-03	-4.97709E-02	9.99675E-01
3	0.	0.	3.46037E-01	3.35270E 01	1.05381E-04	1.63304E-01	1.82910E-01	9.99592E-01
4	0.	0.	6.45300E-01	4.04081E 01	6.45774E-01	1.66783E-01	-1.66722E-01	9.99586E-01

GRP.	RT BDY FLUX	RT BDY J+	RT BDY J	RT LEAKAGE	LFT LEAKAGE	FISS RATE	TOTAL FLUX	DENSITY
1	2.42844E-06	1.55950E-06	1.55950E-06	2.02474E-02	3.20108E-01	0.	3.46968E 00	3.46968E 00
2	2.28539E-06	1.35594E-06	1.35594E-06	1.76045E-02	6.73754E-02	0.	3.69554E 00	3.69554E 00
3	9.83460E-06	5.72510E-06	5.72510E-06	7.43303E-02	-1.08580E-01	0.	1.87826E 01	1.87826E 01
4	1.45484E-05	8.64055E-06	8.64055E-06	1.12182E-01	2.78904E-01	0.	2.59478E 01	2.59478E 01

SUMMARY FOR SYSTEM

GRP.	FIX SOURCE	FISS SOURCE	IN SCATTER	SLF SCATTER	OUT SCATTER	ABSORPTION	LEAKAGE	BALANCE
1	0.	1.00000E 00	0.	8.11641E 00	9.60183E-01	1.95687E-02	2.02474E-02	1.00000E 00
2	0.	0.	9.60138E-01	1.57881E 01	7.68359E-01	1.74174E-01	1.76045E-02	1.00000E 00
3	0.	0.	7.67671E-01	3.82005E 01	5.96868E-03	6.87371E-01	7.43303E-02	1.00000E 00
4	0.	1.00000E 00	1.72781E 00	6.21050E 01	1.73451E 00	8.81113E-01	1.12182E-01	1.00000E 00

GRP.	RT BDY FLUX	RT BDY J+	RT BDY J	RT LEAKAGE	LFT LEAKAGE	FISS RATE	TOTAL FLUX	DENSITY
1	2.42844E-06	1.55950E-06	1.55950E-06	2.02474E-02	0.	3.27005E-02	1.81413E 01	1.81413E 01
2	2.28539E-06	1.35594E-06	1.35594E-06	1.76045E-02	0.	2.23839E-01	1.30072E 01	1.30072E 01
3	9.83460E-06	5.72510E-06	5.72510E-06	7.43303E-02	0.	7.82013E-01	2.22201E 01	2.22201E 01
4	1.45484E-05	8.64055E-06	8.64055E-06	1.12182E-01	0.	1.03855E 00	5.33686E 01	5.33686E 01

ANISN SAMPLE PROBLEM 3 GRP. S4 P3 SPHERE

CROSS SECTION WEIGHTING DATA

ICON	0/1/2=NO/MICRO/MACRO MINUS IMPLIES CELL	2
IHTF	POSITION OF SIGMA TOTAL	3
IHSF	POSITION OF SIGMA GG MINUS IMPLIES REMOVE UPSCATTER	4
IHMF	TABLE LENGTH	4
IPUN	PUNCH TRIGGER 0/1=NO/PUNCH	0
IGMF	NO. OF GROUPS	1

FEW GROUP 1 CONTAINS GROUP(S) 1 2 3

ANISN SAMPLE PROBLEM 3 GRP. S4 P3 SPHERE

THE FOLLOWING MATERIALS WILL BE WEIGHTED

	MATERIAL	ZONE	L OF P(L)
1	1	1	0
2	2	1	1
3	3	1	2
4	4	1	3
5	5	2	0
6	6	2	1
7	7	2	2
8	8	2	3
9	9	3	0
10	10	3	1
11	11	3	2
12	12	3	3

FLUX WEIGHTED CROSS SECTIONS FOR MATERIAL 1 IN ZONE 1

POS.	GROUP 1
1	2.65143E-02
2	4.29068E-02
3	8.86345E-01
4	8.59831E-01

FLUX WEIGHTED CROSS SECTIONS FOR MATERIAL 2 IN ZONE 1

POS.	GROUP 1
1	0.
2	0.
3	6.61038E-01
4	9.50390E-01

FLUX WEIGHTED CROSS SECTIONS FOR MATERIAL 3 IN ZONE 1

POS.	GROUP 1
1	0.
2	0.
3	8.32877E-01
4	4.93768E-01

FLUX WEIGHTED CROSS SECTIONS FOR MATERIAL 4 IN ZONE 1

POS.	GROUP 1
1	0.
2	0.
3	6.68296E-01
4	7.23719E-02

FLUX WEIGHTED CROSS SECTIONS FOR MATERIAL 5 IN ZONE 2

POS.	GROUP 1
1	2.25613E-02
2	0.
3	6.36270E-01
4	6.13708E-01

FLUX WEIGHTED CROSS SECTIONS FOR MATERIAL 6 IN ZONE 2

POS.	GROUP 1
1	0.
2	0.
3	2.78330E-01
4	2.08543E-01

FLUX WEIGHTED CROSS SECTIONS FOR MATERIAL 7 IN ZONE 2

POS.	GROUP 1
1	0.
2	0.
3	4.74740E-01
4	2.40347E-01

FLUX WEIGHTED CROSS SECTIONS FOR MATERIAL 8 IN ZONE 2

POS.	GROUP 1
1	0.
2	0.
3	4.84037E-01
4	9.69775E-02

FLUX WEIGHTED CROSS SECTIONS FOR MATERIAL 9 IN ZONE 3

POS.	GROUP 1
1	6.42761E-03
2	0.
3	1.58859E 00
4	1.58217E 00

FLUX WEIGHTED CROSS SECTIONS FOR MATERIAL 10 IN ZONE 3

POS.	GROUP 1
1	0.
2	0.
3	1.03464E 00
4	1.20021E 00

FLUX WEIGHTED CROSS SECTIONS FOR MATERIAL 11 IN ZONE 3

POS.	GROUP 1
1	0.
2	0.
3	6.26124E-01
4	7.99920E-01

FLUX WEIGHTED CROSS SECTIONS FOR MATERIAL 12 IN ZONE 3

POS.	GROUP 1
1	0.
2	0.
3	8.63878E-01
4	2.05071E-01

ANISN SAMPLE PROBLEM 3 GRP. S4 P3 SPHERE

INTEGRATED FLUX

GRP.	ZONE 1	ZONE 2	ZONE 3	ZONE 4
1	2.42048E 01	3.21590E 00	2.59478E 01	5.33686E 01

AVERAGE FLUX

GRP.	ZONE 1	ZONE 2	ZONE 3	ZONE 4
1	9.47075E-04	5.23615E-04	2.41583E-04	3.83652E-04

AVERAGE FLUX RATIO

GRP.	ZONE 1	ZONE 2	ZONE 3	ZONE 4
1	2.46857E 00	1.36482E 00	6.29693E-01	1.00000E 00

INTEGRATED FLUX RATIO

GRP.	ZONE 1	ZONE 2	ZONE 3	ZONE 4
1	4.53541E-01	6.02583E-02	4.86201E-01	1.00000E 00

ZONE	VOL. FRAC.
1	1.83726E-01
2	4.41513E-02
3	7.72123E-01
4	1.00000E 00

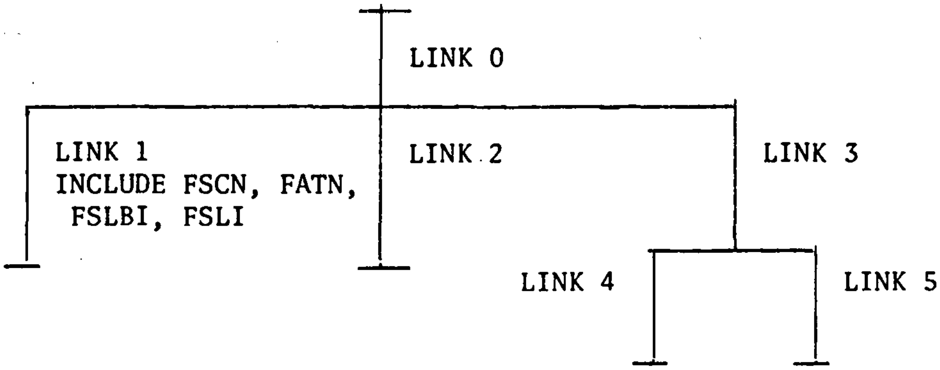
X. ANISN Operation Notes

ANISN, as distributed, is set up to run on the IBM 7090/7094 using the IBJOB system. FORTRAN IV, version 13 is assumed. The overlay feature of the loader is utilized, ANISN being subdivided into six links (link 0 through link 5) as indicated by the $ORIGIN cards in the deck. The NOFLOW option must be specified on the IBJOB card since a link may overlay itself when an error is detected. NOFLOW is legitimate since the ANISN flow logic is such that a return to the overlayed link is never executed.

In its distribution form, ANISN requires a $SIZE card to specify the size of blank COMMON. If the $SIZE card is not an available option, one must add a dimensioned dummy variable to the end of the COMMON statement (after NT7) in subroutine CONTROL. The dimension of the dummy variable should be the largest number which will not cause the core storage to be exceeded. Similarly the number on the $SIZE card should be the largest possible number. If the $SIZE card is used the LIM1 card should contain the same number. If the dummy variable is used the number on the LIM1 card should be N + 232 where N is the dimension of the dummy variable.

In order to retain as many data locations as possible, ALTIO is normally specified on the IBJOB card when using FORTRAN IV, version 13 under IBJOB control. To achieve maximum data storage capabilities, the $INCLUDE card may be used to locate control sections FSCN, FATN, FSLBI, and FSLI in link 1.

A diagram of the ANISN overlay structure and a subroutine list follows. The deck names appear in parentheses after the subroutine name.



LINK 0	MAIN PROGRAM	(MAIN)
	CONTRL	(CNTROL)
	ERRO	(ERROR)
	WOT	(OUTPUT)
LINK 1	PLSNT	(SETUP)
	FIDO	(INPUT)
	TP	(TAPE)
	ADJNT	(ADJNT)
	S805	(ADJCRX)
	S804	(SNPN)
	S814	(FIXED)
	WOT8	(PRINT1)
	S966	(RDCRX)
LINK 2	GUTS	(HEART)
	S807	(MIX)
	S810	(GEOM)
	S821	(FISS)
	S824	(SOURCE)
	DT	(DIFF)
	S833	(ITER)
	S851	(CNVRG)
LINK 3	FINPR1	(FAKE)
	FINPR	(FINOUT)
	PUNSH	(PNSH)
	DTFPUN	(FRMT)
	FLTFX	(FXFL)
LINK 4	BT	(BAL)
	SUMARY	(SUM)
LINK 5	FEWG	(FEW)
	WATE	(WAIT)