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BIGAMON

A Program to Process the GAMMON Activation File

University of California

LOS ALAMOS SCIENTIFIC LABORATORY

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A Program to Process the GAMMON Activation File

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BIGAMON
A PROGRAM TO PROCESS THE GAMMON ACTIVATION FILE

by
P. J. LaBauve and M. E. Battat

ABSTRACT

This report describes the BIGAMON program, designed to process the GAMMON activation file. The program retrieves 100-group, neutron-induced reaction cross sections and 25-group gamma-ray decay spectra from the GAMMON file and rebins these data into broader multigroup sets. The photon broad group boundaries must be a subset of the Gammon group structure.

I. INTRODUCTION

The GAMMON activation library¹ contains multigroup cross section data in 100 groups for 420 important neutron-induced activation reactions and multigroup gamma spectra in 25 groups for 107 unique daughter products. The file also contains maximum permissible concentrations for 200 reaction products and "absorbable" decay energy for 85 products. The latter number is obtained from the file by summing the total gamma energy and "non-gamma" energy, both of which are given in the file. The neutron and photon multigroup structures are shown in Tables I and II, respectively.

The BIGAMON code, listed in Appendix A, is designed to retrieve the multigroup neutron cross sections and multigroup gamma-ray spectra for all reactions of a single element from the GAMMON library and rebin these data into broader energy groups. The photon boundaries of the broad groups must be a subset of the GAMMON group structures; this is not required for the neutron broad groups.

II. APPLICATION OF THE BIGAMON CODE

To illustrate the use of the BIGAMON code, we collapsed the GAMMON data to a 30 (neutron) x 12 (photon) multigroup structure used at the Los Alamos Scientific

Laboratory (LASL); these are shown in Tables III and IV, respectively. The boundaries of these LASL groups are built into BIGAMON, and the default option in the code is to produce output in these groups. Note, however, by comparing Tables I and III, that the energy range of the GAMMON groups is from 0.414 eV to 14.92 MeV (plus a "thermal" value); whereas the range of the LASL groups is from 1.39×10^{-4} eV to 17 MeV. It is thus necessary to extend the range of the GAMMON neutron group structure so that the LASL group structure becomes a subset.

The upper boundary of the GAMMON structure is extended to 20 MeV in the BIGAMON code by means of a simple extrapolation on lethargy. A group is added that extends from 14.92 to 20 MeV, and the cross section for the group is obtained from the groups with boundaries from 13.5 to 14.92 MeV and 12.2 to 13.5 MeV by means of the following expression,

$$\sigma_{14.92 \rightarrow 20} = 2.966 \sigma_{13.5 \rightarrow 14.92} - 1.966 \sigma_{12.2 \rightarrow 13.5} \quad (1)$$

According to Ref. 1, the "thermal" cross-section group is essentially $\sqrt{\pi}/2 \times \sigma_{2200}$. As can be noted from Table III, there are two groups below 0.414 eV in the LASL group structure. The BIGAMON code will add these two groups to the GAMMON structure and calculate cross sections for these groups by simple Maxwellian averaging of the "thermal" cross section provided in GAMMON as follows,

$$\sigma_k = 0.35896 \times \sigma_{th} \times (\sqrt{E_k} - \sqrt{E_{k+1}}) / (E_k - E_{k-1}) \quad (2)$$

where σ_k is the cross section calculated for group k, σ_{th} the "thermal" cross section from GAMMON, and E_k , E_{k+1} are the energy boundaries of the group.

III. BIGAMON INPUT AND OUTPUT

The input to the BIGAMON code, shown in Table V, consists of the name of the desired element, the number of neutron- and photon-group boundaries (number of groups plus one), and the energy boundaries of the groups.

Note that if ILEMT = ZZ, the entire GAMMON file is processed. Also note that if NBEN = 31, the LASL 30-group structure is default, and BEN need not be

entered. Similarly, if NBEG = 13, the LASL 12-group photon structure is default, and BEG need not be entered.

The output of BIGAMON is essentially the same as the original GAMMON file but with the neutron reaction cross sections and gamma-ray spectra in the specified broad group structures. Sample BIGAMON input and output are given in Appendix B.

REFERENCES

1. M. E. Battat, R. J. LaBauve , and D. W. Muir, "The Gammon Activation Library," Los Alamos Scientific Laboratory report LA-8040-MS (1979).

TABLE I
NEUTRON MULTIGROUP STRUCTURE

GROUP	ENERGY RANGE				ENERGY WIDTH	
1	1.350E+01	MEV	T0	1.492E+01	MEV	1.420E+00
2	1.221E+01	MEV	T0	1.350E+01	MEV	1.285E+00
3	1.105E+01	MEV	T0	1.221E+01	MEV	1.162E+00
4	1.000E+01	MEV	T0	1.105E+01	MEV	1.052E+00
5	9.048E+00	MEV	T0	1.000E+01	MEV	9.516E-01
6	8.187E+00	MEV	T0	9.048E+00	MEV	8.611E-01
7	7.408E+00	MEV	T0	8.187E+00	MEV	7.791E-01
8	6.703E+00	MEV	T0	7.408E+00	MEV	7.050E-01
9	6.065E+00	MEV	T0	6.703E+00	MEV	6.379E-01
10	5.488E+00	MEV	T0	6.065E+00	MEV	5.772E-01
11	4.966E+00	MEV	T0	5.488E+00	MEV	5.223E-01
12	4.493E+00	MEV	T0	4.966E+00	MEV	4.726E-01
13	4.066E+00	MEV	T0	4.493E+00	MEV	4.276E-01
14	3.679E+00	MEV	T0	4.066E+00	MEV	3.869E-01
15	3.329E+00	MEV	T0	3.679E+00	MEV	3.501E-01
16	3.012E+00	MEV	T0	3.329E+00	MEV	3.168E-01
17	2.725E+00	MEV	T0	3.012E+00	MEV	2.866E-01
18	2.466E+00	MEV	T0	2.725E+00	MEV	2.593E-01
19	2.231E+00	MEV	T0	2.466E+00	MEV	2.347E-01
20	2.019E+00	MEV	T0	2.231E+00	MEV	2.123E-01
21	1.827E+00	MEV	T0	2.019E+00	MEV	1.921E-01
22	1.653E+00	MEV	T0	1.827E+00	MEV	1.738E-01
23	1.496E+00	MEV	T0	1.653E+00	MEV	1.573E-01
24	1.353E+00	MEV	T0	1.496E+00	MEV	1.423E-01
25	1.225E+00	MEV	T0	1.353E+00	MEV	1.288E-01
26	1.108E+00	MEV	T0	1.225E+00	MEV	1.165E-01
27	1.003E+00	MEV	T0	1.108E+00	MEV	1.054E-01
28	9.072E-01	MEV	T0	1.003E+00	MEV	9.541E-02
29	8.208E-01	MEV	T0	9.072E-01	MEV	8.633E-02
30	7.427E-01	MEV	T0	8.208E-01	MEV	7.811E-02
31	6.721E-01	MEV	T0	7.427E-01	MEV	7.068E-02
32	6.081E-01	MEV	T0	6.721E-01	MEV	6.395E-02
33	5.502E-01	MEV	T0	6.081E-01	MEV	5.787E-02
34	4.979E-01	MEV	T0	5.502E-01	MEV	5.236E-02
35	4.505E-01	MEV	T0	4.979E-01	MEV	4.738E-02
36	4.076E-01	MEV	T0	4.505E-01	MEV	4.287E-02
37	3.688E-01	MEV	T0	4.076E-01	MEV	3.879E-02
38	3.337E-01	MEV	T0	3.688E-01	MEV	3.510E-02
39	3.020E-01	MEV	T0	3.337E-01	MEV	3.176E-02
40	2.732E-01	MEV	T0	3.020E-01	MEV	2.874E-02
41	2.472E-01	MEV	T0	2.732E-01	MEV	2.600E-02
42	2.237E-01	MEV	T0	2.472E-01	MEV	2.353E-02
43	2.024E-01	MEV	T0	2.237E-01	MEV	2.129E-02
44	1.832E-01	MEV	T0	2.024E-01	MEV	1.926E-02
45	1.657E-01	MEV	T0	1.832E-01	MEV	1.743E-02
46	1.500E-01	MEV	T0	1.657E-01	MEV	1.577E-02
47	1.357E-01	MEV	T0	1.500E-01	MEV	1.427E-02
48	1.228E-01	MEV	T0	1.357E-01	MEV	1.291E-02
49	1.111E-01	MEV	T0	1.228E-01	MEV	1.163E-02

TABLE I (contd.)

GROUP	ENERGY RANGE				ENERGY WIDTH	
50	8.652E+01	KEV	T0	1.111E-01	MEV	2.457E+01 KEV
51	6.738E+01	KEV	T0	8.652E+01	KEV	1.914E+01 KEV
52	5.248E+01	KEV	T0	6.738E+01	KEV	1.490E+01 KEV
53	4.087E+01	KEV	T0	5.248E+01	KEV	1.161E+01 KEV
54	3.183E+01	KEV	T0	4.087E+01	KEV	9.040E+00 KEV
55	2.479E+01	KEV	T0	3.183E+01	KEV	7.040E+00 KEV
56	1.930E+01	KEV	T0	2.479E+01	KEV	5.483E+00 KEV
57	1.503E+01	KEV	T0	1.930E+01	KEV	4.270E+00 KEV
58	1.171E+01	KEV	T0	1.503E+01	KEV	3.326E+00 KEV
59	9.119E+00	KEV	T0	1.171E+01	KEV	2.590E+00 KEV
60	7.102E+00	KEV	T0	9.119E+00	KEV	2.017E+00 KEV
61	5.531E+00	KEV	T0	7.102E+00	KEV	1.571E+00 KEV
62	4.307E+00	KEV	T0	5.531E+00	KEV	1.223E+00 KEV
63	3.355E+00	KEV	T0	4.307E+00	KEV	9.528E-01 KEV
64	2.613E+00	KEV	T0	3.355E+00	KEV	7.420E-01 KEV
65	2.035E+00	KEV	T0	2.613E+00	KEV	5.779E-01 KEV
66	1.585E+00	KEV	T0	2.035E+00	KEV	4.501E-01 KEV
67	1.234E+00	KEV	T0	1.585E+00	KEV	3.505E-01 KEV
68	9.611E-01	KEV	T0	1.234E+00	KEV	2.730E-01 KEV
69	7.485E-01	KEV	T0	9.611E-01	KEV	2.126E-01 KEV
70	5.829E-01	KEV	T0	7.485E-01	KEV	1.656E-01 KEV
71	4.540E-01	KEV	T0	5.829E-01	KEV	1.289E-01 KEV
72	3.536E-01	KEV	T0	4.540E-01	KEV	1.004E-01 KEV
73	2.754E-01	KEV	T0	3.536E-01	KEV	7.821E-02 KEV
74	2.145E-01	KEV	T0	2.754E-01	KEV	6.091E-02 KEV
75	1.670E-01	KEV	T0	2.145E-01	KEV	4.744E-02 KEV
76	1.301E-01	KEV	T0	1.670E-01	KEV	3.694E-02 KEV
77	1.013E-01	KEV	T0	1.301E-01	KEV	2.877E-02 KEV
78	7.889E+01	EV	T0	1.013E-01	KEV	2.241E+01 EV
79	6.144E+01	EV	T0	7.889E+01	EV	1.745E+01 EV
80	4.785E+01	EV	T0	6.144E+01	EV	1.359E+01 EV
81	3.727E+01	EV	T0	4.785E+01	EV	1.058E+01 EV
82	2.902E+01	EV	T0	3.727E+01	EV	8.243E+00 EV
83	2.260E+01	EV	T0	2.902E+01	EV	6.420E+00 EV
84	1.760E+01	EV	T0	2.260E+01	EV	5.000E+00 EV
85	1.371E+01	EV	T0	1.760E+01	EV	3.894E+00 EV
86	1.068E+01	EV	T0	1.371E+01	EV	3.033E+00 EV
87	8.315E+00	EV	T0	1.068E+01	EV	2.362E+00 EV
88	6.476E+00	EV	T0	8.315E+00	EV	1.839E+00 EV
89	5.043E+00	EV	T0	6.476E+00	EV	1.432E+00 EV
90	3.928E+00	EV	T0	5.043E+00	EV	1.116E+00 EV
91	3.059E+00	EV	T0	3.928E+00	EV	8.688E-01 EV
92	2.382E+00	EV	T0	3.059E+00	EV	6.767E-01 EV
93	1.855E+00	EV	T0	2.382E+00	EV	5.270E-01 EV
94	1.445E+00	EV	T0	1.855E+00	EV	4.104E-01 EV
95	1.125E+00	EV	T0	1.445E+00	EV	3.196E-01 EV
96	8.764E-01	EV	T0	1.125E+00	EV	2.489E-01 EV
97	6.826E-01	EV	T0	8.764E-01	EV	1.939E-01 EV
98	5.316E-01	EV	T0	6.826E-01	EV	1.510E-01 EV
99	4.140E-01	EV	T0	5.316E-01	EV	1.176E-01 EV
100	THERMAL					

TABLE II
DECAY ENERGY GROUP STRUCTURE

GROUP	ENERGY RANGE				ENERGY WIDTH		
1	9.0000	MEV	T0	10.0000	MEV	1.0000	MEV
2	8.0000	MEV	T0	9.0000	MEV	1.0000	MEV
3	7.0000	MEV	T0	8.0000	MEV	1.0000	MEV
4	6.0000	MEV	T0	7.0000	MEV	1.0000	MEV
5	5.0000	MEV	T0	6.0000	MEV	1.0000	MEV
6	4.0000	MEV	T0	5.0000	MEV	1.0000	MEV
7	3.5000	MEV	T0	4.0000	MEV	.5000	MEV
8	3.0000	MEV	T0	3.5000	MEV	.5000	MEV
9	2.6660	MEV	T0	3.0000	MEV	.3340	MEV
10	2.3330	MEV	T0	2.6660	MEV	.3330	MEV
11	2.0000	MEV	T0	2.3330	MEV	.3330	MEV
12	1.8750	MEV	T0	2.0000	MEV	.1250	MEV
13	1.6600	MEV	T0	1.8750	MEV	.2150	MEV
14	1.5000	MEV	T0	1.6600	MEV	.1600	MEV
15	1.3300	MEV	T0	1.5000	MEV	.1700	MEV
16	1.1250	MEV	T0	1.3300	MEV	.2050	MEV
17	1.0000	MEV	T0	1.1250	MEV	.1250	MEV
18	.9000	MEV	T0	1.0000	MEV	.1000	MEV
19	.7000	MEV	T0	.9000	MEV	.2000	MEV
20	.5000	MEV	T0	.7000	MEV	.2000	MEV
21	.4000	MEV	T0	.5000	MEV	.1000	MEV
22	.3000	MEV	T0	.4000	MEV	.1000	MEV
23	.1000	MEV	T0	.3000	MEV	.2000	MEV
24	.0100	MEV	T0	.1000	MEV	.0900	MEV
25	0.0000	MEV	T0	.0100	MEV	.0100	MEV

TABLE 111

LASL NEUTRON 30-GROUP STRUCTURE

GROUP	ENERGY RANGE		ENERGY WIDTH	
1	1.500E+01	MEV TO	2.000E+00	MEV
2	1.350E+01	MEV TO	1.500E+00	MEV
3	1.200E+01	MEV TO	1.500E+00	MEV
4	1.000E+01	MEV TO	2.000E+00	MEV
5	7.790E+00	MEV TO	2.210E+00	MEV
6	6.070E+00	MEV TO	1.720E+00	MEV
7	3.680E+00	MEV TO	2.390E+00	MEV
8	2.865E+00	MEV TO	8.150E-01	MEV
9	2.232E+00	MEV TO	6.330E-01	MEV
10	1.738E+00	MEV TO	4.940E-01	MEV
11	1.353E+00	MEV TO	3.850E-01	MEV
12	8.230E-01	MEV TO	5.300E-01	MEV
13	5.000E-01	MEV TO	3.230E-01	MEV
14	3.030E-01	MEV TO	1.970E-01	MEV
15	1.840E-01	MEV TO	1.190E-01	MEV
16	6.760E+01	KEV TO	1.164E+02	KEV
17	2.480E+01	KEV TO	4.280E+01	KEV
18	9.120E+00	KEV TO	1.568E+01	KEV
19	3.350E+00	KEV TO	5.770E+00	KEV
20	1.235E+00	KEV TO	2.115E+00	KEV
21	4.540E-01	KEV TO	7.810E-01	KEV
22	1.670E-01	KEV TO	2.870E-01	KEV
23	6.140E+01	EV TO	1.056E+02	EV
24	2.260E+01	EV TO	3.880E+01	EV
25	8.320E+00	EV TO	1.428E+01	EV
26	3.060E+00	EV TO	5.260E+00	EV
27	1.130E+00	EV TO	1.930E+00	EV
28	4.140E-01	EV TO	7.160E-01	EV
29	1.520E-01	EV TO	2.620E-01	EV
30	1.390E-04	EV TO	1.519E-01	EV

TABLE IV
LASL PHOTON 12-GROUP STRUCTURE

GROUP	ENERGY RANGE				ENERGY WIDTH		
1	9.0000	MEV	TO	10.0000	MEV	1.0000	MEV
2	8.0000	MEV	TO	9.0000	MEV	1.0000	MEV
3	7.0000	MEV	TO	8.0000	MEV	1.0000	MEV
4	6.0000	MEV	TO	7.0000	MEV	1.0000	MEV
5	5.0000	MEV	TO	6.0000	MEV	1.0000	MEV
6	4.0000	MEV	TO	5.0000	MEV	1.0000	MEV
7	3.0000	MEV	TO	4.0000	MEV	1.0000	MEV
8	2.0000	MEV	TO	3.0000	MEV	1.0000	MEV
9	1.0000	MEV	TO	2.0000	MEV	1.0000	MEV
10	.5000	MEV	TO	1.0000	MEV	.5000	MEV
11	.1000	MEV	TO	.5000	MEV	.4000	MEV
12	.0100	MEV	TO	.1000	MEV	.0900	MEV

TABLE V
BIGAMON INPUT

<u>Card No.</u>	<u>Variable</u>	<u>Format</u>	<u>Content</u>
1	ILEMT	A6	Symbol of desired element as given in GAMMON
2	NBEN	I6	Number of neutron groups + 1
	NBEG	I6	Number of photon groups + 1
3	BEN	6E12.5	Energy boundaries of neutron groups
4	BEG	6E12.5	Energy boundaries of photon groups

LISTING OF BIGAMON CODE

```

PROGRAM BIGAMON (GAMIN,GAMON,GAMOUT,TAPE5=GAMIN,TAPE6=GAMOUT,
1TAPE10=GAMON,GAMLIB,TAPE11=GAMLIB)
C
C PROGRAM TO COLLAPSE NEUTRON AND GAMMA-RAY DATA IN GAMMON. NEUTRON
C DATA IS THE MONTAGE DLC-33 LIBRARY WITH 100 GPS AND THE GAMMA-RAY
C DATA ARE FOR 25 GROUPS AND WERE BINNED USING THE JULICH GAMMA-RAY
C LIBRARY.
C
C DIMENSION FNS(110),FGS(25),BNS(110),BGS(25),FEN(111),FEG(26),
1 BEN(111),BEG(26),NBDRY(26)
C COMMON /REGRP/ NX,NX1,Y(110),NU,NU1,NFLAG,NOUT
C
C BEN=LASL-TD 30 NEUTRON GROUP BOUNDARIES
C FEG=GAMMA GROUP BOUNDARIES FOR 25-GP STRUCTURE IN MONTAGE
C BEG=GAMMA GROUP BOUNDARIES FOR LASL-TD 12-GP STRUCTURE
C
C DATA BEN /1.7E7,1.5E7,1.35E7,1.2E7,1.0E7,7.79E6,6.07E6,3.68E6,2.86E6,1.5E6,2.23E6,1.73E6,1.35E6,8.23E5,5.0E5,3.03E5,1.84E5,6.76E4,2.4B
1 8E4,9.12E3,3.35E3,1.23E3,4.54E2,1.67E2,6.14E1,2.26E1,8.32,3.06,1B
2 13,4.14E-1,1.52E-1,1.39E-4,80*0.0/
C DATA FEG /10.,9.,8.,7.,6.,5.,4.,3.5,3.,2.666,2.333,2.,1.875,1.66,1B
1 5,1.33,1.125,1.0,0.9,0.7,0.5,0.4,0.3,0.1,0.01,0./
C DATA BEG /10.,9.,8.,7.,6.,5.,4.,3.,2.,1.,0.5,0.1,0.01,13*0.0/
C
C NIN=INPUT NOUT=OUTPUT NDT=GAMMON, T02 HP FILE
C NDT1=DISK ON WHICH DATA FOR SELECTED ELEMENTS ARE WRITTEN
C
C NIN=5
C NOUT=6
C NDT=10
C NDT1=11
C
C READ INPUT
C
C READ (NIN,180) ILEMT
C READ (NIN,190) NBEN,NBEG
C IF (NBEN.EQ.31) GO TO 10
C READ (NIN,200) (BEN(I),I=1,NBEN)
10 CONTINUE
C IF (NBEG.EQ.13) GO TO 20
C READ (NIN,200) (BEG(I),I=1,NBEG)
20 CONTINUE
C
C ILEMT=TWO CHARACTER SYMBOL FOR DESIRED ELEMENT (LEFT ADJUSTED)
C =ZZ THEN DO ENTIRE LIBRARY
C NBEN, NBEG = NO OF BROAD GP NEUTRON AND GAMMA BOUNDS RESP. (NO OF
C GPS + 1)
C BEN, BEG = NEUTRON AND GAMMA GROUP BOUNDARIES
C IF NBEN=31, LASL-TD 30-GP NEUT STRUCTURE DEFAULT
C IF NBEG=13, LASL-TD 12-GP GAMMA STRUCTURE DEFAULT
C
C COMPUTE FEN
C UPPER NEUTRON ENERGY BOUNDARY EXTENDED TO 20 MEV
C
C FEN(1)=2.0E+07
C ALETH=-0.4
C DO 30 I=2,101
C FEN(I)=EXP(-ALETH)*1.0E+07
C DELU=0.1
C IF (I.GT.50) DELU=0.25
C ALETH=ALETH+DELU
30 CONTINUE
C
C TEST PRINT
C
C NX=100
C NX1=NX+1
C NU=NBEN-1
C NU1=NU+1
C
C IF BROAD GP ENERGY BOUNDS GO BELOW 0.414 EV, ADD THESE LOWER

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C
C ENERGIES TO TO THE MONTAGE GROUP STRUCTURE IF THE ONLY ENERGY
C BELOW 0.414 EV IS 0.0253, IT WILL BE ASSUMED THAT THE MAXWELL
C AVERAGED ROOM TEMPERATURE THERMAL CROSS SECTION IS DESIRED.
C
      NCOUNT=0
      DO 50 J=1,NU1
      TEST=FEN(101)
      IF (BEN(J) GT TEST) GO TO 50
      NCOUNT=NCOUNT+1
      NX=NX+1
      NX1=NX+1
      IF (NCOUNT EQ 1 AND BEN(J) EQ 0.0253) GO TO 40
      FEN(NX1)=BEN(J)
      GO TO 50
40  FEN(NX1)=0.0253
      GO TO 60
50  CONTINUE
60  CONTINUE
C
      TEST PRINT
C
      WRITE (NOUT,200) (FEN(I),I=1,NX1)
      CONTINUE
      READ (NDT,180) IEL
      IF (IEL EQ 2HXX) GO TO 170
      IF (ILEMT EQ 2HZZ) GO TO 80
      IF (IEL NE ILEMT) GO TO 70
80  BACKSPACE NDT
      READ (NDT,180) IEL,ISO,REAC,PROD,HLF,UNIT,LIB,DISEN,ILABL
      READ (NDT,210) ISORP,PMC,PEREN,ISORK
      WRITE (NOUT,220) IEL,ISO,REAC,PROD,HLF,UNIT,LIB,DISEN,ILABL
      WRITE (NDT1,180) IEL,ISO,REAC,PROD,HLF,UNIT,LIB,DISEN,ILABL
      WRITE (NDT1,210) ISORP,PMC,PEREN,ISORK
      READ (NDT,200) (FNS(I),I=2,100),SIGTH
      WRITE (NOUT,200) (FNS(I),I=2,100),SIGTH
      FNS(1)=2.966*FNS(2)-1.966*FNS(3)
      IF (FNS(1) LT 0.0) FNS(1)=0.0
      IF (FNS(3) LT 0.1) FNS(1)=FNS(2)
      IF (NX1 EQ 101) GO TO 110
      IF (NX1 EQ 102 AND FEN(102) EQ 0.0253) GO TO 100
      DO 90 K=101,NX
      XFAX=0.35895*(SORT(FEN(K))-SORT(FEN(K+1)))/(FEN(K)-FEN(K+1))
      FNS(K)=XFAX*SIGTH
90  CONTINUE
      GO TO 110
100  NFLAG=1
110  CONTINUE
      CALL REBIN (FEN,BEN,BNS,FNS)
      IF (NFLAG EQ 1) BNS(NU)=FNS(NX1)
      WRITE (NDT1,200) (BNS(I),I=1,NU)
      IF (DISEN EQ 0.0) GO TO 70
      ISTR=1
      DO 140 K=1,NBEG
      TEST=BEG(K)
      DO 120 L=ISTR,26
      IF (TEST NE FEG(L)) GO TO 120
      GO TO 130
120  CONTINUE
      WRITE (NOUT,230) TEST
      CALL EXIT
130  ISTR=I+1
      NBDRY(K)=L
140  CONTINUE
      NCPS=NBEG-1
      READ (NDT,250) (FGS(I),I=1,25)
      WRITE (NOUT,240) (FGS(I),I=1,25)
      DO 160 I=1,NCPS
      I1=NBDRY(I)
      I2=NBDRY(I+1)-1
      I3=I2-1
      BGS(I)=0.0
      DO 150 J=I1,I2
      BGS(I)=BGS(I)+FGS(J)
150  CONTINUE
160  WRITE (NOUT,190) (NBDRY(K),K=1,NBEG)

```

BIGA 720
 BIGA 730
 BIGA 740
 BIGA 750
 BIGA 760
 BIGA 770
 BIGA 780
 BIGA 790
 BIGA 800
 BIGA 810
 BIGA 820
 BIGA 830
 BIGA 840
 BIGA 850
 BIGA 860
 BIGA 870
 BIGA 880
 BIGA 890
 BIGA 900
 BIGA 910
 BIGA 920
 BIGA 930
 BIGA 940
 BIGA 950
 BIGA 960
 BIGA 970
 BIGA 980
 BIGA 990
 BIGA 1000
 BIGA 1010
 BIGA 1020
 BIGA 1030
 BIGA 1040
 BIGA 1050
 BIGA 1060
 BIGA 1070
 BIGA 1080
 BIGA 1090
 BIGA 1100
 BIGA 1110
 BIGA 1120
 BIGA 1130
 BIGA 1140
 BIGA 1150
 BIGA 1160
 BIGA 1170
 BIGA 1180
 BIGA 1190
 BIGA 1200
 BIGA 1210
 BIGA 1220
 BIGA 1230
 BIGA 1240
 BIGA 1250
 BIGA 1260
 BIGA 1270
 BIGA 1280
 BIGA 1290
 BIGA 1300
 BIGA 1310
 BIGA 1320
 BIGA 1330
 BIGA 1340
 BIGA 1350
 BIGA 1360
 BIGA 1370
 BIGA 1380
 BIGA 1390
 BIGA 1400
 BIGA 1410
 BIGA 1420
 BIGA 1430
 BIGA 1440
 BIGA 1450
 BIGA 1450

```

      WRITE (NDT1,250) (BGS(I),I=1,NGPS)
      GO TO 70
170 WRITE (NOUT,260) ILEMT,IEL
      CALL EXIT

```

```

C
180 FORMAT (A2,A4,2X,A10,A8,A10,A2,4X,A10,1X,F8.5,11X,A8)
190 FORMAT (12I6)
200 FORMAT (6E12.5)
210 FORMAT (18X,A7,1X,E9.2,1X,A2,4X,F8.5,2X,A5)
220 FORMAT (1H,A2,A4,2X,A10,A8,A10,A2,4X,A10,1X,F8.5,11X,A8)
230 FORMAT (1H,*GMA ENGY NOT SUBSET OF 25-GP BDRY*,1PE12.5)
240 FORMAT (1H,7F10.5)
250 FORMAT (7F10.5)
260 FORMAT (1H0,*//RUN COMPLETE FOR ELEMENT//*,A2,5X,A2)
      ENO

```

BIGA1470
 BIGA1480
 BIGA1490
 BIGA1500
 BIGA1510
 BIGA1520
 BIGA1530
 BIGA1540
 BIGA1550
 BIGA1560
 BIGA1570
 BIGA1580
 BIGA1590
 BIGA1600
 BIGA1610

```

SUBROUTINE REBIN (X,U,BNS,FNS)
  DIMENSION X(1), U(1), BNS(1), FNS(1)
  COMMON /REGRP/ NX, NX1, Y(110), NU, NU1, NFLAG, NOUT
  IF (X(1).LT.U(1)) GO TO 40
  KOUNT=NX1
  IF (NFLAG.EQ.1) KOUNT=101
  DO 30 I=2,NU1
    I1=I-1
    XNUM=0
    EHI=U(I1)
    ELO=U(I)
    DEN=0
    DO 20 J=2,KOUNT
      IF (EHI.LE.X(J)) GO TO 20
      IF (ELO.LE.X(J)) GO TO 10
      JJ=J-1
      DELE=EHI-ELO
      AREA=DELE*FNS(JJ)
      XNUM=XNUM+AREA
      DEN=DEN+DELE
      BNS(I1)=XNUM/DEN
      GO TO 30
10    ELO=X(J)
      JJ=J-1
      DELE=EHI-ELO
      AREA=DELE*FNS(JJ)
      XNUM=XNUM+AREA
      DEN=DEN+DELE
      BNS(I1)=XNUM/DEN
      GO TO 30
30    CONTINUE
  GO TO 50
40 WRITE (NOUT,60) X(1)
  CALL EXIT
  RETURN

```

REBI 10
 REBI 20
 REBI 30
 REBI 40
 REBI 50
 REBI 60
 REBI 70
 REBI 80
 REBI 90
 REBI 100
 REBI 110
 REBI 120
 REBI 130
 REBI 140
 REBI 150
 REBI 160
 REBI 170
 REBI 180
 REBI 190
 REBI 200
 REBI 210
 REBI 220
 REBI 230
 REBI 240
 REBI 250
 REBI 260
 REBI 270
 REBI 280
 REBI 290
 REBI 300
 REBI 310
 REBI 320
 REBI 330
 REBI 340
 REBI 350
 REBI 360
 REBI 370
 REBI 380
 REBI 390
 REBI 400
 REBI 410

```

C
60 FORMAT (1H,*//TOP GROUP ENERGY GREATER THAN////////*,1PE12.
1 5,* EV *)
      ENO
      END

```

APPENDIX B
SAMPLE INPUT AND OUTPUT

SAMPLE BIGAMON INPUT (TAPE5).

FE 31 13

SAMPLE BIGAMON OUTPUT (TAPE11).

FE 54 (N,2N)	FE 53	*	THRESH	0.00000	26541	0
	FE 53	.30E-05	0.00000			
.12500E-01	.12500E-01	.11766E-04	0.	0.		
0.	0.	0.	0.	0.		
0.	0.	0.	0.	0.		
0.	0.	0.	0.	0.		
0.	0.	0.	0.	0.		
FE 54 (N,P)	MN 54	312.5	D	ENDF/B-IV	.83463	26543
	MN 54	.10E-08	.00560	AERE		
.22218E+00	.35093E+00	.43889E+00	.52870E+00	.58200E+00	.56664E+00	
.38437E+00	.17781E+00	.75476E-01	.14297E-01	.12518E-02	.64341E-05	
0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	
0.00000	0.00000	99.97800	0.00000	0.00000	0.00000	
FE 54 (N,A)	CR 51	27.71	D	BNL-325	.03137	26544
	CR 51	.80E-07	.00500	AERE		
.92043E-01	.92043E-01	.80317E-01	.61857E-01	.39932E-01	.21235E-01	
.85474E-02	.38863E-02	.28434E-02	.19256E-02	.11125E-02	.24236E-03	
.43314E-07	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	
0.00000	0.00000	0.00000	9.80000	0.00000	0.00000	
FE 54 (N,NP+D)	MN 53	3.8	E+6 Y	THRESH	0.00000	26545
	MN 53	.10E-09	0.00000	TISO		
.11030E+00	.11030E+00	.75577E-01	.34398E-01	.26218E-02	.62156E-07	
0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	
FE 54 (N,T)	MN 52	*	THRESH	0.00000	26547	0
	MN 52	.50E-08	0.00000			
.18200E-05	.18200E-05	.17131E-08	0.	0.		
0.	0.	0.	0.	0.		
0.	0.	0.	0.	0.		
0.	0.	0.	0.	0.		
0.	0.	0.	0.	0.		
FE 55 (N,NP+D)	MN 54	312.5	D	THRESH	.83463	26555
	MN 54	.10E-08	.00560	AERE		
.47200E-01	.47200E-01	.27690E-01	.12218E-01	.18904E-02	0.	
0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	
0.00000	0.00000	99.97800	0.00000	0.00000	0.00000	
FE 55 (N,NA)	CR 51	27.71	D	THRESH	.03137	26556
	CR 51	.80E-07	.00500	AERE		
.44300E-02	.44300E-02	.12272E-02	.17273E-03	.44545E-04	0.	
0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	
0.00000	0.00000	0.00000	9.80000	0.00000	0.00000	
FE 56 (N,2N)	FE 55	2.7	Y	THRESH	0.00000	26561
	FE 55	.30E-07	.00590	AERE		
.81646E+00	.51347E+00	.28805E+00	.80167E-02	0.	0.	
0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	

		MN	56	.20E-07		.80000	AERE	
.51000E-05	.51000E-05		.48005E-08	0.		0.		0.
0.	0.	0.	0.	0.	0.	0.		0.
0.	0.	0.	0.	0.	0.	0.		0.
0.	0.	0.	0.	0.	0.	0.		0.
0.	0.	0.	0.	0.	0.	0.		0.
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	.28000
17.96000	30.00000	99.00000	0.00000	0.00000	0.00000			