UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

STSB:CJW

AUG 06 1993

MEMORANDUM FOR: George H. Bidinger
Regulatory and International
Safeguards Branch
Division of Fuel Cycle Safety
and Safeguards, NMSS

FROM: Carl J. Withee
Storage and Transport Systems Branch
Division of Industrial and Medical
Nuclear Safety, NMSS

SUBJECT: ADDITIONAL CRITICALITY CALCULATIONS FOR THE LES APPLICATION

Enclosed is a second report on calculations made to support the review of the Louisiana Enrichment Services application. This report gives a brief description of the calculations performed for the cases you specified along with the calculational results. The results are in tabular form. The benchmarking was described in my previous report and is not repeated here.

Also enclosed are parts of the computer generated output. The output sheets contain a copy of the input data file and the page reporting the calculated result. Convergence plots are included with the output of the KENO runs.

If you have any questions or comments please contact me.

Carl J. Withee

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Storage and Transport Systems Branch
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Nuclear Safety, NMSS

Enclosures: As stated

cc: R. Chappell
C. Haughney

CRITICALITY CALCULATIONS FOR LOUISIANA ENRICHMENT SERVICES APPLICATION SECOND REPORT

Criticality analyses were performed to support the review of the fixed site application made by Louisiana Enrichment Services (LES). The analyses consist of calculating values of k_{eff} for various cases defined by George Bidinger. This report documents work performed previously but not reported and presents the results of new calculations on the final LES application. All calculations involve UO_2F_2 solutions. The calculations used the SCALE computational system and the 27-group neutron cross section set developed by ORNL. The PC version of CSAS25 or XSDRNPM was used as specified. The uranium isotopic composition was modeled as a mix of ^{235}U and ^{238}U with an enrichment of 5.02% by weight. Full reflection by water was assumed. Benchmarking information is given in a previous report dated May 4, 1993.

Tank Wall

The May 4, 1993, report presented the results of an initial set of calculations for the licensing review of the LES application. That report showed that some of the critical dimensions initially proposed as well as calculations of critical experimental configurations gave k_{eff} values above unity. Since those calculations used a model that ignored the presence of a tank wall for the UO_2F_2 solutions, a parametric set of calculations was made to show the effect of including a tank wall in the model. Calculations were performed for the cylindrical and slab shapes because they showed the greatest deviation from unity. The calculations were performed with the XSDRNPM code and a solution density of 1600 g U/L. The results of these parametric calculations are presented in Table 1. These calculations show that the inclusion of a steel tank wall will reduce the value of k_{eff} to almost unity.

Critical and Safe Dimensions

As a result of the findings reported previously, the proposed critical and safe operating dimensions in the LES application were revised. Calculations were performed to determine the k_{eff} values of these revised dimensions. These calculations used the previously determined optimum solution concentrations of 1600 g U/L for the spherical and cylindrical shapes and 1700 g U/L for the slab shape. The calculated k_{eff} values for critical and safe dimensions of a sphere, infinitely long cylinder, and infinite slab are given in Tables 2 and 3. Values from both the CSAS25 and XSDRNPM computer codes are presented.

The LES application also proposed mass limits for the critical value and safe values with double batching possible and double batching not possible. These calculations were performed with a concentration of 883.72 g U/L. This concentration was previously determined to be optimum for a sphere of UO_2F_2 solution under a constraint of constant uranium mass. The spherical volumes were adjusted to maintain the specified concentration and uranium mass. The results of these calculations are reported in Table 4. Values from both CSAS25 and XSDRNPM are reported.

TABLE 1
Effects of the Tank Wall on K_{eff} Values

Wall / Thickness	Cylinder (Radius=14.25 cm)	Slab (Thickness = 14.2 cm)
No Wall	1.02076	1.02548
Aluminum - 1/16"	1.02047	1.02611
Carbon Steel - 1/16"	1.00626	1.00230
Stainless Steel - 1/16"	1.00304	0.99729
Stainless Steel - 1/8"	0.99183	0.97877

TABLE 2
Values of K_{eff} for Critical Configurations

CONFIGURATION	DIMENSION	XSDRNPM RESULTS	CSAS25 RESULTS
SPHERE	25 L	0.95414	0.94504±0.00406
CYLINDER	D = 25.6 cm	0.95291	0.95629±0.00425
SLAB	T = 12.4 cm	0.97866	0.97814±0.00407

TABLE 3
Values of K_{eff} for Safe Configurations

CONFIGURATION	DIMENSION	XSDRNPM RESULTS	CSAS25 RESULTS
SPHERE	18.6 L	0.90120	0.90748±0.00393
CYLINDER	D = 21.9 cm	0.89695	0.88700±0.00399
SLAB	T = 10.5 cm	0.92086	0.92228±0.00464

TABLE 4
Values of K_{eff} for Mass Limit Controls

CONFIGURATION	MASS (kg U)	XSDRNPM RESULTS	CSAS25 RESULTS
CRITICAL	35.5	0.99077	0.98590±0.00397
SAFE-NO DOUBLE BATCHING POSSIBLE	26.4	0.94304	0.94033±0.00417
SAFE-DOUBLE BATCHING POSSIBLE	15.9	0.85509	0.85637±0.00434

TABLE 1
Effects of the Tank Wall on K_{eff} Values

U0XCYOP?.CJW U0XSLOP?.CJW

Wall / Thickness	Cylinder (Radius=14.25 cm)		Slab (Thickness = 14.2 cm)	
No Wall	1.02076	See first report	1.02548	See first report
Aluminum - 1/16"	1.02047	?=H	1.02611	?=H
Carbon Steel - 1/16"	1.00626	?=I	1.00230	?=I
Stainless Steel - 1/16"	1.00304	?=G	0.99729	?=G
Stainless Steel - 1/8"	0.99183	?=J	0.97877	?=J

TABLE 2
Values of K_{eff} for Critical Configurations

CONFIGURATION	DIMENSION	XSDRNPM RESULTS	CSAS25 RESULTS
SPHERE	25 L	0.95414	0.94504±0.00406
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Keff Values by XSDRNPM
Compare to table 1

Wall 1/16"	Cylinder (r=14.25cm)	Slab (t=14.2 cm)	16 gm/l
SS	1.00304	0.997285	USXCYOPG. (JW)
Al	1.02047	1.07611	"
None	1.02076	1.02548	
Carbon Steel	1.00626	1.00230	
1/8" SS	0.991834	0.978768	

```
        primary module access and input record ( scale driver - 10/31/90 - 14:00 )
 module CSASI    will be called
  UO2F2 SOLUTION OPTIMIZE CONCENTRATION  CYLINDER              UOXCYOPG.CJW
  27GROUPNDF4                INFHOMMEDIUM
  SOLNUO2F2     1  1600.0 0 1.0 293   92235 5.02  92238 94.98  END
  SS304         2  1.0  293  END
  H2O           3  1.0  293  END
  END COMP
 secondary module o0o008   has been called.
 module o0o008   is finished.
 secondary module o0o002   has been called.
 module o0o002   is finished.
 secondary module o0o007   has been called.
 module o0o007   is finished.
 module csasi    is finished.
 module XSDRN    will be called
  CYLINDER OPTIMIZATION UO2F2 SOLUTION DENSITY VARIATION
  0$$  A3 2  E
  1$$  2 3 52 1 0   3 3 16 3 1
   10 50 0 0 0
  2$$  -2 0 0 0 0    0 -1 0 0 0
  3$$  0 0 0 1 0     0 0 0 0 0
       0 0
  5**  A4 0  0  E
    T
  13$$  1 2 3
  14$$  1 2 3
  15**  F1
    T
  34**  F1
    T
  35**  15I0 14.25 34I14.40875 49.40875
  36$$  16R1 2 35R3
  39$$  1 2 3
  40$$  F3
    T
WARNING: an "END" statement is assumed at end of input file
  module xsdrn    is finished.
```

1/1 55304

outer iter	inner iters	1 - balance	eigenvalue	1 - source ratio	1 - scatter ratio	1 - upscat ratio	search parameter	time (min)
1	0	-2.22045E-16	1.07754E+00	6.17470E-01	1.00000E+00	0.00000E+00	0.00000E+00	0.0988
2	215	1.13063E-02	9.61247E-01	-2.31344E+00	-6.59352E-01	-5.93549E-02	0.00000E+00	1.3980
3	414	3.99759E-03	1.03165E+00	8.78219E-02	-2.49100E-01	-1.76017E-02	0.00000E+00	2.6072
4	612	1.92097E-03	1.02432E+00	5.97591E-02	-1.28923E-01	-7.85912E-03	0.00000E+00	3.8112
5	797	9.61006E-04	1.01604E+00	3.57913E-02	-6.97071E-02	-3.82994E-03	0.00000E+00	4.9417
6	975	4.89465E-04	1.01049E+00	2.01460E-02	-3.71577E-02	-1.93867E-03	0.00000E+00	6.0327
7	1142	2.52009E-04	1.00718E+00	1.09885E-02	1.96675E-02	-1.00244E-03	0.00000E+00	7.0618
8	1308	1.30257E-04	1.00533E+00	5.88908E-03	-1.03871E-02	-5.23911E-04	0.00000E+00	8.0862
9	1466	6.77226E-05	1.00429E+00	3.14014E-03	-5.48723E-03	-2.76694E-04	0.00000E+00	9.0647
10	1616	3.53474E-05	1.00372E+00	1.67492E-03	-2.91073E-03	-1.47321E-04	0.00000E+00	9.9983
11	1765	1.85330E-05	1.00339E+00	8.97026E-04	-1.55214E-03	-7.91328E-05	0.00000E+00	10.9267
12	1915	9.74986E-06	1.00321E+00	4.83514E-04	-8.33830E-04	-4.28654E-05	0.00000E+00	11.8613
13	2064	5.16676E-06	1.00310E+00	2.63696E-04	-4.51330E-04	-2.35101E-05	0.00000E+00	12.7897
14	2211	2.75740E-06	1.00304E+00	1.45953E-04	-2.47452E-04	-1.30686E-05	0.00000E+00	13.7067
15	2355	1.48953E-06	1.00300E+00	8.24652E-05	-1.37763E-04	-7.40245E-06	0.00000E+00	14.6065

grp to grp	inner iters	mfd int.	max. flux difference	maf int.	max. scale factor	coarse mesh
1	1	16	4.83851E-05	52	9.99989E-01	6
2	1	17	5.18584E-05	6	1.00002E+00	9
3	1	17	5.37584E-05	6	1.00002E+00	10
4	1	16	5.55002E-05	4	1.00002E+00	13
5	1	17	4.46791E-05	3	1.00002E+00	17
6	1	17	3.47371E-05	3	1.00003E+00	17
7	1	16	2.71252E-05	2	1.00003E+00	26
8	1	1	2.31904E-05	2	1.00003E+00	43
9	1	1	2.17297E-05	1	1.00003E+00	51
10	1	1	2.10011E-05	1	1.00003E+00	51
11	1	1	2.00716E-05	1	1.00003E+00	51
12	1	1	2.37300E-05	1	1.00002E+00	51
13	1	1	2.42598E-05	1	1.00002E+00	51
14	1	1	2.34689E-05	1	1.00002E+00	51
15	2	17	4.39118E-06	16	1.00000E+00	51
16	2	17	4.55987E-06	52	1.00000E+00	51
17	2	17	4.08878E-06	52	1.00000E+00	51
18	2	17	3.73206E-06	52	1.00000E+00	51
19	2	17	3.99300E-06	52	1.00000E+00	51
20	2	17	2.63489E-06	38	9.99999E-01	51
21	2	52	2.83019E-06	52	9.99999E-01	51
22	2	52	2.46995E-06	52	9.99999E-01	51
23	1	42	2.94273E-05	42	1.00005E+00	51
24	1	43	8.07511E-05	43	1.00016E+00	51
25	2	52	8.95733E-07	52	9.99999E-01	51
26	2	52	2.64752E-06	52	9.99996E-01	51
27	2	52	1.98373E-06	52	9.99997E-01	51

16	2393	-3.77284E-08	1.00304E+00	9.19243E-06	-5.88759E-05	-1.09520E-06	0.00000E+00	14.8922

final monitor

lambda 1.00304E+00 production/absorption 1.00509E+00 angular flux on 16

elapsed time 14.89 min.

1.02076

```
        primary module access and input record ( scale driver - 10/31/90 - 14:00 )
-   module CSASI    will be called
    UO2F2 SOLUTION OPTIMIZE CONCENTRATION  CYLINDER                UOXCYOPB.CJW
    27GROUPNDF4                  INFHOMMEDIUM
    SOLNUO2F2    1  1600.0 0 1.0 293   92235 5.02  92238 94.98  END
    AL           2  1.0  293  END
    H2O          3  1.0  293  END
    END COMP
   secondary module o0o008   has been called.
   module o0o008   is finished.
   secondary module o0o002   has been called.
   module o0o002   is finished.
   secondary module o0o007   has been called.
   module o0o007   is finished.
   module csasi    is finished.
-   module XSDRN    will be called
    CYLINDER OPTIMIZATION UO2F2 SOLUTION DENSITY VARIATION
    0$$  A3 2  E
    1$$  2 3 52 1 0   3 3 16 3 1
     10 50 0 0 0
    2$$  -2 0 0 0 0    0 -1 0 0 0
    3$$  0 0 0 1 0     0 0 0 0 0
         0 0
    5**  A4 0  0  E
      T
    13$$  1 2 3
    14$$  1 2 3
    15**  F1
       T
    34**  F1
       T
    35**  15I0 14.25 34I14.40875 49.40875
    36$$  16R1 2 35R3
    39$$  1 2 3
    40$$  F3
       T
 WARNING: an "END" statement is assumed at end of input file
   module xsdrn    is finished.
```

outer iter	inner iters	1 - balance	eigenvalue	1 - source ratio	1 - scatter ratio	1 - upscat ratio	search parameter	time (min)
1	0	0.00000E+00	1.08946E+00	6.18047E-01	1.00000E+00	0.00000E+00	0.00000E+00	0.0980
2	215	1.15944E-02	9.69834E-01	-2.38562E+00	-6.73292E-01	-6.00977E-02	0.00000E+00	1.3980
3	416	4.06821E-03	1.04916E+00	8.66337E-02	-2.60699E-01	-1.76556E-02	0.00000E+00	2.6200
4	609	1.95350E-03	1.04309E+00	6.03772E-02	-1.34673E-01	-7.87289E-03	0.00000E+00	3.7965
5	795	9.75519E-04	1.03476E+00	3.68415E-02	-7.28741E-02	-3.83051E-03	0.00000E+00	4.9333
6	976	4.94969E-04	1.02890E+00	2.10202E-02	-3.88033E-02	-1.93268E-03	0.00000E+00	6.0420
7	1148	2.53543E-04	1.02527E+00	1.15859E-02	-2.04726E-02	-9.95012E-04	0.00000E+00	7.1000
8	1314	1.30412E-04	1.02316E+00	6.27297E-03	-1.07678E-02	-5.17894E-04	0.00000E+00	8.1245
9	1475	6.71203E-05	1.02196E+00	3.36652E-03	-5.65597E-03	-2.71211E-04	0.00000E+00	9.1203
10	1626	3.44903E-05	1.02129E+00	1.80112E-03	-2.96923E-03	-1.42551E-04	0.00000E+00	10.0605
11	1776	1.76901E-05	1.02090E+00	9.64169E-04	-1.55940E-03	-7.52280E-05	0.00000E+00	10.9953
12	1930	9.05303E-06	1.02069E+00	5.18499E-04	-8.20715E-04	-3.98955E-05	0.00000E+00	11.9518
13	2083	4.63394E-06	1.02056E+00	2.81364E-04	-4.33973E-04	-2.13411E-05	0.00000E+00	12.9030
14	2232	2.36837E-06	1.02048E+00	1.54474E-04	-2.31332E-04	-1.15290E-05	0.00000E+00	13.8322
15	2376	1.20455E-06	1.02044E+00	8.60709E-05	-1.24482E-04	-6.29640E-06	0.00000E+00	14.7328

grp to grp	inner iters	mfd int.	max. flux difference	msf int.	max. scale factor	coarse mesh
1	1	1	6.43529E-05	52	9.99985E-01	6
2	1	17	6.66582E-05	6	1.00003E+00	9
3	1	17	7.01354E-05	6	1.00002E+00	10
4	1	16	7.17238E-05	4	1.00002E+00	13
5	1	17	5.90630E-05	3	1.00003E+00	17
6	1	17	4.57959E-05	3	1.00004E+00	17
7	1	1	3.62600E-05	2	1.00005E+00	26
8	1	1	3.27498E-05	2	1.00005E+00	43
9	1	1	3.08165E-05	1	1.00004E+00	51
10	1	1	2.98515E-05	1	1.00004E+00	51
11	1	1	2.85913E-05	1	1.00004E+00	51
12	1	1	3.39338E-05	1	1.00003E+00	51
13	1	1	3.48342E-05	1	1.00003E+00	51
14	1	1	3.38573E-05	1	1.00003E+00	51
15	2	17	1.39484E-06	38	1.00000E+00	51
16	2	52	1.75155E-06	52	1.00000E+00	51
17	2	52	1.99451E-06	52	1.00000E+00	51
18	2	52	1.93492E-06	52	1.00000E+00	51
19	2	52	2.32444E-06	52	1.00000E+00	51
20	2	52	1.81693E-06	38	9.99999E-01	51
21	2	52	2.53360E-06	52	9.99999E-01	51
22	2	52	2.25472E-06	52	9.99999E-01	51
23	1	42	2.96498E-05	42	1.00005E+00	51
24	1	43	8.10803E-05	43	1.00016E+00	51
25	2	17	1.08410E-06	37	1.00000E+00	51
26	2	52	2.15965E-06	52	9.99996E-01	51
27	2	52	3.61916E-06	52	9.99996E-01	51

16	2414	-3.77825E-08	1.02047E+00	8.59791E-06	-5.27314E-05	-7.13773E-07	0.00000E+00	15.0167

final monitor
lambda 1.02047E+00 production/absorption 1.02262E+00 angular flux on 1o

- wlapsed time 15.02 min.

```
        primary module access and input record ( scale driver - 10/31/90 - 14:00 )
-   module CSASI    will be called
      UO2F2 SOLUTION OPTIMIZE CONCENTRATION  CYLINDER            UOXCYOPI.CJW
      27GROUPNDF4                INFHOMMEDIUM
      SOLNUO2F2    1  1600.0 0 1.0 293   92235 5.02  92238 94.98  END
      CARBONSTEEL  2  1.0  293  END
      H2O          3  1.0  293  END
      END COMP
    secondary module o0o008   has been called.
    module o0o008   is finished.
    secondary module o0o002   has been called.
    module o0o002   is finished.
    secondary module o0o007   has been called.
    module o0o007   is finished.
    module csasi    is finished.
-   module XSDRN    will be called
      CYLINDER OPTIMIZATION UO2F2 SOLUTION DENSITY VARIATION
      0$$  A3 2  E
      1$$  2 3 52 1 0   3 3 16 3 1
       10 50 0 0 0
      2$$  -2 0 0 0 0    0 -1 0 0 0
      3$$  0 0 0 1 0     0 0 0 0 0
           0 0
      5**  A4 0  0  E
        T
      13$$  1 2 3
      14$$  1 2 3
      15**  F1
        T
      34**  F1
        T
      35**  15I0 14.2$ 34I14.40875 49.40875
      36$$  16R1 2 35R3
      39$$  1 2 3
      40$$  F3
        T
  WARNING: an "END" statement is assumed at end of input file
    module xsdrn    is finished.
```

outer iter	inner iters	1 - balance	eigenvalue	1 - source ratio	1 - scatter ratio	1 - upscat ratio	search parameter	time (min)
1	0	3.33067E-16	1.07980E+00	6.17328E-01	1.00000E+00	0.00000E+00	0.00000E+00	0.0997
2	215	1.13442E-02	9.63332E-01	-2.32465E+00	-6.61475E-01	-5.94675E-02	0.00000E+00	1.4015
3	415	4.01076E-03	1.03490E+00	8.76658E-02	-2.50799E-01	-1.76253E-02	0.00000E+00	2.6182
4	613	1.92736E-03	1.02776E+00	5.98870E-02	-1.29876E-01	-7.86814E-03	0.00000E+00	3.8247
5	798	9.64003E-04	1.01945E+00	3.59779E-02	-7.02437E-02	-3.83339E-03	0.00000E+00	4.9568
6	975	4.91199E-04	1.01382E+00	2.03126E-02	-3.74541E-02	-1.94112E-03	0.00000E+00	6.0455
7	1142	2.52423E-04	1.01048E+00	1.10901E-02	-1.98192E-02	-1.00205E-03	0.00000E+00	7.0770
8	1308	1.30154E-04	1.00860E+00	5.94469E-03	-1.04482E-02	-5.22563E-04	0.00000E+00	8.1033
9	1466	6.74898E-05	1.00754E+00	3.16960E-03	-5.50693E-03	-2.75343E-04	0.00000E+00	9.0845
10	1616	3.51197E-05	1.00695E+00	1.69030E-03	-2.91394E-03	-1.46229E-04	0.00000E+00	10.0200
11	1765	1.83442E-05	1.00662E+00	9.04796E-04	-1.54943E-03	-7.83062E-05	0.00000E+00	10.9512
12	1915	9.60589E-06	1.00643E+00	4.87301E-04	-8.29040E-04	-4.22661E-05	0.00000E+00	11.8875
13	2065	5.06406E-06	1.00632E+00	2.65507E-04	-4.47270E-04	-2.30945E-05	0.00000E+00	12.8242
14	2212	2.69189E-06	1.00626E+00	1.46978E-04	-2.44363E-04	-1.28060E-05	0.00000E+00	13.7432
15	2356	1.44212E-06	1.00622E+00	8.28768E-05	-1.35536E-04	-7.21632E-06	0.00000E+00	14.6458

grp to grp	inner iters	mfd int.	max. flux difference	msf int.	max. scale factor	coarse mesh
1	1	16	5.05118E-05	9	1.00001E+00	6
2	1	17	5.31109E-05	6	1.00002E+00	9
3	1	17	5.60186E-05	6	1.00002E+00	10
4	1	16	5.78044E-05	4	1.00002E+00	13
5	1	17	4.65532E-05	3	1.00002E+00	17
6	1	17	3.65178E-05	3	1.00003E+00	17
7	1	16	2.84542E-05	2	1.00003E+00	26
8	1	1	2.45606E-05	2	1.00003E+00	43
9	1	1	2.30316E-05	1	1.00003E+00	51
10	1	1	2.22653E-05	1	1.00003E+00	51
11	1	1	2.12853E-05	1	1.00003E+00	51
12	1	1	2.51724E-05	1	1.00002E+00	51
13	1	1	2.57404E-05	1	1.00002E+00	51
14	1	1	2.49067E-05	1	1.00002E+00	51
15	2	17	4.31678E-06	16	1.00000E+00	51
16	2	17	4.48897E-06	52	1.00000E+00	51
17	2	17	4.03506E-06	52	1.00000E+00	51
18	2	17	3.67776E-06	52	1.00000E+00	51
19	2	17	3.89061E-06	52	1.00000E+00	51
20	2	17	2.42476E-06	38	9.99999E-01	51
21	2	52	2.82651E-06	52	9.99999E-01	51
22	2	52	2.41825E-06	52	9.99999E-01	51
23	1	43	2.95593E-05	42	1.00003E+00	51
24	1	43	8.09406E-05	43	1.00016E+00	51
25	2	52	8.65671E-07	52	9.99999E-01	51
26	2	52	2.57312E-06	52	9.99996E-01	51
27	2	52	2.40819E-06	52	9.99997E-01	51

16	2394	-3.77460E-08	1.00626E+00	9.06717E-06	-5.78712E-05	-1.03130E-06	0.00000E+00	14.9303

final monitor

lambda 1.00626E+00 production/absorption 1.00832E+00 angular flux on 16

elapsed time 14.93 min.

```
        primary module access and input record ( scale driver - 10/31/90 - 14:00 )
-   module CSASI    will be called
      UO2F2 SOLUTION OPTIMIZE CONCENTRATION  CYLINDER                UOXCYOPG.CJW
      27GROUPNDF4                  INFHOMMEDIUM
      SOLNUO2F2     1  1600.0 0 1.0 293   92235 5.02  92238 94.98  END
      SS304         2  1.0  293  END
      H2O           3  1.0  293  END
      END COMP
    secondary module o0o008   has been called.
    module o0o008   is finished.
    secondary module o0o002   has been called.
    module o0o002   is finished.
    secondary module o0o007   has been called.
    module o0o007   is finished.
    module csasi    is finished.
-   module XSDRN    will be called
      CYLINDER OPTIMIZATION UO2F2 SOLUTION DENSITY VARIATION
      0$$  A3 2  E
      1$$  2 3 52 1 0   3 3 16 3 1
       10 50 0 0 0
      2$$  -2 0 0 0 0    0 -1 0 0 0
      3$$  0 0 0 1 0     0 0 0 0 0
           0 0
      5**  A4 0  0  E
        T
      13$$  1 2 3
      14$$  1 2 3
      15**  F1
        T
      34**  F1
        T
      35**  15I0 14.25 34I14.5675 49.40875
      36$$  16R1 2 35R3
      39$$  1 2 3
      40$$  F3
        T
 WARNING: an "END" statement is assumed at end of input file
    module xsdrn    is finished.
```

outer iter	inner iters	1 - balance	eigenvalue	1 - source ratio	1 - scatter ratio	1 - upscat ratio	search parameter	time (min)
1	0	4.44089E-16	1.06649E+00	6.16515E-01	1.00000E+00	0.00000E+00	0.00000E+00	0.1017
2	215	1.10405E-02	9.55724E-01	-2.25361E+00	-6.46279E-01	-5.87001E-02	0.00000E+00	1.4035
3	414	3.93884E-03	1.01961E+00	8.76068E-02	-2.39057E-01	-1.75805E-02	0.00000E+00	2.6153
4	610	1.89662E-03	1.01173E+00	5.87164E-02	-1.24185E-01	-7.86694E-03	0.00000E+00	3.8100
5	793	9.50345E-04	1.00372E+00	3.46953E-02	-6.71653E-02	-3.83866E-03	0.00000E+00	4.9315
6	971	4.84960E-04	9.98573E-01	1.93137E-02	-3.58235E-02	-1.94592E-03	0.00000E+00	6.0255
7	1137	2.50940E-04	9.95541E-01	1.04659E-02	-1.90024E-02	-1.01040E-03	0.00000E+00	7.0505
8	1301	1.30840E-04	9.93858E-01	5.59092E-03	-1.00903E-02	-5.32026E-04	0.00000E+00	8.0660
9	1459	6.87181E-05	9.92931E-01	2.97639E-03	-5.37412E-03	-2.83410E-04	0.00000E+00	9.0463
10	1608	3.63702E-05	9.92417E-01	1.58950E-03	-2.87978E-03	-1.52661E-04	0.00000E+00	9.9773
11	1754	1.94028E-05	9.92130E-01	8.54227E-04	-1.55596E-03	-8.31617E-05	0.00000E+00	10.8898
12	1903	1.04277E-05	9.91968E-01	4.62927E-04	-8.48706E-04	-4.58025E-05	0.00000E+00	11.8208
13	2050	5.65716E-06	9.91875E-01	2.54072E-04	-4.67982E-04	-2.55582E-05	0.00000E+00	12.7400
14	2194	3.10541E-06	9.91819E-01	1.41825E-04	-2.61608E-04	-1.44864E-05	0.00000E+00	13.6417
15	2338	1.72812E-06	9.91783E-01	8.08549E-05	-1.48694E-04	-8.36047E-06	0.00000E+00	14.5433

grp to grp	inner iters	mfd int.	max. flux difference	msf int.	max. scale factor	coarse mesh
1	1	16	3.74582E-05	9	1.00001E+00	6
2	1	16	3.99150E-05	6	1.00001E+00	9
3	1	16	4.10310E-05	6	1.00001E+00	10
4	1	16	4.37358E-05	4	1.00001E+00	13
5	1	17	3.35669E-05	3	1.00002E+00	17
6	1	15	2.65121E-05	3	1.00002E+00	17
7	1	16	2.08316E-05	2	1.00002E+00	26
8	1	1	1.58953E-05	2	1.00002E+00	43
9	1	1	1.57979E-05	1	1.00002E+00	51
10	1	1	1.52525E-05	1	1.00002E+00	51
11	1	1	1.45630E-05	1	1.00002E+00	51
12	1	1	1.72010E-05	1	1.00002E+00	51
13	1	1	1.75723E-05	1	1.00001E+00	51
14	1	1	1.69876E-05	1	1.00001E+00	51
15	2	17	5.69283E-06	16	9.99999E-01	51
16	2	17	5.96694E-06	18	9.99999E-01	51
17	2	17	5.46553E-06	18	1.00000E+00	51
18	2	17	5.02273E-06	18	1.00000E+00	51
19	2	17	5.30143E-06	18	9.99999E-01	51
20	2	17	3.16038E-06	38	9.99999E-01	51
21	2	52	2.99101E-06	52	9.99999E-01	51
22	2	52	2.59761E-06	52	9.99999E-01	51
23	1	42	2.95680E-05	42	1.00005E+00	51
24	1	43	8.10665E-05	43	1.00016E+00	51
25	2	52	7.83662E-07	38	1.00000E+00	51
26	2	52	3.06174E-06	52	9.99996E-01	51
27	2	52	2.15243E-06	52	9.99997E-01	51

16	2376	-3.74981E-08	9.91833E-01	9.76554E-06	-6.35276E-05	-1.40896E-06	0.00000E+00	14.8280

final monitor

lambda 9.91834E-01 production/absorption 9.93825E-01 angular flux on 16

elapsed time 14.83 min.

```
        primary module access and input record ( scale driver - 10/31/90 - 14:00 )
-   module CSASI    will be called
    UO2F2 SOLUTION   OPTIIMIZE CONCENTRATION   SLAB            UOXSLOPG.CJW
    27GROUPNDF4                INFHOMMEDIUM
    SOLNUO2F2     1  1600.0 0 1.0 293   92235 5.02  92238 94.98  END
    SS304         2  1.0  293  END
    H2O           3  1.0  293  END
    END COMP
   secondary module o0o008   has been called.
   module o0o008   is finished.
   secondary module o0o002   has been called.
   module o0o002   is finished.
   secondary module o0o007   has been called.
   module o0o007   is finished.
   module csasi    is finished.
-   module XSDRN    will be called
    SLAB OPTIMIZATION UO2F2 SOLUTION DENSITY VARIATION
    0$$  A3 2  E
    1$$  1 3 51 1 0   3 3 16 3 1
     10 50 0 0 0
    2$$  -2 0 0 0 0    0 -1 0 0 0
    3$$  0 0 0 1 0     0 0 0 0 0
         0 0
    5**  A4 0  0  E
      T
    13$$  1 2 3
    14$$  1 2 3
    15**  F1
      T
    34**  F1
      1
    35**  9I0 7.1 39I7.25875 47.25875
    36$$  10R1 2 40R3
    39$$  1 2 3
    40$$  F3
      T
 WARNING: an "END" statement is assumed at end of input file
   module xsdrn    is finished.
```

outer iter	inner iters	1 - balance	eigenvalue	1 - source ratio	1 - scatter ratio	1 - upscat ratio	search parameter	time (min)
1	0	-2.22045E-16	1.05382E+00	6.61455E-01	1.00000E+00	0.00000E+00	0.00000E+00	0.0833
2	213	1.19779E-02	9.11617E-01	-2.64626E+00	-6.91401E-01	-6.06603E-02	0.00000E+00	0.3480
3	404	3.67041E-03	1.00855E+00	8.96984E-02	-2.62285E-01	-1.57863E-02	0.00000E+00	0.5923
4	593	1.61259E-03	1.00943E+00	5.46191E-02	-1.19279E-01	-6.49950E-03	0.00000E+00	0.8348
5	775	7.52005E-04	1.00556E+00	2.97331E-02	-5.86285E-02	-2.98069E-03	0.00000E+00	1.0710
6	949	3.62606E-04	1.00246E+00	1.55364E-02	-2.90624E-02	-1.44013E-03	0.00000E+00	1.2998
7	1114	1.79957E-04	1.00042E+00	8.06374E-03	-1.45994E-02	-7.22506E-04	0.00000E+00	1.5207
8	1272	9.15790E-05	9.99165E-01	4.22016E-03	-7.47834E-03	-3.73595E-04	0.00000E+00	1.7347
9	1416	4.78349E-05	9.98400E-01	2.24918E-03	-3.91713E-03	-1.98851E-04	0.00000E+00	1.9362
10	1565	2.56164E-05	9.97934E-01	1.22497E-03	-2.10310E-03	-1.08720E-04	0.00000E+00	2.1412
11	1715	1.40527E-05	9.97648E-01	6.82802E-04	-1.15737E-03	-6.09683E-05	0.00000E+00	2.3480
12	1864	7.90876E-06	9.97469E-01	3.90307E-04	-6.53064E-04	-3.50858E-05	0.00000E+00	2.5540
13	2008	4.54816E-06	9.97357E-01	2.28328E-04	-3.77682E-04	-2.06439E-05	0.00000E+00	2.7545
14	2152	2.67411E-06	9.97285E-01	1.36672E-04	-2.23418E-04	-1.24220E-05	0.00000E+00	2.9560
15	2296	1.60494E-06	9.97238E-01	8.36824E-05	-1.35198E-04	-7.63690E-06	0.00000E+00	3.1575

grp to grp	inner iters	mfd int.	max. flux difference	msf int.	max. scale factor	coarse mesh
1	1	10	2.58682E-05	47	9.99997E-01	6
2	1	10	2.40894E-05	26	9.99994E-01	9
3	1	10	2.50648E-05	24	9.99996E-01	10
4	1	10	2.88962E-05	5	1.00000E+00	12
5	1	11	2.28447E-05	4	1.00001E+00	16
6	1	11	1.84433E-05	4	1.00001E+00	16
7	1	9	1.31407E-05	3	1.00001E+00	24
8	1	10	7.45328E-06	2	1.00001E+00	45
9	1	1	6.07155E-06	2	1.00001E+00	45
10	1	1	5.33125E-06	17	9.99993E-01	45
11	1	18	5.04426E-06	19	9.99993E-01	45
12	1	19	6.12871E-06	19	9.99995E-01	45
13	1	19	6.32883E-06	20	9.99995E-01	45
14	1	20	6.08731E-06	20	9.99995E-01	45
15	2	11	5.00264E-06	30	1.00000E+00	45
16	2	11	5.10575E-06	51	1.00000E+00	45
17	2	11	4.51537E-06	51	1.00000E+00	45
18	2	11	4.13463E-06	51	1.00000E+00	45
19	2	11	4.52325E-06	51	1.00000E+00	45
20	2	11	3.41846E-06	32	9.99999E-01	45
21	2	11	2.90349E-06	51	9.99999E-01	50
22	2	11	2.36262E-06	51	9.99999E-01	50
23	1	37	3.04213E-05	37	1.00005E+00	50
24	1	38	8.18331E-05	38	1.00016E+00	50
25	2	50	7.15845E-07	31	1.00000E+00	50
26	2	51	1.73560E-06	51	9.99997E-01	50
27	2	51	2.70173E-06	51	9.99997E-01	50

16	2334	-3.75709E-08	9.97284E-01	9.90335E-06	-6.12656E-05	-1.38996E-06	0.00000E+00	3.2278

final monitor

lambda 9.97285E-01 production/absorption 9.97917E-01 angular flux on 16

- elapsed time 3.23 min.

```
        primary module access and input record ( scale driver - 10/31/90 - 14:00 )
-   module CSASI    will be called
      UO2F2 SOLUTION   OPTIIMIZE CONCENTRATION   SLAB            UOXSLOPI.CJW
      27GROUPNDF4                INFHOMMEDIUM
      SOLNUO2F2    1  1600.0 0 1.0 293   92235 5.02  92238 94.98  END
      CARBONSTEEL  2  1.0  293  END
      H2O          3  1.0  293  END
      END COMP
    secondary module o0o008   has been called.
    module o0o008   is finished.
    secondary module o0o002   has been called.
    module o0o002   is finished.
    secondary module o0o007   has been called.
    module o0o007   is finished.
    module csasi    is finished.
-   module XSDRN    will be called
      SLAB OPTIMIZATION UO2F2 SOLUTION DENSITY VARIATION
      0$$  A3 2  E
      1$$  1 3 51 1 0   3 3 16 3 1
       10 50 0 0 0
      2$$  -2 0 0 0 0    0 -1 0 0 0
      3$$  0 0 0 1 0     0 0 0 0 0
           0 0
      5**  A4 0  0  E
        T
      13$$  1 2 3
      14$$  1 2 3
      15**  F1
        T
      34**  F1
        T
      35**  9I0 7.1 39I7.25875 47.25875
      36$$  10R1 2 40R3
      39$$  1 2 3
      40$$  F3
        T
 WARNING: an "END" statement is assumed at end of input file
    module xsdrn    is finished.
```

outer iter	inner iters	1 - balance	eigenvalue	1 - source ratio	1 - scatter ratio	1 - upscat ratio	search parameter	time (min)
1	0	0.00000E+00	1.05719E+00	6.61262E-01	1.00000E+00	0.00000E+00	0.00000E+00	0.0853
2	215	1.20215E-02	9.14409E-01	-2.66263E+00	-6.93982E-01	-6.07805E-02	0.00000E+00	0.3527
3	410	3.67642E-03	1.01325E+00	8.95182E-02	-2.64177E-01	-1.57823E-02	0.00000E+00	0.6023
4	602	1.61301E-03	1.01449E+00	5.46318E-02	-1.19975E-01	-6.48835E-03	0.00000E+00	0.8497
5	788	7.50888E-04	1.01070E+00	2.97882E-02	-5.88858E-02	-2.97084E-03	0.00000E+00	1.0903
6	964	3.61632E-04	1.00758E+00	1.55915E-02	-2.91469E-02	-1.43385E-03	0.00000E+00	1.3228
7	1130	1.79192E-04	1.00551E+00	8.10239E-03	-1.46234E-02	-7.18394E-04	0.00000E+00	1.5455
8	1288	9.10552E-05	1.00423E+00	4.24537E-03	-7.48100E-03	-3.71014E-04	0.00000E+00	1.7603
9	1432	4.74625E-05	1.00345E+00	2.26402E-03	-3.91105E-03	-1.97144E-04	0.00000E+00	1.9627
10	1582	2.53585E-05	1.00297E+00	1.23341E-03	-2.09140E-03	-1.07590E-04	0.00000E+00	2.1717
11	1732	1.38881E-05	1.00268E+00	6.87937E-04	-1.17166E-03	-6.02602E-05	0.00000E+00	2.3792
12	1881	7.79953E-06	1.00250E+00	3.93334E-04	-6.78881E-04	-3.46253E-05	0.00000E+00	2.5862
13	2025	4.47715E-06	1.00238E+00	2.30141E-04	-3.74677E-04	-2.03478E-05	0.00000E+00	2.7887
14	2169	2.62906E-06	1.00231E+00	1.37807E-04	-2.21383E-04	-1.22348E-05	0.00000E+00	2.9907
15	2313	1.57687E-06	1.00226E+00	8.44277E-05	-1.33884E-04	-7.52017E-06	0.00000E+00	3.1932

grp	grp	inner iters	mfd int.	max. flux difference	msf int.	max. scale factor	coarse mesh
1	1	1	10	2.67473E-05	47	9.99997E-01	6
2	2	1	10	2.48704E-05	24	9.99994E-01	9
3	3	1	10	2.58673E-05	24	9.99996E-01	10
4	4	1	10	2.98252E-05	5	1.00000E+00	12
5	5	1	11	2.35588E-05	4	1.00001E+00	16
6	6	1	11	1.89916E-05	4	1.00001E+00	16
7	7	1	9	1.35766E-05	3	1.00001E+00	24
8	8	1	10	7.60124E-06	2	1.00001E+00	45
9	9	1	1	6.30185E-06	2	1.00001E+00	45
10	10	1	1	5.53034E-06	17	9.99993E-01	45
11	11	1	18	5.22293E-06	19	9.99993E-01	45
12	12	1	19	6.34596E-06	19	9.99994E-01	45
13	13	1	19	6.55263E-06	20	9.99995E-01	45
14	14	1	20	6.30267E-06	20	9.99995E-01	45
15	15	2	11	4.97146E-06	32	1.00000E+00	45
16	16	2	11	5.07098E-06	51	1.00000E+00	45
17	17	2	11	4.48266E-06	51	1.00000E+00	45
18	18	2	11	4.10089E-06	51	1.00000E+00	45
19	19	2	11	4.45475E-06	51	1.00000E+00	45
20	20	2	11	3.28742E-06	32	9.99999E-01	45
21	21	2	11	2.75879E-06	51	9.99999E-01	50
22	22	2	11	2.20692E-06	51	9.99999E-01	50
23	23	1	37	3.05136E-05	37	1.00005E+00	50
24	24	1	37	8.18714E-05	38	1.00016E+00	50
25	25	2	50	7.19405E-07	31	1.00000E+00	50
26	26	2	51	1.75922E-06	51	9.99997E-01	50
27	27	2	51	2.45119E-06	51	9.99997E-01	50

16	2351	-3.75863E-08	1.00230E+00	9.85022E-06	-6.08100E-05	-1.35894E-06	0.00000E+00	3.2543

final monitor

lambda 1.00230E+00 production/absorption 1.00294E+00 angular flux on 16

elapsed time 3.25 min.

```
        primary module access and input record ( scale driver - 10/31/90 - 14:00 )
-   module CSASI    will be called
    UO2F2 SOLUTION   OPTIIMIZE CONCENTRATION   SLAB            UOXSLOPH.CJW
    27GROUPNDF4                INFHOMMEDIUM
    SOLNUO2F2    1  1600.0 0 1.0 293   92235 5.02  92238 94.98  END
    AL           2  1.0  293  END
    H2O          3  1.0  293  END
    END COMP
   secondary module o0o008   has been called.
   module o0o008   is finished.
   secondary module o0o002   has been called.
   module o0o002   is finished.
   secondary module o0o007   has been called.
   module o0o007   is finished.
   module csasi    is finished.
-   module XSDRN    will be called
    SLAB OPTIMIZATION UO2F2 SOLUTION DENSITY V\RIATION
    0$$  A3 2  E
    1$$  1 3 51 1 0   3 3 16 3 1
     10 50 0 0 0
    2$$  -2 0 0 0 0    0 -1 0 0 0
    3$$  0 0 0 1 0     0 0 0 0 0
         0 0
    5**  A4 0  0  E
      T
    13$$  1 2 3
    14$$  1 2 3
    15**  F1
       T
    34**  F1
       T
    35**  9I0 7.1 39I7.25875 47.25875
    36$$  10R1 2 40R3
    39$$  1 2 3
    40$$  FJ
       T
WARNING: an "END" statement is assumed at end of input file
   module xsdrn    is finished.
```

outer iter	inner iters	1 - balance	eigenvalue	1 - source ratio	1 - scatter ratio	1 - upscat ratio	search parameter	time (min)
1	9	-4.44089E-16	1.07208E+00	6.61661E-01	1.00000E+00	0.00000E+00	0.00000E+00	0.0833
2	214	1.23077E-02	9.24037E-01	-2.74965E+00	-7.08146E-01	-6.14397E-02	0.00000E+00	0.3467
3	409	3.69543E-03	1.03485E+00	8.80761E-02	-2.75226E-01	-1.56622E-02	0.00000E+00	0.5938
4	604	1.60536E-03	1.03839E+00	5.43590E-02	-1.23188E-01	-6.38117E-03	0.00000E+00	0.8402
5	792	7.40445E-04	1.03509E+00	2.99061E-02	-5.98865E-02	-2.89894E-03	0.00000E+00	1.0800
6	967	3.53532E-04	1.03192E+00	1.57688E-02	-2.93844E-02	-1.38917E-03	0.00000E+00	1.3080
7	1138	1.73517E-04	1.02972E+00	8.24084E-03	-1.46192E-02	-6.90617E-04	0.00000E+00	1.5277
8	1291	8.73075E-05	1.02831E+00	4.33922E-03	-7.41272E-03	-3.53871E-04	0.00000E+00	1.7402
9	1435	4.50950E-05	1.02744E+00	2.32523E-03	-3.84425E-03	-1.86722E-04	0.00000E+00	1.9397
10	1585	2.38817E-05	1.02689E+00	1.27280E-03	-2.04448E-03	-1.01250E-04	0.00000E+00	2.1438
11	1735	1.29782E-05	1.02655E+00	7.13451E-04	-1.11559E-03	-5.64122E-05	0.00000E+00	2.3488
12	1885	7.24392E-06	1.02634E+00	4.10004E-04	-6.25206E-04	-3.22941E-05	0.00000E+00	2.5538
13	2032	4.15008E-06	1.02621E+00	2.41490E-04	-3.59958E-04	-1.89733E-05	0.00000E+00	2.7552
14	2176	2.42593E-06	1.02612E+00	1.45250E-04	-2.12424E-04	-1.13845E-05	0.00000E+00	2.9548
15	2320	1.44841E-06	1.02606E+00	8.91981E-05	-1.28149E-04	-6.98331E-06	0.00000E+00	3.1537

grp to grp	inner iters	mfd int.	max. flux difference	mnf int.	max. scale factor	coarse mesh
1	1	10	3.06769E-05	51	9.99996E-01	6
2	1	10	2.88791E-05	32	9.99993E-01	9
3	1	10	3.00736E-05	24	9.99995E-01	10
4	1	10	3.46405E-05	5	1.00001E+00	12
5	1	11	2.74956E-05	4	1.00001E+00	16
6	1	11	2.23105E-05	4	1.00001E+00	16
7	1	9	1.60717E-05	3	1.00001E+00	24
8	1	10	9.28345E-06	2	1.00001E+00	45
9	1	1	7.72725E-06	2	1.00001E+00	45
10	1	1	6.77744E-06	18	9.99992E-01	45
11	1	18	6.32966E-06	19	9.99992E-01	45
12	1	19	7.67724E-06	20	9.99993E-01	45
13	1	20	7.97156E-06	20	9.99994E-01	45
14	1	20	7.67725E-06	21	9.99993E-01	45
15	2	11	2.14445E-06	44	1.00000E+00	45
16	2	11	1.99581E-06	51	1.00000E+00	45
17	2	51	1.67946E-06	51	1.00000E+00	45
18	2	51	1.63028E-06	51	1.00000E+00	45
19	2	51	1.95181E-06	51	1.00000E+00	45
20	2	11	2.10466E-06	32	9.99999E-01	45
21	2	51	2.08052E-06	51	9.99999E-01	50
22	2	11	1.61773E-06	51	9.99999E-01	50
23	1	36	3.03940E-05	37	1.00005E+00	50
24	1	37	8.16655E-05	38	1.00016E+00	50
25	2	11	7.34440E-07	32	1.00000E+00	50
26	2	51	1.90775E-06	30	1.00000E+00	50
27	2	51	2.02525E-06	51	9.99998E-01	50

16	2358	-3.75968E-08	1.02611E+00	9.74620E-06	-5.87418E-05	-1.21750E-06	0.00000E+00	3.2148

final monitor lambda 1.02611E+00 production/absorption 1.02677E+00 angular flux on 16

- elapsed time 3.21 min.

```
        primary module access and input record ( scale driver - 10/31/90 - 14:00 )
-   module CSASI    will be called
      UO2F2 SOLUTION   OPTIIMIZE CONCENTRATION   SLAB            UOXSLOPG.CJW
      27GROUPNDF4                INFHOMMEDIUM
      SOLUTIO2F2     1  1600.0 0 1.0 293   92235 5.02  92238 94.98  END
      SS304          2  1.0  293  END
      H2O            3  1.0  293  END
      END COMP
    secondary module o0o008   has been called.
    module o0o008   is finished.
    secondary module o0o002   has been called.
    module o0o002   is finished.
    secondary module o0o007   has been called.
    module o0o007   is finished.
    module csasi    is finished.
-   module XSDRN    will be called
      SLAB OPTIMIZATION UO2F2 SOLUTION DENSITY VARIATION
      0$$  A3 2  E
      1$$  1 3 51 1 0   3 3 16 3 1
       10 50 0 0 0
      2$$  -2 0 0 0 0    0 -1 0 0 0
      3$$  0 0 0 1 0     0 0 0 0 0
           0 0
      5**  A4 0  0  E
        T
      13$$  1 2 3
      14$$  1 2 3
      15**  F1
        T
      34**  F1
        T
      35**  9I0 7.1 39I7.4175 47.25875
      36$$  10R1 2 40R3
      39$$  1 2 3
      40$$  F3
        T
 WARNING: an "END" statement is assumed at end of input file
    module xsdrn    is finished.
```

outer iter	inner iters	1 - balance	eigenvalue	1 - source ratio	1 - scatter ratio	1 - upscat ratio	search parameter	time (min)
1	0	1.11022E-16	1.03766E+00	6.59935E-01	1.00000E+00	0.00000E+00	0.00000E+00	0.0815
2	214	1.16491E-02	9.04879E-01	-2.55587E+00	-6.74573E-01	-5.99095E-02	0.00000E+00	0.3478
3	400	3.64786E-03	9.91395E-01	8.93481E-02	-2.50215E-01	-1.59259E-02	0.00000E+00	0.5887
4	586	1.62047E-03	9.90671E-01	5.41590E-02	-1.15695E-01	-6.62339E-03	0.00000E+00	0.8293
5	767	7.63596E-04	9.86524E-01	2.93465E-02	-5.74763E-02	-3.06457E-03	0.00000E+00	1.0645
6	940	3.72176E-04	9.83480E-01	1.52895E-02	-2.87824E-02	-1.49411E-03	0.00000E+00	1.2935
7	1105	1.86581E-04	9.81570E-01	7.91612E-03	-1.46037E-02	-7.55869E-04	0.00000E+00	1.5142
8	1263	9.39685E-05	9.80423E-01	4.13499E-03	-7.55186E-03	-3.94243E-04	0.00000E+00	1.7292
9	1407	5.06300E-05	9.79736E-01	2.19943E-03	-3.99265E-03	-2.11490E-04	0.00000E+00	1.9305
10	1551	2.73686E-05	9.79323E-01	1.19515E-03	-2.16171E-03	-1.16446E-04	0.00000E+00	2.1322
11	1699	1.51398E-05	9.79073E-01	6.64203E-04	-1.19844E-03	-6.56863E-05	0.00000E+00	2.3380
12	1843	8.56918E-06	9.78918E-01	3.78034E-04	-6.80075E-04	-3.79325E-05	0.00000E+00	2.5393
13	1987	4.96104E-06	9.78821E-01	2.20443E-04	-3.94975E-04	-2.24105E-05	0.00000E+00	2.7407
14	2131	2.93430E-06	9.78759E-01	1.31673E-04	-2.34672E-04	-1.35308E-05	0.00000E+00	2.9423
15	2275	1.76503E-06	9.78719E-01	8.03048E-05	-1.42372E-04	-8.32078E-06	0.00000E+00	3.1435

grp to grp	inner iters	mfd int.	max. flux difference	msf int.	max. scale factor	coarse mesh
1	1	10	2.10704E-05	47	9.99997E-01	6
2	1	10	1.98355E-05	26	9.99995E-01	9
3	1	10	2.06375E-05	23	9.99996E-01	10
4	1	10	2.38920E-05	15	9.99996E-01	12
5	1	10	1.86974E-05	15	9.99994E-01	16
6	1	11	1.44910E-05	15	9.99994E-01	16
7	1	9	1.06152E-05	3	1.00001E+00	24
8	1	10	5.88214E-06	2	1.00001E+00	45
9	1	1	4.78410E-06	2	1.00001E+00	45
10	1	17	4.22154E-06	17	9.99995E-01	45
11	1	17	4.13690E-06	18	9.99995E-01	45
12	1	19	5.00772E-06	19	9.99996E-01	45
13	1	19	5.18383E-06	19	9.99996E-01	45
14	1	19	4.96966E-06	20	9.99996E-01	45
15	2	11	6.02458E-06	12	9.99999E-01	45
16	2	11	6.23971E-06	12	9.99999E-01	45
17	2	11	5.64927E-06	12	1.00000E+00	45
18	2	11	5.19823E-06	12	1.00000E+00	45
19	2	11	5.58934E-06	12	1.00000E+00	45
20	2	11	3.80866E-06	32	9.99999E-01	45
21	2	11	3.41187E-06	51	9.99999E-01	50
22	2	11	2.55343E-06	51	9.99999E-01	50
23	1	37	3.05715E-05	37	1.00005E+00	50
24	1	38	8.25356E-05	38	1.00016E+00	50
25	2	30	7.24717E-07	30	1.00000E+00	50
26	2	51	1.72124E-06	51	9.99997E-01	50
27	2	51	2.72105E-06	51	9.99997E-01	50

16	2313	-3.75576E-08	9.78768E-01	1.01419E-05	-6.36755E-05	-1.56893E-06	0.00000E+00	3.2077

final monitor

lambda 9.78768E-01 production/absorption 9.79381E-01 angular flux on 16

elapsed time 3.21 min

TABLE 1
Effects of the Tank Wall on K_{eff} Values

Wall / Thickness	Cylinder (Radius=14.25 cm)	Slab (Thickness = 14.2 cm)
No Wall	1.02076	1.02548
Aluminum - 1/16"	1.02047	1.02611
Carbon Steel - 1/16"	1.00626	1.00230
Stainless Steel - 1/16"	1.00304	0.99729
Stainless Steel - 1/8"	0.99183	0.97877

TABLE 2
Values of K_{eff} for Critical Configurations

UOX??CR1.CJX UOF??CR1.CJA

CONFIGURATION	DIMENSION	XSDRNPM RESULTS	CSAS25 RESULTS
SPHERE	25 L	0.95414 ??=SP	0.94504±0.00406 ??=SP
CYLINDER	D = 25.6 cm	0.95291 ??=CY	0.95629±0.00425 ??=CY
SLAB	T = 12.4 cm	0.97866 ??=SL	0.97814±0.00407 ??=SL

TABLE 3
Values of K_{eff} for Safe Configurations

CONFIGURATION	DIMENSION	XSDRNPM RESULTS	CSAS25 RESULTS
SPHERE	18.6 L	0.90120	0.90748±0.00393
CYLINDER	D = 21.9 cm	0.89695	0.88700±0.00399
SLAB	T = 10.5 cm	0.92086	0.92228±0.00464

```
*****************************************************************************************************************
***                                                                                                           ***
***                          uo2f2 solution critical   sphere                    uoxspcr1.cjx                 ***
***                                                                                                           ***
*****************************************************************************************************************
*****************************************************************************************************************
***                                                                                                           ***
***                            ********** data library information **********                               ***
***                                                                                                           ***
***        unit                                                  volume                                       ***
***       number              data set name                      name       unit function                     ***
***       ------              -------------                      ----       -------------                     ***
***                                                                                                           ***
***         89                   ft89f001                                   standard composition library      ***
***                                                                                                           ***
***         82                   ft82f001                                   cross section library             ***
***                                                                                                           ***
***         11                   ft11f001                                   short cross section library       ***
***                                                                                                           ***
*****************************************************************************************************************
*****************************************************************************************************************
***                                                                                                           ***
***                                                                                                           ***
***                                  standard composition library data                                        ***
***                                  ---------------------------------                                        ***
***                                                                                                           ***
***           unit number   :  89                                                                             ***
***                                                                                                           ***
***           dataset name  :                ft89f001                                                         ***
***                                                                                                           ***
***           library title:  scale-4 standard composition library                                            ***
***                           379 standard compositions, 326 nuclides                                         ***
***                           10 elements with variable isotopic distrbutions.                                ***
***                                                                                                           ***
***           creation date:   7/11/91                                                                        ***
***                                                                                                           ***
***                                                                                                           ***
***                                                                                                           ***
***                                  cross section library data                                               ***
***                                  --------------------------                                               ***
***                                                                                                           ***
***           unit number   :  82                                                                             ***
***                                                                                                           ***
***           dataset name  :                ft82f001                                                         ***
***                                                                                                           ***
***           library title:  SCALE 4 - 27 NEUTRON GROUP CRITICALITY SAFETY LIBRARY                           ***
***                             BASED ON ENDF-B VERSION 4 DATA                                                ***
***                               COMPILED FOR NRC       1/27/89                                              ***
***                                 LAST UPDATED        10/12/89                                              ***
***                                   L.M.PETRIE       ORNL                                                   ***
***                                                                                                           ***
***                                                                                                           ***
***                                                                                                           ***
***                                                                                                           ***
*****************************************************************************************************************
*****************************************************************************************************************
                          .......   0 in's were used processing csas input data   .......
 control module csasi     s complete.
-------------------------------------------------------------
  Run with Aug 91 IBM-PC 486 (Extended) on 07/28/93 at 16:51:53
-------------------------------------------------------------
The input deck follows:
=CSASI
UO2F2 SOLUTION CRITICAL   SPHERE                        UOXSPCR1.CJX
27GROUPNDF4                INFHOMMEDIUM
SOLNUO2F2    1  1600.0 0 1.0 293   92235 5.02  92238 94.98  END
H2O          2  1.0  293  END
END COMP
END
=XSDRN
SPHERE CRITICAL  UO2F2 SOLUTION
```

```
0$$  A3 2  E
1$$  3 2 58 1 0   2 2 16 3 1
 10 50 0 0 0
2$$  -2 0 0 0 0    0 -1 0 0 0
3$$  0 0 0 1 0     0 0 0 0 0
     0 0
5**  A4 0  0  E
  T
13$$  1 2
14$$  1 2
15**  F1
   T
34**  F1
   T
35**  22I0 34I18.14 54.14
36$$  23R1 35R2
39$$  1 2
40$$  F3
   T
END
*******************************************************************************
```

outer iter	inner iters	1 - balance	eigenvalue	1 - source ratio	1 - scatter ratio	1 - upscat ratio	search parameter	time (min)
1	0	-4.44089E-16	1.09078E+00	6.13605E-01	1.00000E+00	0.00000E+00	0.00000E+00	0.0785
2	229	1.20747E-02	9.44304E-01	-2.31551E+00	-6.98371E-01	-6.17973E-02	0.00000E+00	0.4493
3	450	4.49142E-03	1.00393E+00	1.02406E-01	-2.89527E-01	-1.89792E-02	0.00000E+00	0.8100
4	659	2.16727E-03	9.88826E-01	7.55371E-02	-1.57471E-01	-8.46411E-03	0.00000E+00	1.1542
5	863	1.07187E-03	9.75072E-01	4.73928E-02	-8.63201E-02	-4.06952E-03	0.00000E+00	1.4928
6	1055	5.36731E-04	9.65996E-01	2.72860E-02	-4.58018E-02	-2.02500E-03	0.00000E+00	1.8153
7	1236	2.70439E-04	9.60622E-01	1.49867E-02	-2.39208E-02	-1.02596E-03	0.00000E+00	2.1238
8	1407	1.36217E-04	9.57615E-01	8.01636E-03	-1.23936E-02	-5.23730E-04	0.00000E+00	2.4183
9	1571	6.83173E-05	9.55975E-01	4.22264E-03	-6.38316E-03	-2.67951E-04	0.00000E+00	2.7042
10	1730	3.39389E-05	9.55096E-01	2.20218E-03	-3.26903E-03	-1.36781E-04	0.00000E+00	2.9843
11	1880	1.66430E-05	9.54625E-01	1.14096E-03	-1.66295E-03	-6.95385E-05	0.00000E+00	3.2513
12	2034	8.00734E-06	9.54374E-01	5.88321E-04	-8.39576E-04	-3.51298E-05	0.00000E+00	3.5243
13	2192	3.75785E-06	9.54238E-01	3.02686E-04	-4.20145E-04	-1.76336E-05	0.00000E+00	3.8025
14	2350	1.73594E-06	9.54162E-01	1.57138E-04	-2.09217E-04	-8.90433E-06	0.00000E+00	4.0808
15	2500	7.72605E-07	9.54118E-01	8.23659E-05	-1.04411E-04	-4.49773E-06	0.00000E+00	4.3490

	grp to grp	inner iters		mfd int.	max. flux difference	msf int.	max. scale factor	coarse mesh
	1	1	2	20	1.09790E-05	56	1.00000E+00	7
	2	2	1	1	9.05336E-05	7	1.00004E+00	11
	3	3	2	19	1.08100E-05	24	1.00000E+00	11
	4	4	2	20	7.56483E-06	25	1.00000E+00	14
	5	5	1	1	8.80618E-05	4	1.00005E+00	18
	6	6	1	1	7.10093E-05	3	1.00007E+00	25
	7	7	1	1	5.93624E-05	2	1.00008E+00	29
	8	8	1	1	5.43084E-05	2	1.00008E+00	46
	9	9	1	1	5.53492E-05	2	1.00007E+00	46
	10	10	1	1	5.49979E-05	2	1.00007E+00	46
	11	11	1	1	5.40554E-05	2	1.00007E+00	46
	12	12	1	1	6.47106E-05	2	1.00006E+00	46
	13	13	1	1	6.72528E-05	2	1.00006E+00	46
	14	14	1	1	6.50921E-05	1	1.00006E+00	58
	15	15	2	18	1.59634E-06	44	1.00000E+00	46
	16	16	2	58	1.62679E-06	58	1.00000E+00	46
	17	17	2	58	1.86684E-06	58	1.00000E+00	46
	18	18	2	58	1.82948E-06	58	1.00000E+00	46
	19	19	2	58	2.17684E-06	58	1.00000E+00	46
	20	20	2	58	1.61938E-06	44	9.99999E-01	58
	21	21	2	58	2.50649E-06	58	9.99999E-01	58
	22	22	2	58	2.32561E-06	58	9.99999E-01	58
	23	23	1	48	2.97136E-05	48	1.00005E+00	58
	24	24	1	48	7.96150E-05	48	1.00015E+00	58
	25	25	2	58	1.28792E-06	58	9.99999E-01	58
	26	26	2	58	2.57530E-06	58	9.99996E-01	58
	27	27	2	58	1.88426E-06	58	9.99998E-01	58
16	2541	1.21266E-10	9.54141E-01	6.69670E-06	-4.31340E-05	-1.09581E-07	0.00000E+00	4.4398

final monitor

lambda 9.54141E-01 production/absorption 9.56859E-01 angular flux on 16

elapsed time 4.44 min.

```
*********************************************************************************************************************
***                                                                                                               ***
***                          uo2f2 solution   critical  cylinder                 uoxcycr1.cjx                      ***
***                                                                                                               ***
*********************************************************************************************************************
*********************************************************************************************************************
***                                                                                                               ***
***                            ********** data library information **********                                    ***
***                                                                                                               ***
***          unit                                              volume                                             ***
***         number              data set name                  name          unit function                        ***
***         ------              -------------                  ----          -------------                        ***
***                                                                                                               ***
***           89                   ft89f001                                  standard composition library        ***
***                                                                                                               ***
***           82                   ft82f001                                  cross section library               ***
***                                                                                                               ***
***           11                   ft11f001                                  short cross section library         ***
***                                                                                                               ***
*********************************************************************************************************************
*********************************************************************************************************************
***                                                                                                               ***
***                                                                                                               ***
***                                    standard composition library data                                          ***
***                                    ---------------------------------                                          ***
***                                                                                                               ***
***           unit number  :  89                                                                                  ***
***                                                                                                               ***
***           dataset name :                  ft89f001                                                          ***
***                                                                                                               ***
***           library title:  scale-4 standard composition library                                              ***
***                           379 standard compositions, 326 nuclides                                           ***
***                           10 elements with variable isotopic distrbutions.                                  ***
***                                                                                                               ***
***           creation date:   7/11/91                                                                          ***
***                                                                                                               ***
***                                                                                                               ***
***                                                                                                               ***
***                                    cross section library data                                                 ***
***                                    --------------------------                                                 ***
***                                                                                                               ***
***           unit number  :  82                                                                                  ***
***                                                                                                               ***
***           dataset name :                  ft82f001                                                          ***
***                                                                                                               ***
***           library title:  SCALE 4 - 27 NEUTRON GROUP CRITICALITY SAFETY LIBRARY                             ***
***                             BASED ON ENDF-B VERSION 4 DATA                                                    ***
***                               COMPILED FOR NRC       1/27/89                                                ***
***                                 LAST UPDATED        10/12/89                                                ***
***                                   L.M.PETRIE       ORNL                                                     ***
***                                                                                                               ***
***                                                                                                               ***
***                                                                                                               ***
***                                                                                                               ***
*********************************************************************************************************************
*********************************************************************************************************************
                          ........   0 io's were used processing csas input data   ........
 control module csasi    is complete.
-----------------------------------------------------------------
  Run with Aug 91 IBM-PC 486 (Extended) on 07/28/93 at 17:08:56
-----------------------------------------------------------------
 The input deck follows:
*********************************************************************
 =CSASI
 UO2F2 SOLUTION   CRITICAL  CYLINDER                  UOXCYCR1.CJX
 27GROUPNDF4                INFHOMMEDIUM
 SOLNUO2F2    1  1600.0 0 1.0 293   92235 5.02  92238 94.98  END
 H2O          2  1.0  293  END
 END COMP
 END
 =XSDRN
 CYLINDER CRITICAL UO2F2
```

```
 0$$  A3 2  E
 1$$  2 2 51 1 0   2 2 16 3 1
  10 50 0 0 0
 2$$  -2 0 0 0 0    0 -1 0 0 0
 3$$  0 0 0 1 0     0 0 0 0 0
      0 6
 5**  A4 0  0  E
   T
 13$$  1 2
 14$$  1 2
 15**  F1
    T
 34**  F1
    T
 35**  15I0 34I12.3 47.3
 36$$  16R1 35R2
 39$$  1 2
 40$$  F3
    T
END
```

outer iter	inner iters	1 - balance	eigenvalue	1 - source ratio	1 - scatter ratio	1 - upscat ratio	search parameter	time (min)
1	0	0.00000E+00	1.07359E+00	6.51196E-01	1.00000E+00	0.00000E+00	0.00000E+00	0.0863
2	216	1.28970E-02	8.90728E-01	-2.58531E+00	-7.39504E-01	-6.36185E-02	0.00000E+00	1.3660
3	415	4.10788E-03	9.81072E-01	1.07130E-01	-3.08986E-01	-1.69647E-02	0.00000E+00	2.5523
4	612	1.80288E-03	9.75435E-01	7.05117E-02	-1.46822E-01	-6.94508E-03	0.00000E+00	3.7278
5	799	8.31595E-04	9.66780E-01	4.01742E-0.	-7.27999E-02	-3.14398E-03	0.00000E+00	4.8482
6	977	3.92532E-04	9.60855E-01	2.13924E-02	-3.58169E-02	-1.48743E-03	0.00000E+00	5.9185
7	1149	1.87485E-04	9.57369E-01	1.10437E-02	-1.75951E-02	-7.20398E-04	0.00000E+00	6.9555
8	1313	9.03679E-05	9.55398E-01	5.64403E-03	-8.66948E-03	-3.54933E-04	0.00000E+00	7.9488
9	1464	4.38227E-05	9.54300E-01	2.88730E-03	-4.30098E-03	-1.77265E-04	0.00000E+00	8.8697
10	1622	2.12945E-05	9.53690E-01	1.48580E-03	-2.15034E-03	-8.94840E-05	0.00000E+00	9.8298
11	1780	1.04828E-05	9.53338E-01	7.77893E-04	-1.08684E-03	-4.61116E-05	0.00000E+00	10.7893
12	1938	5.24114E-06	9.53130E-01	4.16839E-04	-5.60550E-04	-2.43310E-05	0.00000E+00	11.7495
13	2089	2.66438E-06	9.53005E-01	2.29247E-04	-2.96075E-04	-1.31692E-05	0.00000E+00	12.6707
14	2238	1.33437E-06	9.52932E-01	1.27854E-04	-1.59374E-04	-7.17473E-06	0.00000E+00	13.5803
15	2382	6.67232E-07	9.52887E-01	7.28730E-05	-8.66515E-05	-3.98800E-06	0.00000E+00	14.4630

grp to grp	inner iters		mfd int.	max. flux difference	msf int.	max. scale factor	coarse mesh
1	1	1	1	6.16050E-05	10	1.00001E+00	6
2	2	1	1	5.95639E-05	7	1.00002E+00	9
3	3	1	1	6.19431E-05	6	1.00002E+00	10
4	4	1	1	6.34331E-05	5	1.00002E+00	12
5	5	1	16	5.94935E-05	4	1.00003E+00	16
6	6	1	1	4.25008E-05	3	1.00004E+00	17
7	7	1	1	3.33310E-05	2	1.00004E+00	36
8	8	1	1	2.94313E-05	2	1.00004E+00	43
9	9	1	1	2.90006E-05	2	1.00004E+00	43
10	10	1	1	2.80116E-05	2	1.00004E+00	43
11	11	1	1	2.68436E-05	2	1.00003E+00	43
12	12	1	1	3.11625E-05	2	1.00003E+00	43
13	13	1	1	3.17406E-05	2	1.00003E+00	43
14	14	1	1	3.07516E-05	2	1.00002E+00	43
15	15	2	10	8.41974E-07	38	1.00000E+00	43
16	16	2	51	1.55258E-06	51	1.00000E+00	43
17	17	2	51	1.78909E-06	51	1.00000E+00	43
18	18	2	51	1.73996E-06	51	1.00000E+00	43
19	19	2	51	2.08926E-06	51	1.00000E+00	43
20	20	2	51	1.64650E-06	37	9.99999E-01	51
21	21	2	51	2.32078E-06	51	9.99999E-01	51
22	22	2	51	2.10010E-06	51	9.99999E-01	51
23	23	1	42	2.88350E-05	42	1.00005E+00	51
24	24	1	42	7.65141E-05	42	1.00015E+00	51
25	25	2	50	8.31635E-07	37	1.00000E+00	51
26	26	2	50	1.74540E-06	37	1.00000E+00	51
27	27	2	51	3.07478E-06	51	9.99997E-01	51

16	2420	-3.82022E-08	9.52907E-01	6.66095E-06	-3.87375E-05	-3.33055E-0	0.00000E+00	14.7422

final monitor

lambda 9.52906E-01 production/absorption 9.5 .69E-01 angular flux on 16

elapsed time 14.74 min.

```
******************************************************************************************************************************
***                                                                                                                        ***
***                          uo2f2 solution   critical   slab                  uoxslcr1.cjx                             ***
***                                                                                                                        ***
******************************************************************************************************************************
******************************************************************************************************************************
***                                                                                                                        ***
***                            ********** data library information **********                                            ***
***                                                                                                                        ***
***          unit                                                volume                                                ***
***         number              data set name                    name        unit function                             ***
***         ------              -------------                    ----        -------------                             ***
***                                                                                                                        ***
***           89                   ft89f001                                  standard composition library              ***
***                                                                                                                        ***
***           82                   ft82f001                                  cross section library                     ***
***                                                                                                                        ***
***           11                   ft11f001                                  short cross section library               ***
***                                                                                                                        ***
******************************************************************************************************************************
******************************************************************************************************************************
***                                                                                                                        ***
***                                                                                                                        ***
***                                  standard composition library data                                                     ***
***                                  ---------------------------------                                                     ***
***                                                                                                                        ***
***           unit number   :  89                                                                                          ***
***                                                                                                                        ***
***           dataset name :                 ft89f001                                                                    ***
***                                                                                                                        ***
***           library title:  scale-4 standard composition library                                                         ***
***                           379 standard compositions, 326 nuclides                                                      ***
***                           10 elements with variable isotopic distrbutions.                                             ***
***                                                                                                                        ***
***           creation date:   7/11/91                                                                                     ***
***                                                                                                                        ***
***                                                                                                                        ***
***                                                                                                                        ***
***                                  cross section library data                                                            ***
***                                  --------------------------                                                            ***
***                                                                                                                        ***
***           unit number   :  82                                                                                          ***
***                                                                                                                        ***
***           dataset name :                 ft82f001                                                                    ***
***                                                                                                                        ***
***           library title:  SCALE 4 - 27 NEUTRON GROUP CRITICALITY SAFETY LIBRARY                                        ***
***                             BASED ON ENDF-B VERSION 4 DATA                                                             ***
***                               COMPILED FOR NRC       1/27/89                                                           ***
***                                 LAST UPDATED        10/12/89                                                           ***
***                                   L.M.PETRIE       ORNL                                                              ***
***                                                                                                                        ***
***                                                                                                                        ***
***                                                                                                                        ***
***                                                                                                                        ***
******************************************************************************************************************************
******************************************************************************************************************************
                        ........    0 io's were used processing csas input data    ........
 control module csasi    is complete.
------------------------------------------------------------
  Run with Aug 91 IBM-PC 486 (Extended) on 07/28/93 at 17:31:17
------------------------------------------------------------
 The input deck follows:
******************************************************************************
=CSASI
UO2F2 SOLUTION   CRITICAL   SLAB                  UOXSLCR1.CJX
27GROUPNDF4                INFHOMMEDIUM
SOLNUO2F2     1  1600.0 0 1.0 293   92235 5.02  92238 94.98  END
H2O           2  1.0  293  END
END COMP
END
=XSDRN
SLAB   CRITICAL    UO2F2 SOLUTION
```

```
 0$$  A3 2  E
 1$$  1 2 50 1 0   2 2 16 3 1
  10 50 0 0 0
 2$$  -2 0 0 0 0    0 -1 0 0 0
 3$$  0 0 0 1 0     0 0 0 0 0
      0 0
 5**  A4 0  0  E
   T
 13$$  1 2
 14$$  1 2
 15**  F1
    T
 34**  F1
    T
 35**  9I0 39I6.2 46.2
 36$$  10R1 40R2
 39$$  1 2
 40$$  F3
    T
 END
*******************************************************************************
```

outer iter	inner iters	1 - balance	eigenvalue	1 - source ratio	1 - scatter ratio	1 - upscat ratio	search parameter	time (min)
1	0	0.00000E+00	1.05913E+00	6.87337E-01	1.00000E+00	0.00000E+00	0.00000E+00	0.0740
2	215	1.32433E-02	8.65830E-01	-2.95426E+00	-7.57499E-01	-6.38226E-02	0.00000E+00	0.3315
3	412	3.68716E-03	9.87287E-01	1.01578E-01	-3.11976E-01	-1.50987E-02	0.00000E+00	0.5720
4	606	1.49429E-03	9.91789E-01	5.99143E-02	-1.30297E-01	-5.76001E-03	0.00000E+00	0.8102
5	789	6.49832E-04	9.88268E-01	3.10259E-02	-5.91344E-02	-2.48160E-03	0.00000E+00	1.0388
6	961	2.95734E-04	9.84854E-01	1.58010E-02	-2.74061E-02	-1.14059E-03	0.00000E+00	1.2568
7	1126	1.39867E-04	9.82500E-01	7.98699E-03	-1.30469E-02	-5.49860E-04	0.00000E+00	1.4692
8	1274	6.87069E-05	9.80999E-01	4.12256E-03	-6.41443E-03	-2.76705E-04	0.00000E+00	1.6662
9	1425	3.49428E-05	9.80072E-01	2.18688E-03	-3.26678E-03	-1.44616E-04	0.00000E+00	1.8648
10	1576	1.84044E-05	9.79499E-01	1.19611E-03	-1.72269E-03	-7.83850E-05	0.00000E+00	2.0643
11	1726	1.00509E-05	9.79142E-01	6.75554E-04	-9.41309E-04	-4.40353E-05	0.00000E+00	2.2630
12	1875	5.66887E-06	9.78917E-01	3.93018E-04	-5.32470E-04	-2.55270E-05	0.00000E+00	2.4607
13	2019	3.29035E-06	9.78774E-01	2.34747E-04	-3.10616E-04	-1.52121E-05	0.00000E+00	2.6537
14	2163	1.95908E-06	9.78682E-01	1.43565E-04	-1.86236E-04	-9.29274E-06	0.00000E+00	2.8470
15	2307	1.18999E-06	9.78623E-01	8.96365E-05	-1.14403E-04	-5.79718E-06	0.00000E+00	3.0400

grp to grp	inner iters	mfd int.	max. flux difference	msf int.	max. scale factor	coarse mesh
1	1	10	2.51204E-05	50	9.99997E-01	6
2	1	10	2.36336E-05	26	9.99995E-01	8
3	1	10	2.48867E-05	24	9.99996E-01	10
4	1	10	2.64939E-05	6	1.00000E+00	12
5	1	10	2.94755E-05	5	1.00001E+00	16
6	1	10	1.78352E-05	4	1.00001E+00	16
7	1	9	1.28936E-05	3	1.00001E+00	4
8	1	1	6.95126E-06	2	1.00001E+00	45
9	1	1	5.72931E-06	2	1.00001E+00	45
10	1	1	4.71180E-06	2	1.00001E+00	45
11	1	18	4.24796E-06	19	9.99994E-01	45
12	1	19	5.18899E-06	19	9.99995E-01	45
13	1	19	5.35356E-06	20	9.99996E-01	45
14	1	20	5.14291E-06	20	9.99996E-01	45
15	2	10	7.53909E-07	31	1.00000E+00	45
16	2	50	1.38790E-06	50	1.00000E+00	45
17	2	50	1.59919E-06	50	1.00000E+00	45
18	2	50	1.55317E-06	50	1.00000E+00	45
19	2	50	1.86307E-06	50	1.00000E+00	45
20	2	50	1.39483E-06	31	9.99999E-01	45
21	2	50	2.00119E-06	50	9.99999E-01	45
22	2	50	1.80752E-06	50	9.99999E-01	45
23	1	36	2.97382E-05	36	1.00005E+00	50
24	1	37	7.91269E-05	37	1.00015E+00	50
25	2	49	7.06985E-07	31	1.00000E+00	50
26	2	50	1.89160E-06	50	9.99997E-01	50
27	2	50	1.88531E-06	50	9.99998E-01	50

16	2345	-3.77786E-08	9.78658E-01	9.58952E-06	-5.44458E-05	-9.81480E-07	0.00000E+00	3.0988

final monitor lambda 9.78658E-01 production/absorption 9.79360E-01 angular flux on 16

elapsed time 3.10 min.

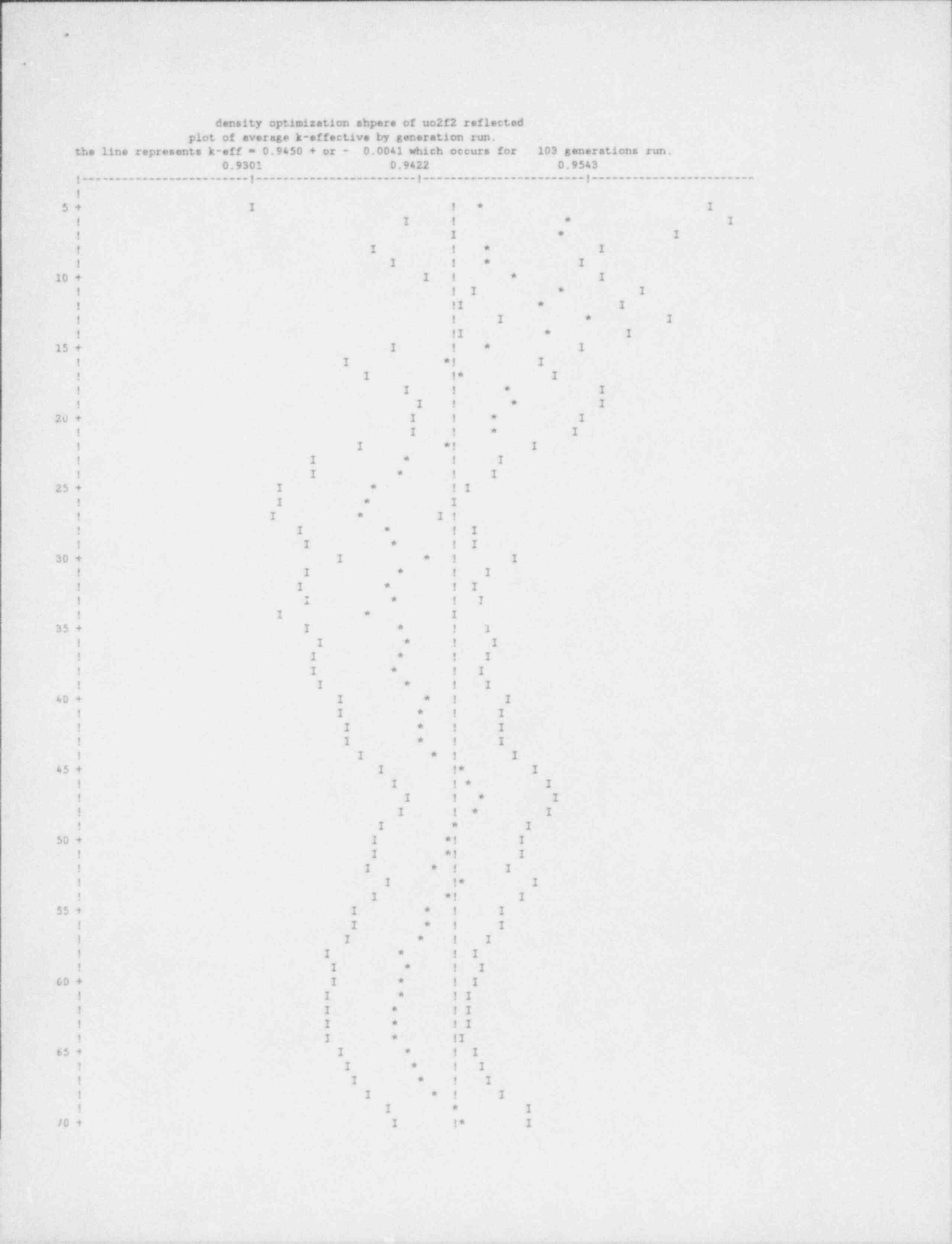
0.94504

```
#C5AS25
CRITICAL    SPHERICAL UO2F2                                    UOFSPCR1.CJA
27GROUPNDF4                INFHOMMEDIUM
SOLNUO2F2   1  1600.0 0 1.0 293  92235 5.02  92238 94.98  END
H2O         2  1.0 293 END
END COMP
DENSITY OPTIMIZATION SHPERE OF UO2F2 REFLECTED
READ PARM  RUN=YES PLT=YES  TME=45 END PARM
READ GEOM
GLOBAL UNIT  1
COM='REFLECTED SHPERE OF UO2F2'
SPHERE      1 1    18.14
CUBE        2 1    53.14  -53.14
END GEOM
READ BNDS  ALL=VACUUM  END BNDS
READ START  NST=6  TFX=0.0 TFY=0.0 TFZ=0.0  LNU=300  END START
READ PLOT
TTL='X - Y  SLICE AT Z = 0.0'
PLT=NO PIC=MIXTURE XUL=-35 YUL=35 ZUL=0 XLR=35 YLR=-35 ZLR=0
UAX=1 VAX=0 WAX=0 UDN=0 VDN=-1 WDN=0 NAX=130
NCH='VFW' END
END PLOT
END DATA
END
```

density optimization shpere of uo2f2 reflected

lifetime = 1.76229E-04 + or - 1.91373E-06 generation time = 5.68378E-05 + or - 6.10286E-07

no. of initial generations skipped	average k-effective	deviation	67 per cent confidence interval	95 per cent confidence interval	99 per cent confidence interval	number of histories
3	0.94504	+ or - 0.00406	0.94098 to 0.94911	0.93692 to 0.95317	0.93285 to 0.95724	30000
4	0.94520	+ or - 0.00410	0.94109 to 0.94930	0.93699 to 0.95340	0.93289 to 0.95750	29700
5	0.94501	+ or - 0.00414	0.94087 to 0.94915	0.93673 to 0.95329	0.93259 to 0.95743	29400
6	0.94480	+ or - 0.00418	0.94062 to 0.94897	0.93644 to 0.95315	0.93226 to 0.95733	29100
7	0.94472	+ or - 0.00422	0.94050 to 0.94894	0.93628 to 0.95316	0.93206 to 0.95739	28800
8	0.94493	+ or - 0.00426	0.94067 to 0.94919	0.93641 to 0.95345	0.93215 to 0.95771	28500
9	0.94491	+ or - 0.00431	0.94061 to 0.94922	0.93630 to 0.95352	0.93199 to 0.95783	28200
10	0.94472	+ or - 0.00435	0.94037 to 0.94907	0.93602 to 0.95342	0.93168 to 0.95777	27900
11	0.94441	+ or - 0.00438	0.94002 to 0.94879	0.93564 to 0.95318	0.93125 to 0.95756	27600
12	0.94444	+ or - 0.00443	0.94001 to 0.94888	0.93558 to 0.95331	0.93115 to 0.95774	27300
17	0.94499	+ or - 0.00461	0.94038 to 0.94961	0.93576 to 0.95422	0.93115 to 0.95884	25800
22	0.94517	+ or - 0.00481	0.94036 to 0.94997	0.93556 to 0.95478	0.93075 to 0.95958	24300
27	0.94729	+ or - 0.00499	0.94230 to 0.95228	0.93732 to 0.95727	0.93233 to 0.96225	22800
32	0.94717	+ or - 0.00511	0.94206 to 0.95229	0.93695 to 0.95740	0.93183 to 0.96251	21300
37	0.94708	+ or - 0.00527	0.94181 to 0.95235	0.93654 to 0.95762	0.93127 to 0.96289	19800
42	0.94660	+ or - 0.00561	0.94099 to 0.95220	0.93539 to 0.95781	0.92978 to 0.96341	18300
47	0.94363	+ or - 0.00587	0.93775 to 0.94950	0.93188 to 0.95538	0.92601 to 0.96125	16800
52	0.94646	+ or - 0.00626	0.94019 to 0.95272	0.93393 to 0.95898	0.92767 to 0.96524	15300
57	0.94838	+ or - 0.00634	0.94205 to 0.95472	0.93571 to 0.96106	0.92937 to 0.96740	13800
62	0.95133	+ or - 0.00678	0.94454 to 0.95811	0.93776 to 0.96490	0.93097 to 0.97168	12300
67	0.94959	+ or - 0.00749	0.94210 to 0.95709	0.93461 to 0.96458	0.92711 to 0.97208	10800
72	0.94287	+ or - 0.00734	0.93553 to 0.95022	0.92818 to 0.95756	0.92084 to 0.96490	9300
77	0.94319	+ or - 0.00857	0.93462 to 0.95176	0.92606 to 0.96033	0.91749 to 0.96889	7800
82	0.93813	+ or - 0.00986	0.92827 to 0.94799	0.91841 to 0.95785	0.90855 to 0.96771	6300
87	0.94334	+ or - 0.01193	0.93141 to 0.95528	0.91948 to 0.96721	0.90755 to 0.97914	4800
92	0.93976	+ or - 0.01348	0.92628 to 0.95325	0.91279 to 0.96673	0.89931 to 0.98021	3300


density optimization shpere of uo2f2 reflected
plot of average k-effective by generation run.
the line represents k-eff = 0.9450 + or - 0.0041 which occurs for 103 generations run.
0.9301
0.9422
0.9543
5
10
15
20
25
30
35
40
45
50
55
60
65
70


75
80
85
90
95
100

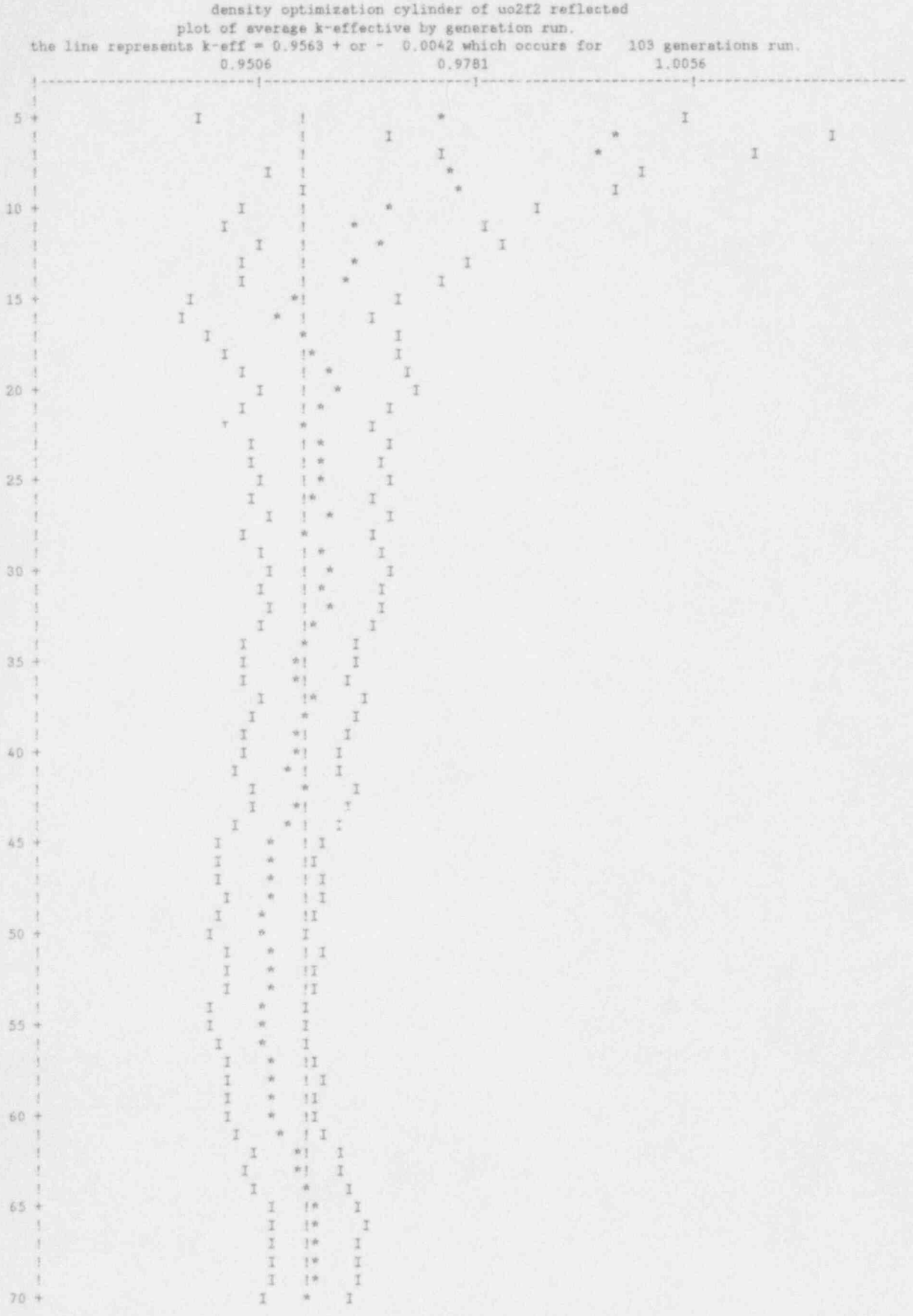
0.95629

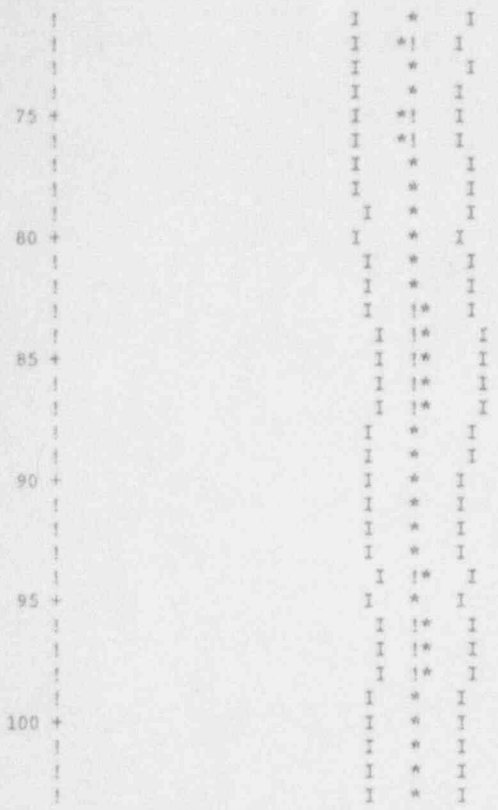
```
********************************************************************************
#CSAS25
CRITICAL     CYLINDER UO2F2                                  UOFCYCR1.CJA
27GROUPNDF4                  INFHOMMEDIUM
SOLNUO2F2   1  1600.0 0 1.0 293  92235 5.02  92238 94.98  END
H2O         2  1.0 293 END
END COMP
DENSITY OPTIMIZATION CYLINDER OF UO2F2 REFLECTED
READ PARM  RUN=YES PLT=YES  TME=45 END PARM
READ GEOM
GLOBAL UNIT  1
 OM=!REFLECTED CYLINDER OF UO2F2!
CYLINDER   1 1    12.3    2P200.0
CUBOID     2 1    4P47.3  2P200.0
END GEOM
READ BNDS  +XB=VACUUM -XB=VACUUM +YB=VACUUM -YB=VACUUM +ZB=MIRROR -ZB=MIRROR
 END BNDS
READ PLOT
TTL='X - Y  SLICE AT Z = 0.0'
PLT NO PIC=MIXTURE XUL=-25 YUL=25 ZUL=0 XLR=25 YLR=-25 ZLR=0 UAX=1 VAX=0 WAX=0
UDN=0 VDN=-1 WDN=0 NAX=130
NCH='VFW' END
END PLOT
END DATA
END
********************************************************************************
```

density optimization cylinder of uo2f2 reflected

lifetime = 1.75981E-04 + or - 1.54512E-06 generation time = 6.09431E-05 + or - 6.47076E-07

no. of initial generations skipped	average k-effective	deviation	67 per cent confidence interval	95 per cent confidence interval	99 per cent confidence interval	number of histories
3	0.95629	+ or - 0.00425	0.95204 to 0.96054	0.94779 to 0.96478	0.94354 to 0.96903	30000
4	0.95579	+ or - 0.00426	0.95153 to 0.96005	0.94726 to 0.96431	0.94300 to 0.96858	29700
5	0.95591	+ or - 0.00430	0.95161 to 0.96022	0.94730 to 0.96452	0.94300 to 0.96883	29400
6	0.95506	+ or - 0.00426	0.95080 to 0.95932	0.94653 to 0.96359	0.94227 to 0.96785	29100
7	0.95471	+ or - 0.00429	0.95042 to 0.95901	0.94612 to 0.96330	0.94183 to 0.96759	28800
8	0.95526	+ or - 0.00430	0.95095 to 0.95956	0.94665 to 0.96387	0.94235 to 0.96817	28500
9	0.95500	+ or - 0.00434	0.95066 to 0.95935	0.94632 to 0.96369	0.94198 to 0.96803	28200
10	0.95545	+ or - 0.00437	0.95109 to 0.95982	0.94672 to 0.96418	0.94236 to 0.96855	27900
11	0.95569	+ or - 0.00441	0.95128 to 0.96010	0.94688 to 0.96450	0.94247 to 0.96891	27600
12	0.95526	+ or - 0.00443	0.95083 to 0.95970	0.94639 to 0.96413	0.94196 to 0.96856	27300
17	0.95622	+ or - 0.00459	0.95163 to 0.96081	0.94704 to 0.96540	0.94244 to 0.96999	25800
22	0.95627	+ or - 0.00481	0.95147 to 0.96108	0.94666 to 0.96589	0.94186 to 0.97069	24300
27	0.95526	+ or - 0.00503	0.95023 to 0.96029	0.94520 to 0.96533	0.94016 to 0.97036	22800
32	0.95489	+ or - 0.00525	0.94964 to 0.96014	0.94439 to 0.96539	0.93914 to 0.97064	21300
37	0.95562	+ or - 0.00543	0.95019 to 0.96106	0.94476 to 0.96649	0.93933 to 0.97192	19800
42	0.95625	+ or - 0.00568	0.95057 to 0.96193	0.94488 to 0.96762	0.93920 to 0.97330	18300
47	0.95956	+ or - 0.00583	0.95373 to 0.96539	0.94791 to 0.97122	0.94208 to 0.97704	16800
52	0.96025	+ or - 0.00611	0.95413 to 0.96636	0.94802 to 0.97247	0.94191 to 0.97858	15300
57	0.96111	+ or - 0.00635	0.95476 to 0.96746	0.94842 to 0.97380	0.94207 to 0.98015	13800
62	0.95753	+ or - 0.00618	0.95135 to 0.96371	0.94516 to 0.96989	0.93898 to 0.97608	12300
67	0.95389	+ or - 0.00607	0.94782 to 0.95997	0.94175 to 0.96604	0.93568 to 0.97211	10800
72	0.95689	+ or - 0.00667	0.95022 to 0.96357	0.94354 to 0.97024	0.93687 to 0.97691	9300
77	0.95504	+ or - 0.00747	0.94757 to 0.96251	0.94010 to 0.96998	0.93264 to 0.97745	7800
82	0.95345	+ or - 0.00888	0.94457 to 0.96233	0.93569 to 0.97121	0.92681 to 0.98009	6300
87	0.94641	+ or - 0.01075	0.93566 to 0.95715	0.92491 to 0.96790	0.91416 to 0.97865	4800
92	0.95196	+ or - 0.01338	0.93857 to 0.96534	0.92519 to 0.97873	0.91180 to 0.99211	3300


density optimization cylinder of uo2f2 reflected
plot of average k-effective by generation run.
the line represents k-eff = 0.9563 + or - 0.0042 which occurs for 103 generations run.
0.9506
0.9781
1.0056


75
80
85
90
95
100

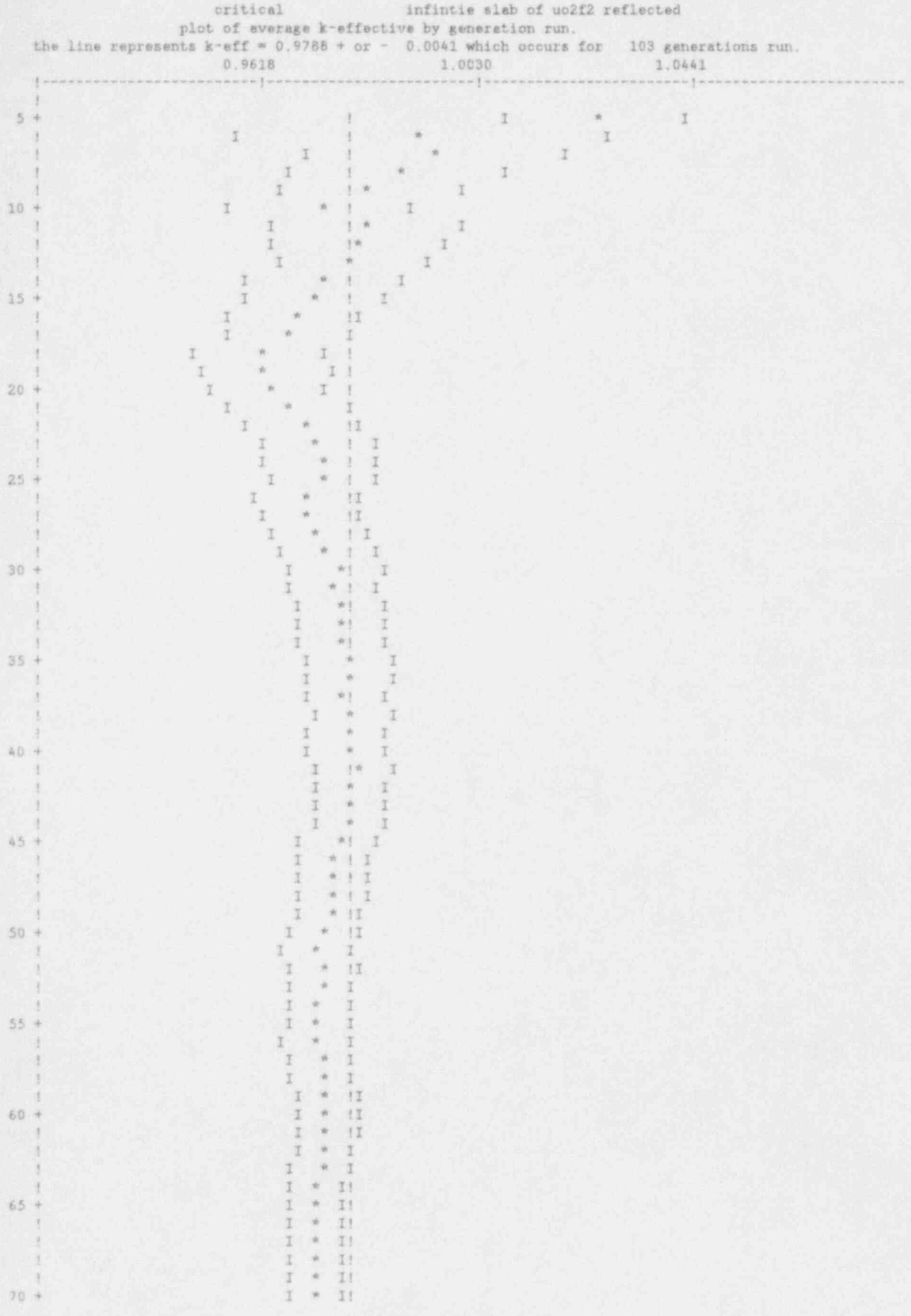
0.97880

```
*****************************************************************************
 #CSAS25
 CRITICAL                  INFINITE SLAB UO2F2              UOFSLCR1.CJA
 27GROUPNDF4                 INFHOMMEDIUM
 SOLNUO2F2   1  1700.0 0 1.0 293  92235 5.02  92238 94.98  END
 H2O         2  1.0 293 END
 END COMP
 CRITICAL              INFINTIE SLAB OF UO2F2 REFLECTED
 READ PARM  RUN=YES PLT=YES  TME=45 END PARM
 READ GEOM
 GLOBAL UNIT  1
 COM='REFLECTED SLAB OF UO2F2'
 CUBOID     1 1    2P6.2   4P100.0
 CUBOID     2 1    2P41.2  4P100.0
 END GEOM
 READ BNDS  +XB=VACUUM -XB=VACUUM +YB=MIRROR -YB=MIRROR +ZB=MIRROR -ZB=MIRROR
  END BNDS
 READ PLOT
 TTL='X - Y  SLICE AT Z = 0.0'
 PLT=NO PIC=MIXTURE XUL=-25 YUL=25 ZUL=0 XLR=25 YLR=-25 ZLR=0 UAX=1 VAX=0 WAX=0
 UDN=0 VDN=-1 WDN=0 NAX=130
 NCH='VFW' END
 END PLOT
 END DATA
 END
*****************************************************************************
```

critical infintie slab of uo2f2 reflected

lifetime = 1.69776E-04 + or - 1.21169E-06 generation time = 6.34988E-05 + or - 6.15793E-07

no. of initial generations skipped	average k-effective	deviation	67 per cent confidence interval	95 per cent confidence interval	99 per cent confidence interval	number of histories
3	0.97880	+ or - 0.00409	0.97471 to 0.98288	0.97062 to 0.98697	0.96654 to 0.99106	30000
4	0.97814	+ or - 0.00407	0.97406 to 0.98221	0.96999 to 0.98629	0.96591 to 0.99036	29700
5	0.97702	+ or - 0.00410	0.97372 to 0.98192	0.96961 to 0.98603	0.96551 to 0.99013	29400
6	0.97837	+ or - 0.00411	0.97426 to 0.98248	0.97015 to 0.98659	0.96604 to 0.99069	29100
7	0.97810	+ or - 0.00414	0.97395 to 0.98224	0.96981 to 0.98638	0.96567 to 0.99053	28800
8	0.97830	+ or - 0.00418	0.97412 to 0.98248	0.96994 to 0.98667	0.96576 to 0.99085	28500
9	0.97852	+ or - 0.00422	0.97430 to 0.98274	0.97007 to 0.98696	0.96585 to 0.99118	28200
10	0.97920	+ or - 0.00421	0.97499 to 0.98341	0.97078 to 0.98762	0.96657 to 0.99183	27900
11	0.97845	+ or - 0.00419	0.97427 to 0.98264	0.97008 to 0.98683	0.96589 to 0.99102	27600
12	0.97864	+ or - 0.00423	0.97441 to 0.98287	0.97018 to 0.98709	0.96595 to 0.99132	27300
17	0.98061	+ or - 0.00435	0.97626 to 0.98496	0.97192 to 0.98930	0.96757 to 0.99365	25800
22	0.98083	+ or - 0.00435	0.97648 to 0.98518	0.97212 to 0.98953	0.96777 to 0.99388	24300
27	0.98106	+ or - 0.00447	0.97659 to 0.98552	0.97212 to 0.98999	0.96765 to 0.99446	22800
32	0.97925	+ or - 0.00461	0.97464 to 0.98386	0.97002 to 0.98848	0.96541 to 0.99309	21300
37	0.97916	+ or - 0.00489	0.97427 to 0.98406	0.96938 to 0.98895	0.96449 to 0.99384	19800
42	0.97855	+ or - 0.00502	0.97354 to 0.98357	0.96852 to 0.98859	0.96350 to 0.99360	18300
47	0.98072	+ or - 0.00512	0.97560 to 0.98584	0.97048 to 0.99096	0.96536 to 0.99608	16800
52	0.98343	+ or - 0.00527	0.97816 to 0.98871	0.97289 to 0.99398	0.96762 to 0.99925	15300
57	0.98477	+ or - 0.00559	0.97918 to 0.99037	0.97358 to 0.99596	0.96799 to 1.00155	13800
62	0.98495	+ or - 0.00619	0.97876 to 0.99114	0.97257 to 0.99734	0.96638 to 1.00353	12300
67	0.99058	+ or - 0.00635	0.98423 to 0.99693	0.97788 to 1.00328	0.97153 to 1.00963	10800
72	0.99009	+ or - 0.00681	0.98328 to 0.99690	0.97646 to 1.00371	0.96965 to 1.01052	9300
77	0.98982	+ or - 0.00725	0.98257 to 0.99707	0.97531 to 1.00432	0.96806 to 1.01157	7800
82	0.98725	+ or - 0.00872	0.97853 to 0.99598	0.96980 to 1.00470	0.96108 to 1.01342	6300
87	0.99138	+ or - 0.01106	0.98032 to 1.00245	0.96925 to 1.01351	0.95819 to 1.02457	4800
92	0.98119	+ or - 0.01466	0.96653 to 0.99584	0.95187 to 1.01050	0.93722 to 1.02516	3300


critical infintie slab of uo2f2 reflected
plot of average k-effective by generation run.
the line represents k-eff = 0.9788 + or - 0.0041 which occurs for 103 generations run.
0.9618
1.0030
1.0441
5
10
15
20
25
30
35
40
45
50
55
60
65
70

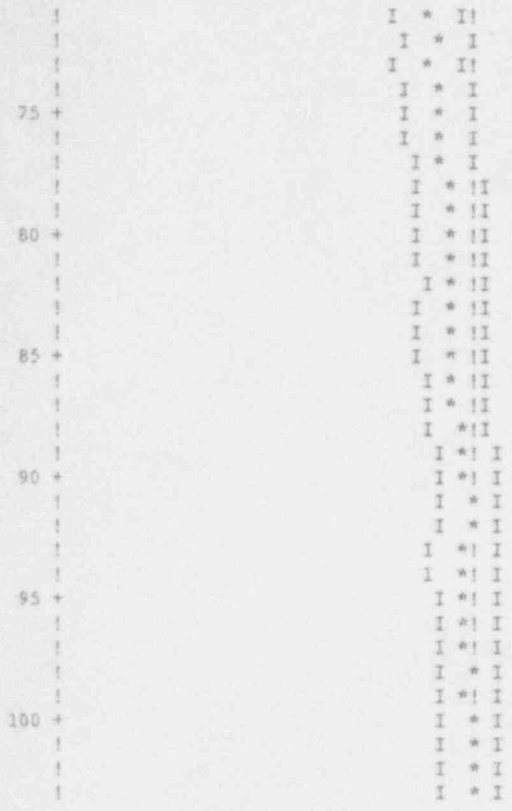

75
80
85
90
95
100

TABLE 1
Effects of the Tank Wall on K_{eff} Values

Wall / Thickness	Cylinder (Radius=14.25 cm)	Slab (Thickness = 14.2 cm)
No Wall	1.02076	1.02548
Aluminum - 1/16"	1.02047	1.02611
Carbon Steel - 1/16"	1.00626	1.00230
Stainless Steel - 1/16"	1.00304	0.99729
Stainless Steel - 1/8"	0.99183	0.97877

TABLE 2
Values of K_{eff} for Critical Configurations

CONFIGURATION	DIMENSION	XSDRNPM RESULTS	CSAS25 RESULTS
SPHERE	25 L	0.95414	0.94504±0.00406
CYLINDER	D = 25.6 cm	0.95291	0.95629±0.00425
SLAB	T = 12.4 cm	0.97866	0.97814±0.00407

TABLE 3
Values of K_{eff} for Safe Configurations

40X ??SF1.CJX UOF??SF1.CJA

CONFIGURATION	DIMENSION	XSDRNPM RESULTS	CSAS25 RESULTS
SPHERE	18.6 L	0.90120 ??=SP	0.90748±0.00393 ??=SP
CYLINDER	D = 21.9 cm	0.89695 ??=CY	0.88700±0.00399 ??=CY
SLAB	T = 10.5 cm	0.92086 ??=SL	0.92228±0.00464 ??=SL

```
*****************************************************************************************************************
***                                                                                                           ***
***                                 uo2f2 solution safe   sphere                        uoxspsf1.cjx          ***
***                                                                                                           ***
*****************************************************************************************************************
*****************************************************************************************************************
***                                                                                                           ***
***                                ********** data library information **********                            ***
***                                                                                                           ***
***         unit                                                     volume                                   ***
***        number                data set name                        name        unit function               ***
***        ------                -------------                        ----        -------------               ***
***                                                                                                           ***
***          89                     ft89f001                                      standard composition library ***
***                                                                                                           ***
***          82                     ft82f001                                      cross section library       ***
***                                                                                                           ***
***          11                     ft11f001                                      short cross section library ***
***                                                                                                           ***
*****************************************************************************************************************
*****************************************************************************************************************
***                                                                                                           ***
***                                                                                                           ***
***                                       standard composition library data                                  ***
***                                       ---------------------------------                                  ***
***                                                                                                           ***
***           unit number  :  89                                                                              ***
***                                                                                                           ***
***           dataset name :                 ft89f001                                                         ***
***                                                                                                           ***
***           library title:  scale-4 standard composition library                                           ***
***                           379 standard compositions, 326 nuclides                                        ***
***                           10 elements with variable isotopic distrbutions.                               ***
***                                                                                                           ***
***           creation date:   7/11/91                                                                        ***
***                                                                                                           ***
***                                                                                                           ***
***                                                                                                           ***
***                                            cross section library data                                    ***
***                                           ---------------------------                                    ***
***                                                                                                           ***
***           unit number  :  82                                                                              ***
***                                                                                                           ***
***           dataset name :                 ft82f001                                                         ***
***                                                                                                           ***
***           library title:  SCALE 4 - 27 NEUTRON GROUP CRITICALITY SAFETY LIBRARY                          ***
***                             BASED ON ENDF-B VERSION 4 DATA                                               ***
***                               COMPILED FOR NRC        1/27/89                                            ***
***                                 LAST UPDATED          10/12/89                                           ***
***                                   L.M.PETRIE       ORNL                                                  ***
***                                                                                                           ***
***                                                                                                           ***
***                                                                                                           ***
***                                                                                                           ***
*****************************************************************************************************************
*****************************************************************************************************************
                               ........    0 io's were used processing csas input data    ........
 control module csasi    is complete.
 ------------------------------------------------------------
  Run with Aug 91 IBM-PC 486 (Extended) on 07/28/93 at 16:45:13
 ------------------------------------------------------------
 The input deck follows:
 ****************************************************************************
 =CSAS1
 UO2F2 SOLUTION SAFE   SPHERE                         UOXSPSF1.CJX
 27GROUPNDF4              INFHOMMEDIUM
 SOLNUO2F2    1  1600.0 0 1.0 293   92235 5.02  92238 94.98  END
 H2O          2  1.0  293  END
 END COMP
 END
 =XSDRN
 SPHERE SAFE               UO2F2 SOLUTION
```

```
08$  A3 2  E
19$  3 2 58 1 0   2 2 16 3 1
 10 50 0 0 0
20$  -2 0 0 0 0    0 -1 0 0 0
38$  0 0 0 1 0     0 0 0 0 0
     0 0
5**  A4 0  0  E
  T
13$$  1 2
14$$  1 2
15**  F1
   T
34**  F1
   T
35**  22I0 34I16.44  51.44
36$$  23R1 35R2
39$$  1 2
40$$  F3
   T
END
*******************************************************************************
```

outer iter	inner iters	1 - balance	eigenvalue	1 - source ratio	1 - scatter ratio	1 - upscat ratio	search parameter	time (min)
1	0	-2.22045E-16	1.07804E+00	6.38026E-01	1.00000E+00	0.00000E+00	0.00000E+00	0.0762
2	230	1.30740E-02	8.80865E-01	-2.43793E+00	-7.49988E-01	-6.44759E-02	0.00000E+00	0.4487
3	448	4.47595E-03	9.48154E-01	1.20368E-01	-3.27255E-01	-1.82507E-02	0.00000E+00	0.8047
4	656	1.99933E-03	9.33833E-01	8.42030E-02	-1.65944E-01	-7.57083E-03	0.00000E+00	1.1482
5	857	9.25377E-04	9.20293E-01	4.96792E-02	-8.43908E-02	-3.42889E-03	0.00000E+00	1.4820
6	1046	4.36180E-04	9.11660E-01	2.68996E-02	-4.18634E-02	-1.61719E-03	0.00000E+00	1.8007
7	1221	2.07616E-04	9.06748E-01	1.39626E-02	-2.05897E-02	-7.79736E-04	0.00000E+00	2.1010
8	1390	9.86534E-05	9.04122E-01	7.08456E-03	-1.00983E-02	-3.78966E-04	0.00000E+00	2.3928
9	1552	4.66547E-05	9.02736E-01	3.55737E-03	-4.93539E-03	-1.85019E-04	0.00000E+00	2.6767
10	1702	2.18776E-05	9.02004E-01	1.78174E-03	-2.40798E-03	-9.05824E-05	0.00000E+00	2.9440
11	1860	1.00274E-05	9.01623E-01	8.89704E-04	-1.17113E-03	-4.41182E-05	0.00000E+00	3.2225
12	2018	4.56307E-06	9.01413E-01	4.49630E-04	-5.67655E-04	-2.17395E-05	0.00000E+00	3.5005
13	2176	2.03646E-06	9.01295E-01	2.30982E-04	-2.77640E-04	-1.08146E-05	0.00000E+00	3.7790
14	2334	8.84006E-07	9.01228E-01	1.21248E-04	-1.36956E-04	-5.45161E-06	0.00000E+00	4.0572
15	2484	3.68849E-07	9.01187E-01	6.54168E-05	-6.84727E-05	-2.80081E-06	0.00000E+00	4.3245

grp to grp	inner iters	mfd int.	max. flux difference	maf int.	max. scale factor	coarse mesh
1	1	1	9.51015E-05	11	1.00002E+00	6
2	1	1	8.58222E-05	7	1.00004E+00	10
3	1	1	9.59430E-05	7	1.00003E+00	11
4	1	1	9.99094E-05	5	1.00003E+00	14
5	1	1	8.33326E-05	4	1.00005E+00	18
6	1	1	6.75752E-05	4	1.00006E+00	18
7	1	1	5.76698E-05	3	1.00007E+00	25
8	1	1	4.99649E-05	2	1.00007E+00	46
9	1	1	5.05459E-05	2	1.00007E+00	46
10	1	1	4.99276E-05	2	1.00007E+00	46
11	1	1	4.88105E-05	2	1.00006E+00	46
12	1	1	5.81725E-05	2	1.00005E+00	46
13	1	1	6.02602E-05	2	1.00005E+00	46
14	1	1	5.91862E-05	2	1.00005E+00	46
15	2	18	1.30080E-06	44	1.00000E+00	46
16	2	58	1.60087E-06	58	1.00000E+00	46
17	2	58	1.81598E-06	58	1.00000E+00	46
18	2	58	1.77654E-06	58	1.00000E+00	46
19	2	58	2.13425E-06	58	1.00000E+00	46
20	2	58	1.80204E-06	46	9.99999E-01	46
21	2	58	2.49418E-06	58	9.99999E-01	58
22	2	58	2.28532E-06	58	9.99999E-01	58
23	1	49	2.90556E-05	49	1.00005E+00	58
24	1	49	7.59282E-05	49	1.00015E+00	58
25	2	58	1.03341E-06	58	9.99999E-01	58
26	2	58	2.24474E-06	58	9.99997E-01	58
27	2	58	1.77499E-06	58	9.99998E-01	58

outer iter	inner iters	1 - balance	eigenvalue	1 - source ratio	1 - scatter ratio	1 - upscat ratio	search parameter	time (min)
16	2522	-6.07780E-12	9.01198E-01	4.40202E-06	-2.96228E-05	8.57385E-08	0.00000E+00	4.4033

final monitor
lambda 9.01198E-01 production/absorption 9.04498E-01 angular flux on 16

elapsed time 4.40 min.

```
*****************************************************************************************************************
***                                                                                                           ***
***                          uo2f2 solution   safe  cylinder                uoxcysf1.cjx                      ***
***                                                                                                           ***
*****************************************************************************************************************
*****************************************************************************************************************
***                                                                                                           ***
***                            ********** data library information **********                               ***
***                                                                                                           ***
***          unit                                                volume                                       ***
***         number              data set name                    name        unit function                    ***
***         ------              -------------                    ----        -------------                    ***
***                                                                                                           ***
***           89                   ft89f001                                 standard composition library     ***
***                                                                                                           ***
***           82                   ft82f001                                 cross section library            ***
***                                                                                                           ***
***           11                   ft11f001                                 short cross section library      ***
***                                                                                                           ***
*****************************************************************************************************************
*****************************************************************************************************************
***                                                                                                           ***
***                                                                                                           ***
***                                  standard composition library data                                        ***
***                                  ---------------------------------                                        ***
***                                                                                                           ***
***           unit number   :  89                                                                             ***
***                                                                                                           ***
***           dataset name :                ft89f001                                                        ***
***                                                                                                           ***
***           library title:  scale-4 standard composition library                                            ***
***                           379 standard compositions, 326 nuc..ides                                        ***
***                           10 elements with variable isotopic distrbutions.                                ***
***                                                                                                           ***
***           creation date:   7/11/91                                                                        ***
***                                                                                                           ***
***                                                                                                           ***
***                                                                                                           ***
***                                  cross section library data                                               ***
***                                  --------------------------                                               ***
***                                                                                                           ***
***           unit number   :  82                                                                             ***
***                                                                                                           ***
***           dataset name :                ft82f001                                                        ***
***                                                                                                           ***
***           library title:  SCALE 4 - 27 NEUTRON GROUP CRITICALITY SAFETY LIBRARY                           ***
***                             BASED ON ENDF-B VERSION 4 DATA                                                ***
***                               COMPILED FOR NRC       1/27/89                                              ***
***                                 LAST UPDATED        10/12/89                                              ***
***                                   L.M.PETRIE       ORNL                                                   ***
***                                                                                                           ***
***                                                                                                           ***
***                                                                                                           ***
***                                                                                                           ***
*****************************************************************************************************************
*****************************************************************************************************************
                        .....   0 io's were used processing csas input data   .....
 control module csasi    is complete.
-------------------------------------------------------------
  Run with Aug 91 IBM-PC 486 (Extended) on 07/28/93 at 17:25:55
-------------------------------------------------------------
 The input deck follows:
************************************************************************
=CSASI
UO2F2 SOLUTION   SAFE  CYLINDER                UOXCYSF1.CJX
27GROUPNDF4              INFHOMMEDIUM
SOLNUO2F2    1  1600.0 0 1.0 293   92235 5.02  92238 94.98  END
H2O          2  1.0  293  END
END COMP
END
=XSDRN
CYLINDER SAFE UO2F2
```

```
 0$$  A3 2  E
 1$$  2 2 51 1 0   2 2 16 3 1
  10 50 0 0 0
 2 \$  -2 0 0 0 0    0 -1 0 0 0
 3$$  0 0 0 1 0     0 0 0 0 0
      0 0
 5**  A4 0  0  E
   T
 13$$  1 2
 14$$  1 2
 15**  F1
    T
 34**  F1
    T
 35**  15I0 34I10.95 45.95
 36$$  16R1 35R2
 39$$  1 2
 40$$  F3
    T
 END
*******************************************************************************
```

outer iter	inner iters	1 - balance	eigenvalue	1 - source ratio	1 - scatter ratio	1 - upscat ratio	search parameter	time (min)
1	0	-4.44089E-16	1.05739E+00	6.79308E-01	1.00000E+00	0.00000E+00	0.00000E+00	0.0852
2	217	1.38628E-02	8.25464E-01	-2.77141E+00	-7.91368E-01	-6.60203E-02	0.00000E+00	1.3715
3	416	4.03827E-03	9.24976E-01	1.24546E-01	-3.49429E-01	-1.61433E-02	0.00000E+00	2.5577
4	612	1.64542E-03	9.19392E-01	7.78716E-02	-1.53650E-01	-6.16246E-03	0.00000E+00	3.7278
5	797	7.11453E-04	9.10497E-01	4.18278E-02	-7.06650E-02	-2.63238E-03	0.00000E+00	4.8363
6	975	3.16832E-04	9.04611E-01	2.10552E-02	-3.25791E-02	-1.18385E-03	0.00000E+00	5.9065
7	1143	1.43733E-04	9.01232E-01	1.03652E-02	-1.51445E-02	-5.49292E-04	0.00000E+00	6.9215
8	1301	6.61574E-05	8.99362E-01	5.09989E-03	-7.12933E-03	-2.61177E-04	0.00000E+00	7.8820
9	1459	3.08436E-05	8.98329E-01	2.53961E-03	-3.40994E-03	-1.27032E-04	0.00000E+00	8.8412
10	1617	1.47021E-05	8.97738E-01	1.29654E-03	-1.66543E-03	-6.37118E-05	0.00000E+00	9.8017
11	1775	7.20032E-06	8.97393E-01	6.83623E-04	-8.38316E-04	-3.30782E-05	0.00000E+00	10.7618
12	1933	3.62566E-06	8.97186E-01	3.73012E-04	-4.36692E-04	-1.77774E-05	0.00000E+00	11.7213
13	2084	1.86110E-06	8.97062E-01	2.09728E-04	-2.35138E-04	-9.82960E-06	0.00000E+00	12.6422
14	2233	9.57280E-07	8.96986E-01	1.20680E-04	-1.29912E-04	-5.53780E-06	0.00000E+00	13.5530
15	2377	4.88625E-07	8.96939E-01	7.09039E-05	-7.31007E-05	-3.17245E-06	0.00000E+00	14.4353

grp to grp	inner iters	mfd int.	max. flux difference	msf int.	max. scale factor	coarse mesh
1	1	1	5.58571E-05	11	1.00001E+00	6
2	1	1	5.32749E-05	7	1.00002E+00	9
3	1	1	5.71708E-05	7	1.00002E+00	10
4	1	1	5.79225E-05	6	1.00001E+00	12
5	1	16	4.92804E-05	4	1.00003E+00	16
6	1	16	4.26644E-05	4	1.00003E+00	16
7	1	1	3.19818E-05	3	1.00003E+00	23
8	1	1	2.37222E-05	2	1.00004E+00	43
9	1	1	2.48107E-05	2	1.00003E+00	43
10	1	1	2.35067E-05	2	1.00003E+00	43
11	1	1	2.21172E-05	2	1.00003E+00	43
12	1	1	2.52972E-05	2	1.00002E+00	43
13	1	1	2.54733E-05	2	1.00002E+00	43
14	1	1	2.44217E-05	2	1.00002E+00	43
15	2	10	5.99985E-07	38	1.00000E+00	43
16	2	51	1.48160E-06	51	1.00000E+00	43
17	2	51	1.70539E-06	51	1.00000E+00	43
18	2	51	1.65963E-06	51	1.00000E+00	43
19	2	51	1.99894E-06	51	1.00000E+00	43
20	2	51	1.60652E-06	38	9.99999E-01	43
21	2	51	2.24650E-06	51	9.99999E-01	43
22	2	51	2.02950E-06	51	9.99999E-01	51
23	1	42	2.83501E-05	42	1.00005E+00	51
24	1	42	7.39760E-05	43	1.00014E+00	51
25	2	50	7.96290E-07	37	1.00000E+00	51
26	2	50	1.67933E-06	37	1.00000E+00	51
27	2	51	2.93893E-06	51	9.99997E-01	51

16	2415	-3.81852E-08	8.96953E-01	6.22825E-06	-3.42426E-05	-2.60610E-07	0.00000E+00	14.7165

final monitor

lambda 8.96952E-01 production/absorption 8.99440E-01 angular flux on 16

elapsed time 14.72 min.

```
uo2f2 solution   safe   slab                    uoxslsf1.cjx

********** data library information **********

      unit                                          volume
    number          data set name                   name      unit function
    ------          -------------                   ----      -------------

      89              ft89f001                                standard composition library

      82              ft82f001                                cross section library

      11              ft11f001                                short cross section library

                              standard composition library data
                              ---------------------------------

        unit number  :  89

        dataset name :              ft89f001

        library title:  scale-4 standard composition library
                        379 standard compositions, 326 nuclides
                        10 elements with variable isotopic distrbutions.

        creation date:  7/11/91

                              cross section library data
                              --------------------------

        unit number  :  82

        dataset name :              ft82f001

        library title:  SCALE 4 - 27 NEUTRON GROUP CRITICALITY SAFETY LIBRARY
                          BASED ON ENDF-B VERSION 4 DATA
                            COMPILED FOR NRC       1/27/89
                            LAST UPDATED          10/12/89
                              L.M.PETRIE         ORNL

                    ........   0 io's were used processing csas input data   ........
 control module csasi    is complete.
-------------------------------------------------------------
  Run with Aug 91 IBM-PC 486 (Extended) on 07/28/93 at 17:36:36
-------------------------------------------------------------
 The input deck follows:
=CSASI
UO2F2 SOLUTION   SAFE   SLAB                    UOXSLSF1.CJX
27GROUPNDF4              INFHOMMEDIUM
SOLNUO2F2    1  1600.0 0 1.0 293   92235 5.02  92238 94.98  END
H2O          2  1.0  293  END
END COMP
END
=XSDRN
SLAB   SAFE    UO2F2 SOLUTION
```

```
09$  A3 2  E
18$  1 2 50 1 0   2 2 16 3 1
 10 50 0 0 0
25$  -2 0 0 0 0    0 -1 0 0 0
35$  0 0 0 1 0     0 0 0 0 0
     0 0
5**  A4 0  0  E
  T
138$  1 2
148$  1 2
15**  F1
   T
34**  F1
   T
35**  9I0 39I5.25 45.25
366$  10R1 40R2
398$  1 2
408$  F3
   T
END
```

outer iter	inner iters	1 - balance	eigenvalue	1 - source ratio	1 - scatter ratio	1 - upscat ratio	search parameter	time (min)
1	0	1.11022E-16	1.03957E+00	7.18052E-01	1.00000E+00	0.00000E+00	0.00000E+00	0.0697
2	215	1.42635E-02	7.95505E-01	-3.22239E+00	-8.13483E-01	-6.62735E-02	0.00000E+00	0.3268
3	410	3.58315E-03	9.29793E-01	1.17563E-01	-3.56151E-01	-1.42050E-02	0.00000E+00	0.5657
4	602	1.33248E-03	9.35196E-01	6.51651E-02	-1.35372E-01	-4.99911E-03	0.00000E+00	0.8018
5	784	5.41764E-04	9.31270E-01	3.20248E-02	-5.63508E-02	-2.02915E-03	0.00000E+00	1.0288
6	952	2.35749E-04	9.27488E-01	1.54394E-02	-2.45000E-02	-8.96910E-04	0.00000E+00	1.2442
7	1110	1.07917E-04	9.24943E-01	7.59541E-03	-1.11930E-02	-4.22691E-04	0.00000E+00	1.4500
8	1260	5.22417E-05	9.23344E-01	3.87883E-03	-5.37967E-03	-2.11078E-04	0.00000E+00	1.6477
9	1412	2.65901E-05	9.22359E-01	2.06455E-03	-2.72305E-03	-1.10973E-04	0.00000E+00	1.8483
10	1563	1.41891E-05	9.21751E-01	1.14466E-03	-1.44721E-03	-6.11077E-05	0.00000E+00	2.0477
11	1713	7.87975E-06	9.21373E-01	6.57635E-04	-8.03726E-04	-3.49577E-05	0.00000E+00	2.2465
12	1862	4.53206E-06	9.21136E-01	3.89637E-04	-4.63239E-04	-2.06625E-05	0.00000E+00	2.4442
13	2006	2.67539E-06	9.20985E-01	2.36576E-04	-2.75403E-04	-1.25217E-05	0.00000E+00	2.6372
14	2150	1.61009E-06	9.20889E-01	1.46456E-04	-1.67682E-04	-7.74003E-06	0.00000E+00	2.8303
15	2294	9.82304E-07	9.20827E-01	9.21743E-05	-1.04068E-04	-4.86343E-06	0.00000E+00	3.0235

grp to grp	inner iters	mfd int.	max. flux difference	msf int.	max. scale factor	coarse mesh
1	1	10	1.95273E-05	50	9.99998E-01	6
2	1	10	2.60850E-05	28	9.99997E-01	8
3	1	1	2.09618E-05	25	9.99998E-01	9
4	1	10	2.04305E-05	7	1.00000E+00	12
5	1	10	2.07288E-05	6	1.00000E+00	15
6	1	10	1.94333E-05	5	1.00001E+00	16
7	1	9	9.82828E-06	3	1.00001E+00	24
8	1	1	5.38480E-06	2	1.00001E+00	45
9	1	1	4.11628E-06	2	1.00000E+00	45
10	1	1	3.17258E-06	2	1.00000E+00	45
11	1	19	2.89447E-06	19	9.99996E-01	45
12	1	20	3.50402E-06	20	9.99997E-01	45
13	1	20	3.62600E-06	21	9.99997E-01	45
14	1	21	3.50543E-06	21	9.99997E-01	45
15	2	10	6.71940E-07	31	1.00000E+00	45
16	2	50	1.34279E-06	50	1.00000E+00	45
17	2	50	1.54798E-06	50	1.00000E+00	45
18	2	50	1.50384E-06	50	1.00000E+00	45
19	2	50	1.80629E-06	50	1.00000E+00	45
20	2	50	1.36084E-06	31	9.99999E-01	45
21	2	50	1.94879E-06	50	1.00000E+00	45
22	2	50	1.76143E-06	50	9.99999E-01	45
23	1	36	2.90867E-05	37	1.00005E+00	45
24	1	37	7.68642E-05	37	1.00015E+00	50
25	2	49	6.88287E-07	31	1.00000E+00	50
26	2	50	1.84401E-06	50	9.99997E-01	50
27	2	50	1.81838E-06	50	9.99998E-01	50

16	2332	-3.79749E-08	9.20855E-01	9.54706E-06	-5.10306E-05	-7.83700E-07	0.00000E+00	3.0830

final monitor

lambda 9.20855E-01 production/absorption 9.21583E-01 angular flux on 16

- elapsed time 3.08 min.

0.90748

```
*********************************************************************************
#CSAS25
SAFE     SPHERICAL UO2F2                                          UOFSPSF1.CJA
27GROUPNDF4                  INFHOMMEDIUM
SOLNUO2F2   1  1600.0 0 1.0 293  92235 5.02  92238 94.98  END
H2O         2  1.0 293 END
END COMP   ↑SAFE
DENSITY OPTIMIZATION SHPERE OF UO2F2 REFLECTED
READ PARM  RUN=Y'S PLT=YES  TME=45 END PARM
READ GEOM
GLOBAL UNIT  1
COM=!REFLECTED SHPERE OF UO2F2!
SPHERE      1 1    16.44
CUBE        2 1    51.44  -51.44
END GEOM
READ BNDS  ALL=VACUUM  END BNDS
READ START  NST=6  TFX=0.0 TFY=0.0 TFZ=0.0  LNU=300  END START
READ PLOT
TTL='X - Y  SLICE AT Z = 0.0'
PLT=NO PIC=MIXTURE XUL=-35 YUL=35 ZUL=0 XLR=35 YLR=-35 ZLR=0
UAX=1 VAX=0 WAX=0 UDN=0 VDN=-1 WDN=0 NAX=130
NCH='VFW' END
END PLOT
END DATA
END
*********************************************************************************
```

density optimization shpere of uo2f2 reflected

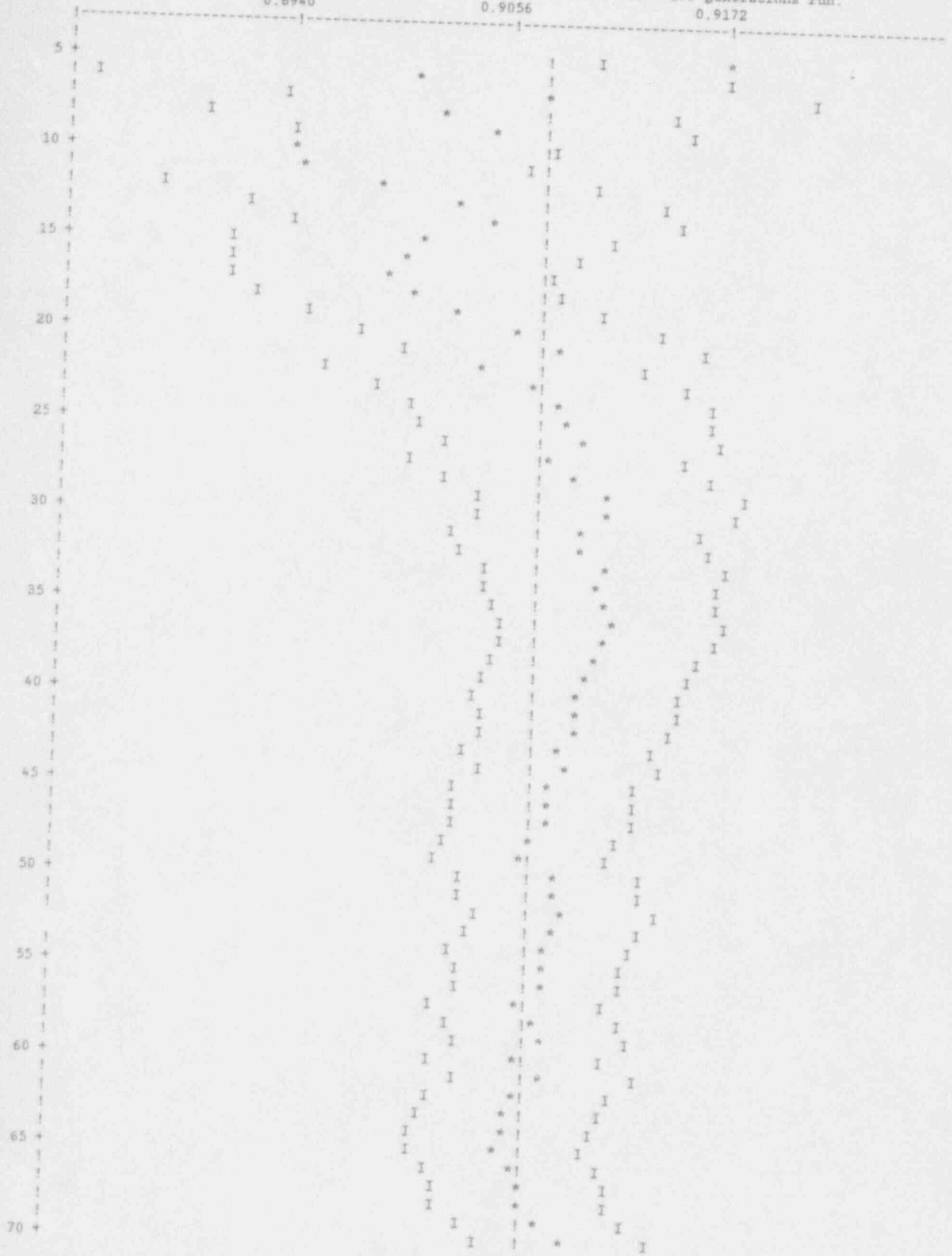
lifetime = 1.86778E-04 + or - 1.80229E-06 generation time = 5.89034E-05 + or - 6.38189E-07

no. of initial generations skipped	average k-effective	deviation	67 per cent confidence interval	95 per cent confidence interval	99 per cent confidence interval	number of histories
3	0.90748	+ or - 0.00393	0.90354 to 0.91141	0.89961 to 0.91535	0.89567 to 0.91928	30000
4	0.90745	+ or - 0.00397	0.90347 to 0.91142	0.89950 to 0.91539	0.89552 to 0.91937	29700
5	0.90728	+ or - 0.00401	0.90327 to 0.91129	0.89926 to 0.91530	0.89525 to 0.91931	29400
6	0.90769	+ or - 0.00403	0.90366 to 0.91172	0.89963 to 0.91576	0.89560 to 0.91979	29100
7	0.90746	+ or - 0.00407	0.90339 to 0.91153	0.89933 to 0.91559	0.89526 to 0.91966	28800
8	0.90777	+ or - 0.00410	0.90367 to 0.91186	0.89957 to 0.91596	0.89547 to 0.92006	28500
9	0.90764	+ or - 0.00414	0.90350 to 0.91178	0.89936 to 0.91592	0.89522 to 0.92006	28200
10	0.90849	+ or - 0.00409	0.90440 to 0.91259	0.90030 to 0.91668	0.89621 to 0.92077	27900
11	0.90851	+ or - 0.00414	0.90447 to 0.91275	0.90033 to 0.91688	0.89620 to 0.92102	27600
12	0.90834	+ or - 0.00417	0.90417 to 0.91252	0.90000 to 0.91669	0.89582 to 0.92087	27300
17	0.90877	+ or - 0.00435	0.90441 to 0.91312	0.90006 to 0.91748	0.89571 to 0.92183	25800
22	0.90814	+ or - 0.00446	0.90368 to 0.91260	0.89923 to 0.91706	0.89477 to 0.92151	24300
27	0.90732	+ or - 0.00464	0.90267 to 0.91196	0.89803 to 0.91661	0.89338 to 0.92125	22800
32	0.90635	+ or - 0.00485	0.90151 to 0.91120	0.89666 to 0.91604	0.89182 to 0.92089	21300
37	0.90540	+ or - 0.00517	0.90023 to 0.91057	0.89507 to 0.91574	0.88990 to 0.92091	19800
42	0.90592	+ or - 0.00558	0.90034 to 0.91150	0.89476 to 0.91708	0.88918 to 0.92267	18300
47	0.90676	+ or - 0.00598	0.90078 to 0.91274	0.89481 to 0.91871	0.88883 to 0.92469	16800
52	0.90542	+ or - 0.00622	0.89920 to 0.91165	0.89297 to 0.91787	0.88675 to 0.92409	15300
57	0.90765	+ or - 0.00672	0.90093 to 0.91437	0.89421 to 0.92108	0.88750 to 0.92780	13800
62	0.90763	+ or - 0.00659	0.90104 to 0.91423	0.89445 to 0.92082	0.88785 to 0.92742	12300
67	0.907	+ or - 0.00727	0.90015 to 0.91470	0.89287 to 0.92197	0.88560 to 0.92924	10800
72	0.90068	+ or - 0.00759	0.89309 to 0.90827	0.88550 to 0.91586	0.87791 to 0.92345	9300
77	0.90049	+ or - 0.00858	0.89191 to 0.90907	0.88333 to 0.91765	0.87476 to 0.92623	7800
82	0.89692	+ or - 0.01041	0.88651 to 0.90733	0.87610 to 0.91774	0.86569 to 0.92815	6300
87	0.88664	+ or - 0.01206	0.87458 to 0.89870	0.86252 to 0.91076	0.85046 to 0.92282	4800
92	0.88039	+ or - 0.01568	0.86471 to 0.89607	0.84903 to 0.91175	0.83335 to 0.92743	3300

density optimization sphere of uo2f2 reflected

plot of average k-effective by generation run.

the line represents k-eff = 0.9075 + or - 0.0039 which occurs for 103 generations run.




75
80
85
90
95
100

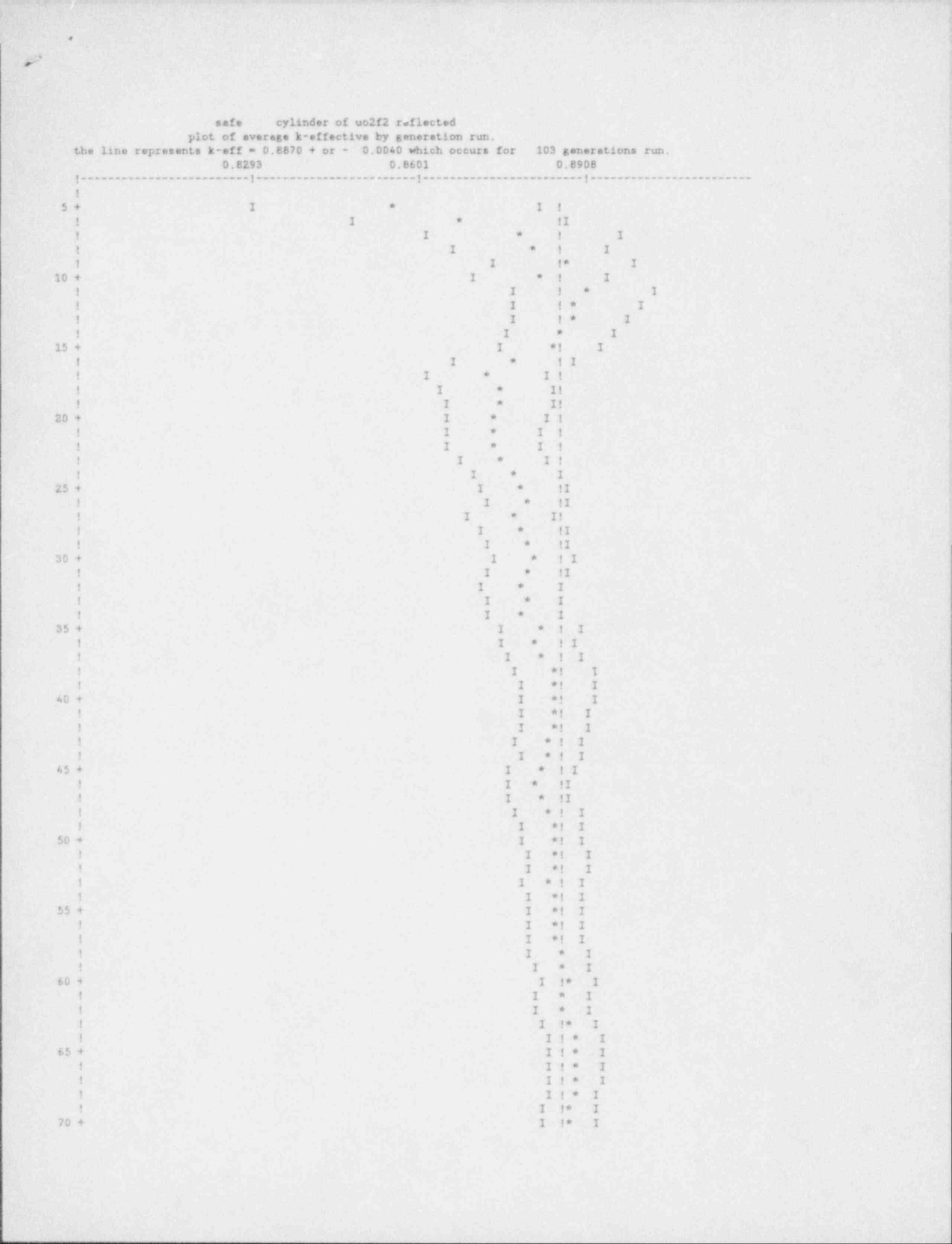
0.88700

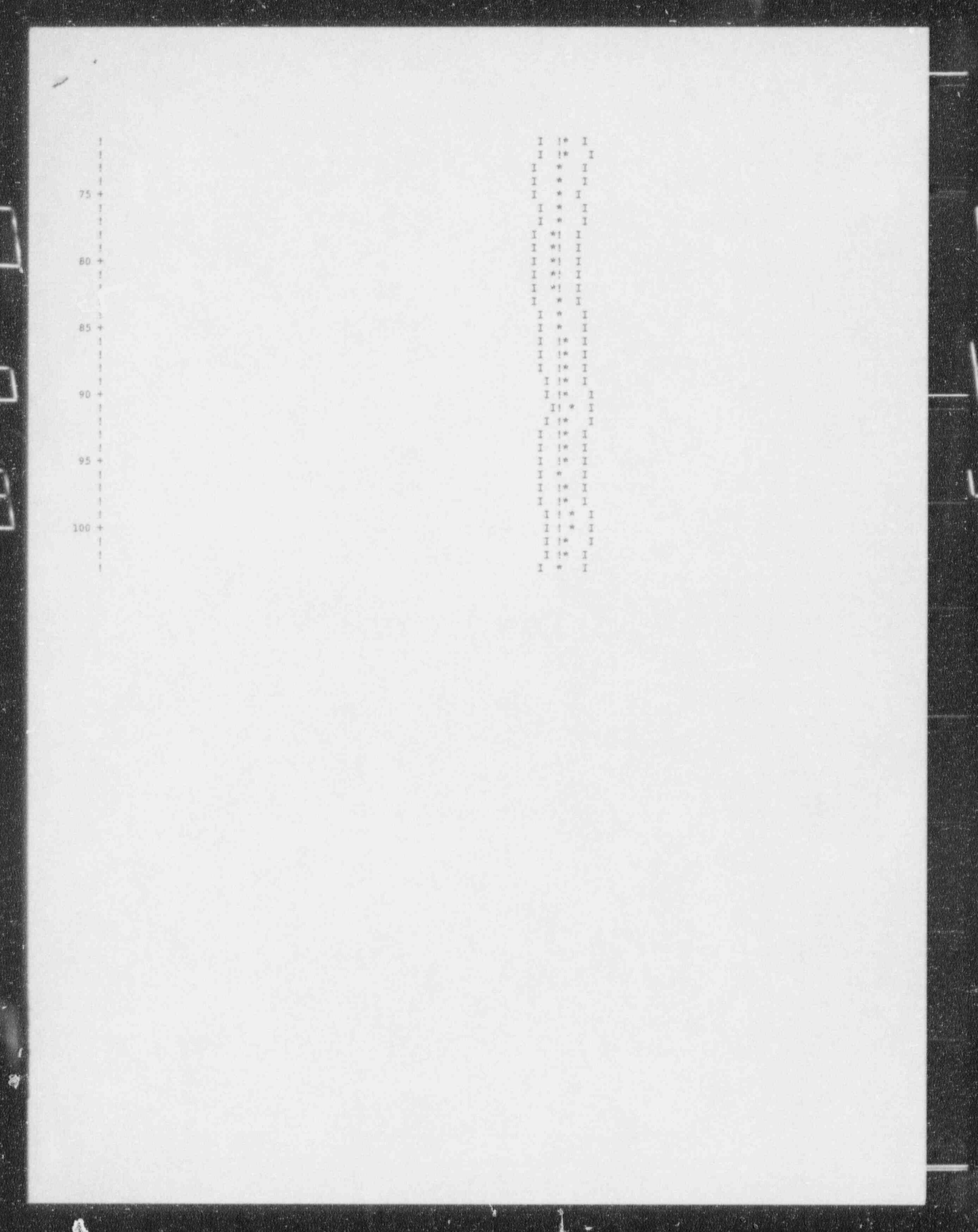
```
*******************************************************************************
#CSAS25
SAFE       CYLINDER UO2F2                              UOFCYSF1.CJA
27GROUPNDF4                  INFHOMMEDIUM
SOLNUO2F2   1  1600.0 0 1.0 293  92235 5.02  92238 94.98  END
H2O         2  1.0 293 END
END COMP
SAFE     CYLINDER OF UO2F2 REFLECTED
READ PARM  RUN=YES PLT=YES  TME=45 END PARM
READ GEOM
GLOBAL UNIT  1
COM='REFLECTED CYLINDER OF UO2F2'
CYLINDER   1 1    10.95    2P200.0
CUBOID     2 1    4P45.95  2P200.0
END GEOM
READ BNDS  +XB=VACUUM -XB=VACUUM +YB=VACUUM -YB=VACUUM +ZB=MIRROR -ZB=MIRROR
 END BNDS
READ PLOT
TTL='X - Y  SLICE AT Z = 0.0'
PLT=NO PIC=MIXTURE XUL=-25 YUL=25 ZUL=0 XLR=25 YLR=-25 ZLR=0 UAX=1 VAX=0 WAX=0
UDN=0 VDN=-1 WDN=0 NAX=130
NCH='VFW' END
END PLOT
END DATA
END
*******************************************************************************
```

safe cylinder of uo2f2 reflected

lifetime = 1.91946E-04 + or - 1.45320E-06 generation time = 6.24552E-05 + or - 5.99646E-07

no. of initial generations skipped	average k-effective	deviation	67 per cent confidence interval	95 per cent confidence interval	99 per cent confidence interval	number of histories
3	0.88700	+ or - 0.00399	0.88301 to 0.89099	0.87902 to 0.89498	0.87503 to 0.89897	30000
4	0.88759	+ or - 0.00399	0.88360 to 0.89157	0.87961 to 0.89556	0.87562 to 0.89955	29700
5	0.88763	+ or - 0.00403	0.88360 to 0.89166	0.87957 to 0.89569	0.87555 to 0.89971	29400
6	0.88759	+ or - 0.00407	0.88352 to 0.89166	0.87945 to 0.89573	0.87538 to 0.89979	29100
7	0.88731	+ or - 0.00410	0.88320 to 0.89141	0.87910 to 0.89551	0.87500 to 0.89961	28800
8	0.88732	+ or - 0.00415	0.88317 to 0.89147	0.87903 to 0.89561	0.87488 to 0.89976	28500
9	0.88698	+ or - 0.00418	0.88280 to 0.89115	0.87862 to 0.89533	0.87445 to 0.89950	28200
10	0.88734	+ or - 0.00420	0.88314 to 0.89155	0.87894 to 0.89575	0.87473 to 0.89996	27900
11	0.88667	+ or - 0.00420	0.88248 to 0.89087	0.87828 to 0.89506	0.87409 to 0.89926	27600
12	0.88678	+ or - 0.00424	0.88254 to 0.89102	0.87830 to 0.89526	0.87406 to 0.89950	27300
17	0.88920	+ or - 0.00425	0.88494 to 0.89345	0.88069 to 0.89770	0.87643 to 0.90196	25800
22	0.89004	+ or - 0.00449	0.88556 to 0.89452	0.88107 to 0.89901	0.87658 to 0.90350	24300
27	0.88995	+ or - 0.00461	0.88534 to 0.89456	0.88073 to 0.89917	0.87613 to 0.90378	22800
32	0.89024	+ or - 0.00481	0.88543 to 0.89505	0.88062 to 0.89986	0.87581 to 0.90467	21300
37	0.88911	+ or - 0.00495	0.88416 to 0.89405	0.87921 to 0.89900	0.87427 to 0.90395	19800
42	0.88812	+ or - 0.00521	0.88290 to 0.89333	0.87769 to 0.89854	0.87248 to 0.90375	18300
47	0.89060	+ or - 0.00546	0.88514 to 0.89606	0.87967 to 0.90152	0.87421 to 0.90699	16800
52	0.88858	+ or - 0.00579	0.88279 to 0.89437	0.87700 to 0.90016	0.87121 to 0.90595	15300
57	0.88882	+ or - 0.00630	0.88252 to 0.89512	0.87622 to 0.90142	0.86992 to 0.90772	13800
62	0.88696	+ or - 0.00671	0.88025 to 0.89367	0.87354 to 0.90037	0.86683 to 0.90708	12300
67	0.88380	+ or - 0.00725	0.87655 to 0.89105	0.86930 to 0.89830	0.86205 to 0.90555	10800
72	0.88563	+ or - 0.00829	0.87733 to 0.89392	0.86904 to 0.90221	0.86075 to 0.91050	9300
77	0.88719	+ or - 0.00907	0.87813 to 0.89626	0.86906 to 0.90533	0.85999 to 0.91440	7800
82	0.89265	+ or - 0.01001	0.88263 to 0.90266	0.87262 to 0.91267	0.86261 to 0.92268	6300
87	0.88438	+ or - 0.01225	0.87213 to 0.89663	0.85988 to 0.90888	0.84762 to 0.92113	4800
92	0.87850	+ or - 0.01437	0.86413 to 0.89287	0.84975 to 0.90725	0.83538 to 0.92162	3300


safe cylinder of uo2f2 reflected
plot of average k-effective by generation run.
the line represents k-eff = 0.8870 + or - 0.0040 which occurs for 103 generations run.
0.8293
0.8601
0.8908



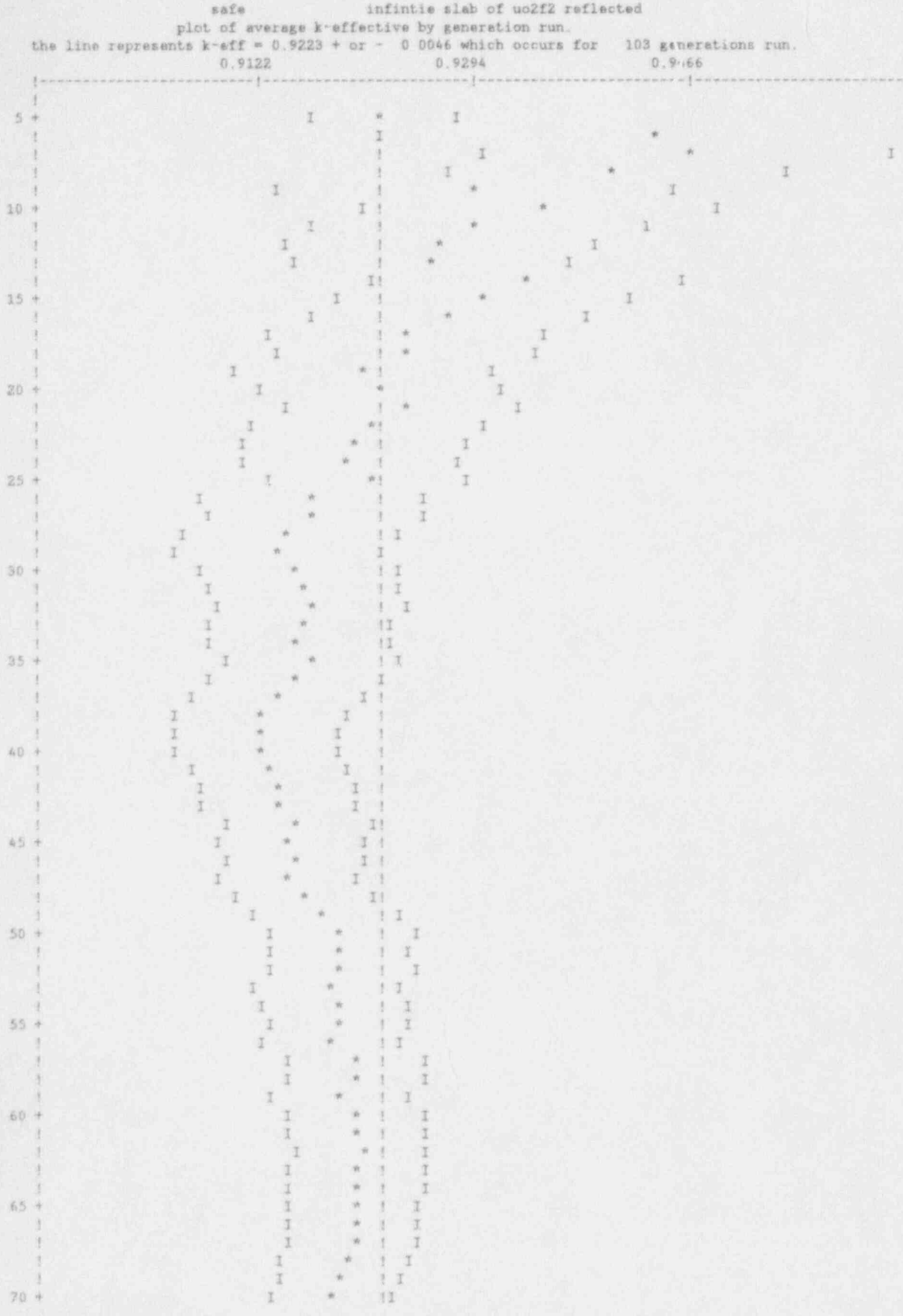
0.92228

```
*******************************************************************************
#CSAS25
SAFE                  INFINITE SLAB UO2F2              UOFSLSF1.CJA
27GROUPNDF4                  INFHOMMEDIUM
SOLNUO2F2   1  1700.0 0 1.0 293  92235 5.02  92238 94.98  END
H2O         2  1.0 293 END
END COMP
SAFE              INFINTIE SLAB OF UO2F2 REFLECTED
READ PARM  RUN=YES PLT=YES  TME=45 END PARM
READ GEOM
GLOBAL UNIT  1
COM=!REFLECTED SLAB OF UO2F2!
CUBOID     1 1    2P5.25   4P100.0
CUBOID     2 1    2P40.25  4P100.0
END GEOM
READ BNDS  +XB=VACUUM -XB=VACUUM +YB=MIRROR -YB=MIRROR +ZB=MIRROR -ZB=MIRROR
 END BNDS
READ PLOT
TTL='X - Y  SLICE AT Z = 0.0'
PLT=NO PIC=MIXTURE XUL=-25 YUL=25 ZUL=0 XLR=25 YLR=-25 ZLR=0 UAX=1 VAX=0 WAX=0
UDN=0 VDN=-1 WDN=0 NAX=130
NCH='VFW' END
END PLOT
END DATA
END
*******************************************************************************
```

safe infintie slab of uo2f2 reflected

lifetime = 1.84790E-04 + or - 1.49094E-06 generation time = 6.97578E-05 + or - 7.85242E-07

no. of initial generations skipped	average k-effective	deviation	67 per cent confidence interval	95 per cent confidence interval	99 per cent confidence interval	number of histories
3	0.92228	+ or - 0.00464	0.91764 to 0.92693	0.91100 to 0.93157	0.90835 to 0.93621	30000
4	0.92222	+ or - 0.00469	0.91753 to 0.92691	0.91284 to 0.93160	0.90815 to 0.93629	29700
5	0.92228	+ or - 0.00474	0.91754 to 0.92702	0.91281 to 0.93176	0.90807 to 0.93649	29400
6	0.92160	+ or - 0.00474	0.91686 to 0.92634	0.91213 to 0.93108	0.90739 to 0.93581	29100
7	0.92127	+ or - 0.00478	0.91649 to 0.92604	0.91172 to 0.93082	0.90694 to 0.93559	28800
8	0.92130	+ or - 0.00483	0.91648 to 0.92613	0.91165 to 0.93095	0.90683 to 0.93578	28500
9	0.92181	+ or - 0.00485	0.91696 to 0.92666	0.91211 to 0.93151	0.90726 to 0.93636	28200
10	0.92132	+ or - 0.00488	0.91645 to 0.92620	0.91157 to 0.93108	0.90669 to 0.93596	27900
11	0.92162	+ or - 0.00492	0.91670 to 0.92655	0.91178 to 0.93147	0.90686 to 0.93639	27600
12	0.92181	+ or - 0.00497	0.91684 to 0.92678	0.91166 to 0.93176	0.90689 to 0.93673	27300
17	0.92200	+ or - 0.00511	0.91689 to 0.92711	0.91177 to 0.93222	0.90666 to 0.93733	25800
22	0.92254	+ or - 0.00533	0.91721 to 0.92786	0.91188 to 0.93319	0.90655 to 0.93852	24300
27	0.92401	+ or - 0.00550	0.91851 to 0.92951	0.91301 to 0.93501	0.90752 to 0.94051	22800
32	0.92454	+ or - 0.00580	0.91874 to 0.93034	0.91294 to 0.93615	0.90714 to 0.94195	21300
37	0.92657	+ or - 0.00610	0.92047 to 0.93267	0.91438 to 0.93876	0.90828 to 0.94486	19800
42	0.92771	+ or - 0.00648	0.92123 to 0.93419	0.91476 to 0.94067	0.90828 to 0.94715	18300
47	0.92822	+ or - 0.00693	0.92129 to 0.93515	0.91436 to 0.94207	0.90744 to 0.94900	16800
52	0.92539	+ or - 0.00734	0.91804 to 0.93273	0.91070 to 0.94008	0.90336 to 0.94742	15300
57	0.92484	+ or - 0.00763	0.91721 to 0.93247	0.90958 to 0.94011	0.90195 to 0.94774	13800
62	0.92479	+ or - 0.00829	0.91650 to 0.93307	0.90821 to 0.94136	0.89993 to 0.94964	12300
67	0.92662	+ or - 0.00937	0.91724 to 0.93599	0.90787 to 0.94536	0.89850 to 0.95474	10800
72	0.93314	+ or - 0.01022	0.92292 to 0.94336	0.91270 to 0.95357	0.90249 to 0.96379	9300
77	0.93062	+ or - 0.01091	0.91971 to 0.94153	0.90880 to 0.95244	0.89789 to 0.96335	7800
82	0.93505	+ or - 0.01174	0.92331 to 0.94679	0.91157 to 0.95853	0.89983 to 0.97026	6300
87	0.93897	+ or - 0.01118	0.92780 to 0.95015	0.91662 to 0.96132	0.90544 to 0.97250	4800
92	0.93301	+ or - 0.01409	0.91892 to 0.94710	0.90484 to 0.96118	0.89075 to 0.97527	3300


safe infintie slab of uo2f2 reflected
plot of average k-effective by generation run.
the line represents k-eff = 0.9223 + or - 0 0046 which occurs for 103 generations run.
0.9122
0.9294
0.9466

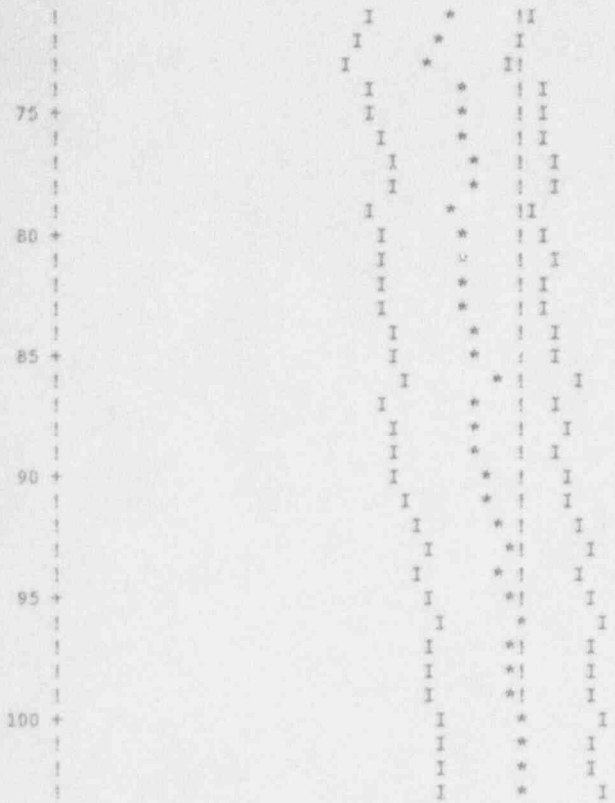

75
80
85
90
95
100

TABLE 4
Values of K_{eff} for Mass Limit Controls

UOXSP??M.CJX UOFSP??M.CJA

CONFIGURATION	MASS (kg U)	XSDRNPM RESULTS	CSAS25 RESULTS
CRITICAL	35.5	0.99077 ??=CR	0.98590±0.00397 ??=CR
SAFE-NO DOUBLE BATCHING POSSIBLE	26.4	0.94304 ??=SF	0.94033±0.00417 ??=SF
SAFE-DOUBLE BATCHING POSSIBLE	15.9	0.85509 ??=DB	0.85637±0.00434 ??=DB

```
uo2f2 solution critical by mass  sphere                    uoxspcrm.cjx

********** data library information **********

      unit                                          volume
     number          data set name                  name      unit function
     ------          -------------                  ----      -------------

       89              ft89f001                              standard composition library

       82              ft82f001                              cross section library

       11              ft11f001                              short cross section library

                          standard composition library data
                          ---------------------------------

      unit number  :  89

      dataset name :              ft89f001

      library title:  scale-4 standard composition library
                      379 standard compositions, 326 nuclides
                      10 elements with variable isotopic distrbutions.

      creation date:  7/11/91

                          cross section library data
                          --------------------------

      unit number  :  82

      dataset name :              ft82f001

      library title:  SCALE 4 - 27 NEUTRON GROUP CRITICALITY SAFETY LIBRARY
                        BASED ON ENDF-B VERSION 4 DATA
                          COMPILED FOR NRC       1/27/89
                            LAST UPDATED        10/12/89
                              L.M.PETRIE       ORNL

                    ........   0 io's were used processing csas input data   ........
 control module csasi    is complete.
-------------------------------------------------------------
  Run with Aug 91 IBM-PC 486 (Extended) on 07/28/93 at 17:51:21
-------------------------------------------------------------
 The input deck follows:
=CSAS1
UO2F2 SOLUTION CRITICAL BY MASS  SPHERE                    UOXSPCRM.CJX
27GROUPNDF4                INFHOMMEDIUM
SOLNUO2F2    1  883.72 0 1.0 293   92235 5.02  92238 94.98  END
H2O          2  1.0  293  END
END COMP
END
=XSDRN
SPHERE CRITICAL BY MASS    UO2F2 SOLUTION
```

```
0$$  A3 2  E
1$$  3 2 58 1 0   2 2 16 3 1
 10 50 0 0 0
2$$  -2 0 0 0 0    0 -1 0 0 0
3$$  0 0 0 1 0     0 0 0 0 0
     0 0
5**  A4 0  0  E
  T
13$$  1 2
14$$  1 2
15**  F1
   T
34**  F1
   T
35**  2210 34I21.246 56.246
36$$  23R1 35R2
39$$  1 2
40$$  F3
   T
END
```

outer iter	inner iters	1 - balance	eigenvalue	1 - source ratio	1 - scatter ratio	1 - upscat ratio	search parameter	time (min)
1	0	-2.22045E-16	9.60082E-01	7.49105E-01	1.00000E+00	0.00000E+00	0.00000E+00	0.0722
2	224	1.25458E-02	8.77790E-01	-3.94313E+00	-7.94687E-01	-5.83786E-02	0.00000E+00	0.4365
3	434	2.69858E-03	1.06798E+00	6.23775E-02	-2.63394E-01	-1.16528E-02	0.00000E+00	0.7828
4	633	1.47992E-03	1.04999E+00	5.09394E-02	-9.83441E-02	-6.05235E-03	0.00000E+00	1.1150
5	827	8.89001E-04	1.03016E+00	3.69311E-02	-6.05428E-02	-3.57599E-03	0.00000E+00	1.4400
6	1004	5.41113E-04	1.01589E+00	2.53108E-02	-3.87137E-02	-2.16213E-03	0.00000E+00	1.7430
7	1180	3.28670E-04	1.00646E+00	1.66512E-02	-2.44727E-02	-1.31166E-03	0.00000E+00	2.0442
8	1351	1.99158E-04	1.00041E+00	1.06518E-02	-1.52479E-02	-7.96453E-04	0.00000E+00	2.3388
9	1519	1.20172E-04	9.96622E-01	6.67808E-03	-9.40088E-03	-4.82703E-04	0.00000E+00	2.6300
10	1685	7.21831E-05	9.94283E-01	4.12679E-03	-5.74555E-03	-2.91709E-04	0.00000E+00	2.9192
11	1849	4.32042E-05	9.92850E-01	2.52549E-03	-3.48793E-03	-1.75871E-04	0.00000E+00	3.2048
12	2009	2.57498E-05	9.91978E-01	1.53458E-03	-2.10669E-03	-1.05708E-04	0.00000E+00	3.4858
13	2167	1.52191E-05	9.91455E-01	9.24794E-04	-1.26508E-03	-6.31057E-05	0.00000E+00	3.7643
14	2325	8.92580E-06	9.91142E-01	5.53253E-04	-7.53928E-04	-3.74400E-05	0.00000E+00	4.0425
15	2479	5.20059E-06	9.90956E-01	3.29311E-04	-4.46404E-04	-2.21033E-05	0.00000E+00	4.3152
16	2623	3.01009E-06	9.90845E-01	1.95246E-04	-2.62927E-04	-1.29888E-05	0.00000E+00	4.5752
17	2767	1.72191E-06	9.90779E-01	1.15029E-04	-1.53917E-04	-7.56796E-06	0.00000E+00	4.8352
18	2911	9.67603E-07	9.90741E-01	6.71231E-05	-8.91843E-05	-4.35256E-06	0.00000E+00	5.0953

grp to grp	inner iters	mfd int.	max. flux difference	msf int.	max. scale factor	coarse mesh
1	1	23	1.63664E-05	9	1.00000E+00	7
2	1	23	2.01234E-05	48	9.99992E-01	10
3	1	23	1.98301E-05	45	9.99995E-01	12
4	1	23	2.05439E-05	4	1.00000E+00	15
5	1	23	1.81921E-05	3	1.00001E+00	20
6	1	23	1.46528E-05	3	1.00001E+00	20
7	1	24	9.77028E-06	2	1.00001E+00	29
8	1	6	8.48737E-06	2	1.00001E+00	46
9	1	1	9.19009E-06	1	1.00001E+00	58
10	1	1	9.71988E-06	1	1.00001E+00	58
11	1	1	1.00843E-05	1	1.00001E+00	58
12	1	1	1.25796E-05	1	1.00001E+00	58
13	1	1	1.33912E-05	1	1.00001E+00	58
14	1	1	1.33835E-05	1	1.00001E+00	58
15	2	58	3.53101E-07	45	1.00000E+00	58
16	2	58	9.44666E-07	58	1.00000E+00	58
17	2	58	1.08E-06	58	1.00000E+00	58
18	2	58	1.[illegible]8E-06	58	1.00000E+00	58
19	2	58	1.[illegible]5855E-06	58	1.00000E+00	58
20	2	58	1.02095E-06	46	1.00000E+00	58
21	2	58	1.40648E-06	58	1.00000E+00	58
22	2	58	1.28571E-06	58	1.00000E+00	58
23	1	49	1.43981E-05	49	1.00002E+00	58
24	[illegible]	1	50	4.06342E-05	50	1.00008E+00	58
25	25	1	50	5.90508E-05	50	1.00008E+00	58
26	26	1	50	6.47687E-05	50	1.00014E+00	58
27	27	2	58	1.33601E-06	58	9.99999E-01	58

19	2947	2.96949E-10	9.90772E-01	5.54664E-06	-3.98785E-05	-5.57881E-07	0.00000E+00	5.1732

final monitor

lambda 9.90772E-01 production/absorption 9.93329E-01 angular flux on 16

- elapsed time 5.17 min.

```
*****************************************************************************************************************
***                                                                                                           ***
***                          uo2f2 solution safe by mass  sphere                  uoxspsfm.cjx                ***
***                                                                                                           ***
*****************  ***********************************************************************************************
*****************  ***********************************************************************************************
***                                                                                                           ***
***                              ********** data library information **********                             ***
***                                                                                                           ***
***          unit                                                volume                                       ***
***         number              data set name                    name        unit function                   ***
***         ------              -------------                    ----        -------------                   ***
***                                                                                                           ***
***           89                   ft89f001                                 standard composition library    ***
***                                                                                                           ***
***           82                   ft82f001                                 cross section library           ***
***                                                                                                           ***
***           11                   ft11f001                                 short cross section library     ***
***                                                                                                           ***
*****************************************************************************************************************
*****************************************************************************************************************
***                                                                                                           ***
***                                                                                                           ***
***                                    standard composition library data                                      ***
***                                    ---------------------------------                                      ***
***                                                                                                           ***
***            unit number   :  89                                                                            ***
***                                                                                                           ***
***            dataset name :                  ft89f001                                                       ***
***                                                                                                           ***
***            library title:  scale-4 standard composition library                                           ***
***                            379 standard compositions, 326 nuclides                                        ***
***                            10 elements with variable isotopic distrbutions.                               ***
***                                                                                                           ***
***            creation date:   7/11/91                                                                       ***
***                                                                                                           ***
***                                                                                                           ***
***                                                                                                           ***
***                                    cross section library data                                             ***
***                                    --------------------------                                             ***
***                                                                                                           ***
***            unit number   :  82                                                                            ***
***                                                                                                           ***
***            dataset name :                  ft82f001                                                       ***
***                                                                                                           ***
***            library title:  SCALE 4 - 27 NEUTRON GROUP CRITICALITY SAFETY LIBRARY                          ***
***                              BASED ON ENDF-B VERSION 4 DATA                                               ***
***                                COMPILED FOR NRC       1/27/89                                             ***
***                                 LAST UPDATED        10/12/89                                             ***
***                                  L.M.PETRIE        ORNL                                                  ***
***                                                                                                           ***
***                                                                                                           ***
***                                                                                                           ***
***                                                                                                           ***
*****************************************************************************************************************
*****************************************************************************************************************
                        .........   0 io's were used processing csas input data   .........
 control module csasi    is complete.
-------------------------------------------------------------
 Run with Aug 91 IBM-PC 486 (Extended) on 07/28/93 at 17:43:45
-------------------------------------------------------------
The input deck follows:
=CSASI
UO2F2 SOLUTION SAFE BY MASS  SPHERE                    UOXSPSFM.CJX
27GROUPNDF4                INFHOMMEDIUM
SOLNUO2F2    1  883.72 0 1.0 293   92235 5.02  92238 94.98  END
H2O          2  1.0  293  END
END COMP
END
=XSDRN
SPHERE SAFE BY MASS    UO2F2 SOLUTION
```

```
0$$  A3 2  E
1$$  3 2 58 1 0   2 2 16 3 1
 10 50 0 0 0
2$$  -2 0 0 0 0    0 -1 0 0 0
3$$  0 0 0 1 0     0 0 0 0 0
     0 0
5**  A4 0  0  E
  T
13$$  1 2
14$$  1 2
15**  F1
   T
34**  F1
   T
35**  22I0 34I19.249 54.249
36$$  23R1 35R2
39$$  1 2
40$$  F3
   T
END
```

outer iter	inner iters	1 - balance	eigenvalue	1 - source ratio	1 - scatter ratio	1 - upscat ratio	search parameter	time (min)
1	0	-6.66134E-16	9.49728E-01	7.60488E-01	1.00000E+00	0.00000E+00	0.00000E+00	0.0750
2	225	1.32649E-02	8.30383E-01	-4.05388E+00	-8.28254E-01	-6.06769E-02	0.00000E+00	0.4412
3	435	2.83057E-03	1.01970E+00	7.50734E-02	-2.95876E-01	-1.19304E-02	0.00000E+00	0.7870
4	633	1.47082E-03	1.00016E+00	5.89612E-02	-1.07986E-01	-5.86748E-03	0.00000E+00	1.1168
5	827	8.37360E-04	9.79650E-01	4.09426E-02	-6.30376E-02	-3.29087E-03	0.00000E+00	1.4425
6	1005	4.84396E-04	9.65483E-01	2.67609E-02	-3.82392E-02	-1.89616E-03	0.00000E+00	1.7465
7	1178	2.80829E-04	9.56460E-01	1.67988E-02	-2.29973E-02	-1.10111E-03	0.00000E+00	2.0442
8	1346	1.62234E-04	9.50943E-01	1.02466E-02	-1.36705E-02	-6.39569E-04	0.00000E+00	2.3352
9	1512	9.32813E-05	9.47639E-01	6.12639E-03	-8.04055E-03	-3.70718E-04	0.00000E+00	2.6245
10	1678	5.33866E-05	9.45684E-01	3.61415E-03	-4.69046E-03	-2.14333E-04	0.00000E+00	2.9127
11	1840	3.04569E-05	9.44533E-01	2.11569E-03	-2.72032E-03	-1.23740E-04	0.00000E+00	3.1955
12	1998	1.72423E-05	9.43863E-01	1.22900E-03	-1.57035E-03	-7.10625E-05	0.00000E+00	3.4740
13	2156	9.66824E-06	9.43476E-01	7.08450E-04	-9.00146E-04	-4.05361E-05	0.00000E+00	3.7523
14	2302	5.38392E-06	9.43253E-01	4.06720E-04	-5.12455E-04	-2.30318E-05	0.00000E+00	4.0150
15	2446	2.96171E-06	9.43124E-01	2.32194E-04	-2.90128E-04	-1.29371E-05	0.00000E+00	4.2750
16	2590	1.60205E-06	9.43051E-01	1.31625E-04	-1.62802E-04	-7.24807E-06	0.00000E+00	4.5348
17	2734	8.49794E-07	9.43009E-01	7.41497E-05	-9.03581E-05	-4.00206E-06	0.00000E+00	4.7948

grp to grp	inner iters	mfd int.	max. flux difference	msf int.	max. scale factor	coarse mesh
1	1	1	3.91002E-05	10	1.00001E+00	7
2	1	23	3.62000E-05	6	1.00002E+00	10
3	1	1	4.05833E-05	6	1.00001E+00	11
4	1	1	4.22213E-05	5	1.00001E+00	14
5	1	1	3.57794E-05	4	1.00002E+00	16
6	1	1	2.97097E-05	3	1.00002E+00	20
7	1	1	2.50180E-05	2	1.00003E+00	29
8	1	1	2.29622E-05	2	1.00003E+00	46
9	1	1	2.31512E-05	1	1.00003E+00	58
10	1	1	2.33166E-05	1	1.00003E+00	58
11	1	1	2.31924E-05	1	1.00003E+00	58
12	1	1	2.81451E-05	1	1.00003E+00	58
13	1	1	2.93940E-05	1	1.00002E+00	58
14	1	1	2.88921E-05	1	1.00002E+00	58
15	2	58	4.02291E-07	45	1.00000E+00	58
16	2	58	1.10708E-06	58	1.00000E+00	58
17	2	58	1.27331E-06	58	1.00000E+00	58
18	2	58	1.23973E-06	58	1.00000E+00	58
19	2	58	1.48077E-06	58	1.00000E+00	58
20	2	58	1.18648E-06	46	9.99999E-01	58
21	2	58	1.66126E-06	58	1.00000E+00	58
22	2	58	1.50788E-06	58	9.99999E-01	58
23	1	49	1.80052E-05	49	1.00003E+00	58
24	1	49	4.97401E-05	49	1.00010E+00	58
25	1	50	7.20657E-05	50	1.00010E+00	58
26	1	50	7.90397E-05	50	1.00017E+00	58
27	2	58	1.50343E-06	58	9.99998E-01	58

18	2770	1.03498E-10	9.43035E-01	5.89924E-06	-4.00462E-05	-4.21500E-07	0.00000E+00	4.8710

final monitor lambda 9.43036E-01 production/absorption 9.45807E-01 angular flux on 16

elapsed time 4.87 min.

```
*****************************************************************************************************************************
***                                                                                                                       ***
***                          uo2f2 solution double batch safe by mass  sphere              uoxspdbm.cjx                  ***
***                                                                                                                       ***
*****************************************************************************************************************************
*****************************************************************************************************************************
***                                                                                                                       ***
***                                ********** data library information **********                                         ***
***                                                                                                                       ***
***          unit                                                   volume                                                ***
***         number                  data set name                    name         unit function                          ***
***         ------                  -------------                    ----         -------------                          ***
***                                                                                                                       ***
***           89                       ft89f001                                   standard composition library           ***
***                                                                                                                       ***
***           82                       ft82f001                                   cross section library                  ***
***                                                                                                                       ***
***           11                       ft11f001                                   short cross section library            ***
***                                                                                                                       ***
*****************************************************************************************************************************
*****************************************************************************************************************************
***                                                                                                                       ***
***                                                                                                                       ***
***                                            standard composition library data                                          ***
***                                            ---------------------------------                                          ***
***                                                                                                                       ***
***             unit number  :  8>                                                                                        ***
***                                                                                                                       ***
***             dataset name :                    ft89f001                                                                ***
***                                                                                                                       ***
***             library title:  scale-4 standard composition library                                                      ***
***                             379 standard compositions, 326 nuclides                                                   ***
***                             10 elements with variable isotopic distrbutions.                                          ***
***                                                                                                                       ***
***             creation date:   7/11/91                                                                                  ***
***                                                                                                                       ***
***                                                                                                                       ***
***                                                                                                                       ***
***                                               cross section library data                                              ***
***                                               --------------------------                                              ***
***                                                                                                                       ***
***             unit number  :  82                                                                                        ***
***                                                                                                                       ***
***             dataset name :                    ft82f001                                                                ***
***                                                                                                                       ***
***             library title:  SCALE 4 - 27 NEUTRON GROUP CRITICALITY SAFETY LIBRARY                                     ***
***                               BASED ON ENDF-B VERSION 4 DATA                                                          ***
***                                 COMPILED FOR NRC        1/27/89                                                       ***
***                                   LAST UPDATED         10/12/89                                                       ***
***                                     L.M.PETRIE       ORNL                                                             ***
***                                                                                                                       ***
***                                                                                                                       ***
***                                                                                                                       ***
***                                                                                                                       ***
*****************************************************************************************************************************
*****************************************************************************************************************************
                                  ........   0 io's were used processing csas input data     ........
 control module csasi    is complete.
-----------------------------------------------------------------
  Run with Aug 91 IBM-PC 486 (Extended) on 07/28/93 at 17:58:15
-----------------------------------------------------------------
 The input deck follows:
***************************************************************************
 =CSASI
 UO2F2 SOLUTION DOUBLE BATCH SAFE BY MASS  SPHERE            UOXSPDBM.CJX
 27GROUPNDF4                 INFHOMMEDIUM
 SOLNUO2F2     1  883.72 0 1.0 293    92235 5.02  92238 94.98  END
 H2O           2  1.0  293  END
 END COMP
 END
 =XSDRN
 SPHERE DOUBLE BATCH SAFE BY MASS    UO2F2 SOLUTION
```

```
 0$$  A3 2  E
 1$$  3 2 58 1 0   2 2 16 3 1
  10 50 0 0 0
 2$$  -2 0 0 0 0    0 -1 0 0 0
 3$$  0 0 0 1 0     0 0 0 0 0
      0 0
 5**  A4 0  0  E
   T
 13$$  1 2
 14$$  1 2
 15**  F1
    T
 34**  F1
    T
 35**  22I0 34I16.255 51.255
 36$$  23R1 35R2
 39$$  1 2
 40$$  F3
    T
 END
*******************************************************************************
```

outer iter	inner iters	1 - balance	eigenvalue	1 - source ratio	1 - scatter ratio	1 - upscat ratio	search parameter	time (min)
1	0	-2.22045E-16	9.26610E-01	7.83316E-01	1.00000E+00	0.00000E+00	0.00000E+00	0.0743
2	228	1.45452E-02	7.40462E-01	-4.29501E+00	-8.90706E-01	-6.45500E-02	0.00000E+00	0.4430
3	443	2.91787E-03	9.30085E-01	9.98107E-02	-3.59558E-01	-1.18488E-02	0.00000E+00	0.7957
4	650	1.37022E-03	9.08201E-01	7.28838E-02	-1.21672E-01	-5.26327E-03	0.00000E+00	1.1380
5	852	7.10743E-04	8.87020E-01	4.67631E-02	-6.40896E-02	-2.70105E-03	0.00000E+00	1.4730
6	1041	3.76510E-04	8.73472E-01	2.80849E-02	-3.53943E-02	-1.43414E-03	0.00000E+00	1.7917
7	1217	2.01084E-04	8.65429E-01	1.62385E-02	-1.95087E-02	-7.72449E-04	0.00000E+00	2.0935
8	1389	1.07276E-04	8.60841E-01	9.15803E-03	-1.07030E-02	-4.17537E-04	0.00000E+00	2.3892
9	1553	5.72112E-05	8.58251E-01	5.09715E-03	-5.84043E-03	-2.26412E-04	0.00000E+00	2.6760
10	1713	3.03304E-05	8.56810E-01	2.80986E-03	-3.17778E-03	-1.22567E-04	0.00000E+00	2.9558
11	1871	1.59124E-05	8.56016E-01	1.53646E-03	-1.71971E-03	-6.60146E-05	0.00000E+00	3.2343
12	2017	8.29513E-06	8.55575E-01	8.38303E-04	-9.25341E-04	-3.55294E-05	0.00000E+00	3.4970
13	2166	4.26655E-06	8.55331E-01	4.56173E-04	-4.96518E-04	-1.90324E-05	0.00000E+00	3.7635
14	2315	2.16229E-06	8.55196E-01	2.48222E-04	-2.65014E-04	-1.01600E-05	0.00000E+00	4.0297
15	2464	1.07953E-06	8.55119E-01	1.35636E-04	-1.40964E-04	-5.42079E-06	0.00000E+00	4.2960
16	2609	5.28614E-07	8.55076E-01	7.46847E-05	-7.49155E-05	-2.89353E-06	0.00000E+00	4.5578

		grp to grp inner iters	mfd int.	max. flux difference	msf int.	max. scale factor	coarse mesh
1	1	1	1	7.25171E-05	12	1.00001E+00	6
2	2	1	1	6.63786E-05	7	1.00003E+00	10
3	3	1	1	7.27522E-05	7	1.00002E+00	11
4	4	1	1	7.35924E-05	5	1.00002E+00	14
5	5	1	1	6.32177E-05	4	1.00003E+00	18
6	6	1	1	5.07768E-05	3	1.00004E+00	20
7	7	1	1	4.08952E-05	2	1.00005E+00	29
8	8	1	1	3.63554E-05	2	1.00005E+00	46
9	9	1	1	3.64271E-05	2	1.00005E+00	46
10	10	1	1	3.57984E-05	2	1.00004E+00	46
11	11	1	1	3.48624E-05	2	1.00004E+00	46
12	12	1	1	4.10215E-05	2	1.00003E+00	46
13	13	1	1	4.21299E-05	2	1.00003E+00	46
14	14	1	1	4.08988E-05	2	1.00003E+00	46
15	15	2	16	7.73355E-07	44	1.00000E+00	46
16	16	2	58	1.27862E-06	58	1.00000E+00	46
17	17	2	58	1.45758E-06	58	1.00000E+00	46
18	18	2	58	1.42080E-06	58	1.00000E+00	46
19	19	2	58	1.70662E-06	58	1.00000E+00	46
20	20	2	58	1.37177E-06	46	9.99999E-01	58
21	21	2	58	1.92551E-06	58	1.00000E+00	58
22	22	2	58	1.74386E-06	58	9.99999E-01	58
23	23	1	49	2.23854E-05	49	1.00004E+00	58
24	24	1	49	5.96667E-05	49	1.00012E+00	58
25	25	1	50	8.62490E-05	49	1.00012E+00	58
26	26	1	50	9.45168E-05	50	1.00021E+00	58
27	27	2	58	1.76394E-06	58	9.99998E-01	58

17	2645	1.75215E-10	8.55091E-01	5.46407E-06	-3.34297E-05	-2.05977E-07	0.00000E+00	4.6350

final monitor lambda 8.55091E-01 production/absorption 8.58185E-01 angular flux on 16

elapsed time 4.64 min.

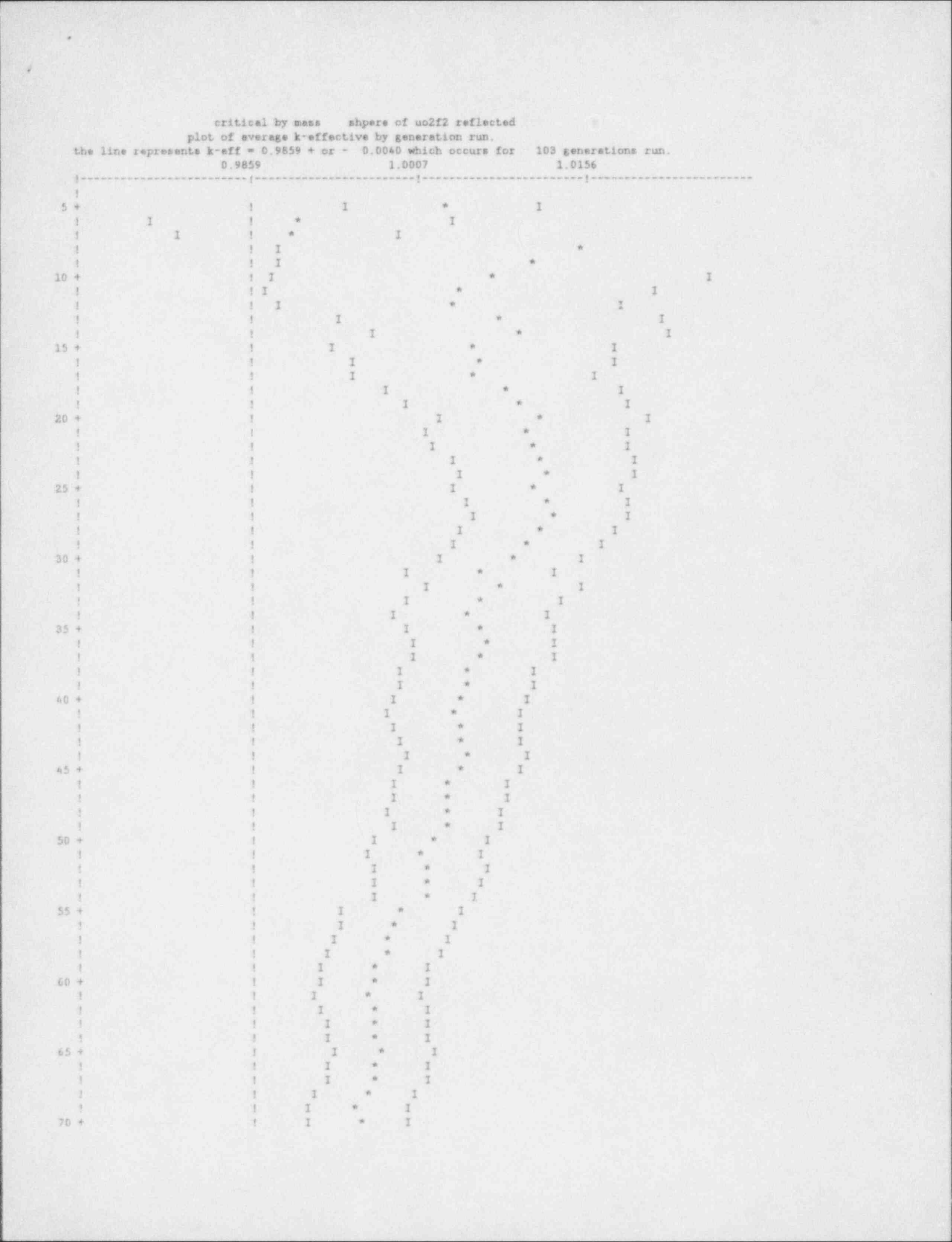
0.98590

```
*******************************************************************************
 =CSAS25
 CRITICAL BY MASS   SPHERICAL UO2F2                          UOFSPCRM.CJA
 27GROUPNDF4                  INFHOMMEDIUM
 SOLNUO2F2   1  883.72 0 1.0 293  92235 5.02  92238 94.98  END
 H2O         2  1.0 293 END
 END COMP
 CRITICAL BY MASS    SHPERE OF UO2F2 REFLECTED
 READ PARM  RUN=YES PLT=YES  TME=45 END PARM
 READ GEOM
 GLOBAL UNIT  1
 COM='REFLECTED SHPERE OF UO2F2'
 SPHERE      1 1    21.246
 CUBE        2 1    56.246  -56.246
 END GEOM
 READ BNDS  ALL=VACUUM  END BNDS
 READ START  NST=6  TFX=0.0 TFY=0.0 TFZ=0.0  LNU=300  END START
 READ PLOT
 TTL='X - Y  SLICE AT Z = 0.0'
 PLT=NO PIC=MIXTURE XUL=-35 YUL=35 ZUL=0 XLR=35 YLR=-35 ZLR=0
 UAX=1 VAX=0 WAX=0 UDN=0 VDN=-1 WDN=0 NAX=130
 NCH='VFW' END
 END PLOT
 END DATA
 END
*******************************************************************************
```

critical by mass sphere of uo2f2 reflected

lifetime = 1.75998E-04 + or - 1.57576E-06 generation time = 7.53992E-05 + or - 5.02891E-07

no. of initial generations skipped	average k-effective	deviation	67 per cent confidence interval	95 per cent confidence interval	99 per cent confidence interval	number of histories
3	0.98590	+ or - 0.00397	0.98193 to 0.98987	0.97796 to 0.99384	0.97399 to 0.99781	30000
4	0.98564	+ or - 0.00400	0.98164 to 0.98964	0.97763 to 0.99364	0.97363 to 0.99765	29700
5	0.98555	+ or - 0.00404	0.98150 to 0.98959	0.97746 to 0.99363	0.97342 to 0.99767	29400
6	0.98576	+ or - 0.00406	0.98168 to 0.98983	0.97760 to 0.99391	0.97352 to 0.99799	29100
7	0.98575	+ or - 0.00412	0.98163 to 0.98987	0.97751 to 0.99399	0.97338 to 0.99811	28800
8	0.98434	+ or - 0.00391	0.98043 to 0.98825	0.97651 to 0.99217	0.97260 to 0.99608	28500
9	0.98429	+ or - 0.00396	0.98034 to 0.98825	0.97638 to 0.99221	0.97243 to 0.99616	28200
10	0.98429	+ or - 0.00400	0.98029 to 0.98829	0.97629 to 0.99229	0.97229 to 0.99629	27900
11	0.98428	+ or - 0.00404	0.98024 to 0.98833	0.97620 to 0.99237	0.97216 to 0.99641	27600
12	0.98413	+ or - 0.00408	0.98004 to 0.98821	0.97596 to 0.99230	0.97188 to 0.99638	27300
17	0.98268	+ or - 0.00420	0.97847 to 0.98688	0.97427 to 0.99108	0.97007 to 0.99528	25800
22	0.98005	+ or - 0.00425	0.97580 to 0.98430	0.97155 to 0.98855	0.96730 to 0.99280	24300
27	0.97741	+ or - 0.00434	0.97307 to 0.98175	0.96872 to 0.98610	0.96438 to 0.99044	22800
32	0.97675	+ or - 0.00445	0.97230 to 0.98121	0.96784 to 0.98566	0.96339 to 0.99011	21300
37	0.97521	+ or - 0.00463	0.97058 to 0.97984	0.96595 to 0.98447	0.96132 to 0.98910	19800
42	0.97407	+ or - 0.00492	0.96914 to 0.97899	0.96422 to 0.98391	0.95930 to 0.98883	18300
47	0.97201	+ or - 0.00519	0.96682 to 0.97720	0.96162 to 0.98240	0.95643 to 0.98759	16800
52	0.97058	+ or - 0.00545	0.96513 to 0.97602	0.95969 to 0.98147	0.95424 to 0.98692	15300
57	0.97132	+ or - 0.00576	0.96556 to 0.97709	0.95980 to 0.98285	0.95404 to 0.98861	13800
62	0.97013	+ or - 0.00631	0.96382 to 0.97645	0.95751 to 0.98276	0.95120 to 0.98907	12300
67	0.96618	+ or - 0.00675	0.95944 to 0.97293	0.95269 to 0.97967	0.94595 to 0.98642	10800
72	0.96688	+ or - 0.00751	0.95937 to 0.97438	0.95186 to 0.98189	0.94435 to 0.98940	9300
77	0.96846	+ or - 0.00815	0.96031 to 0.97661	0.95216 to 0.98476	0.94401 to 0.99291	7800
82	0.96639	+ or - 0.00977	0.95662 to 0.97616	0.94685 to 0.98593	0.93708 to 0.99570	6300
87	0.97638	+ or - 0.00925	0.96712 to 0.98563	0.95787 to 0.99488	0.94862 to 1.00414	4800
92	0.97352	+ or - 0.01263	0.96089 to 0.98614	0.94827 to 0.99877	0.93564 to 1.01140	3300


critical by mass shpere of uo2f2 reflected
plot of average k-effective by generation run.
the line represents k-eff = 0.9859 + or - 0.0040 which occurs for 103 generations run.
0.9859
1.0007
1.0156
5
10
15
20
25
30
35
40
45
50
55
60
65
70


75
80
85
90
95
100

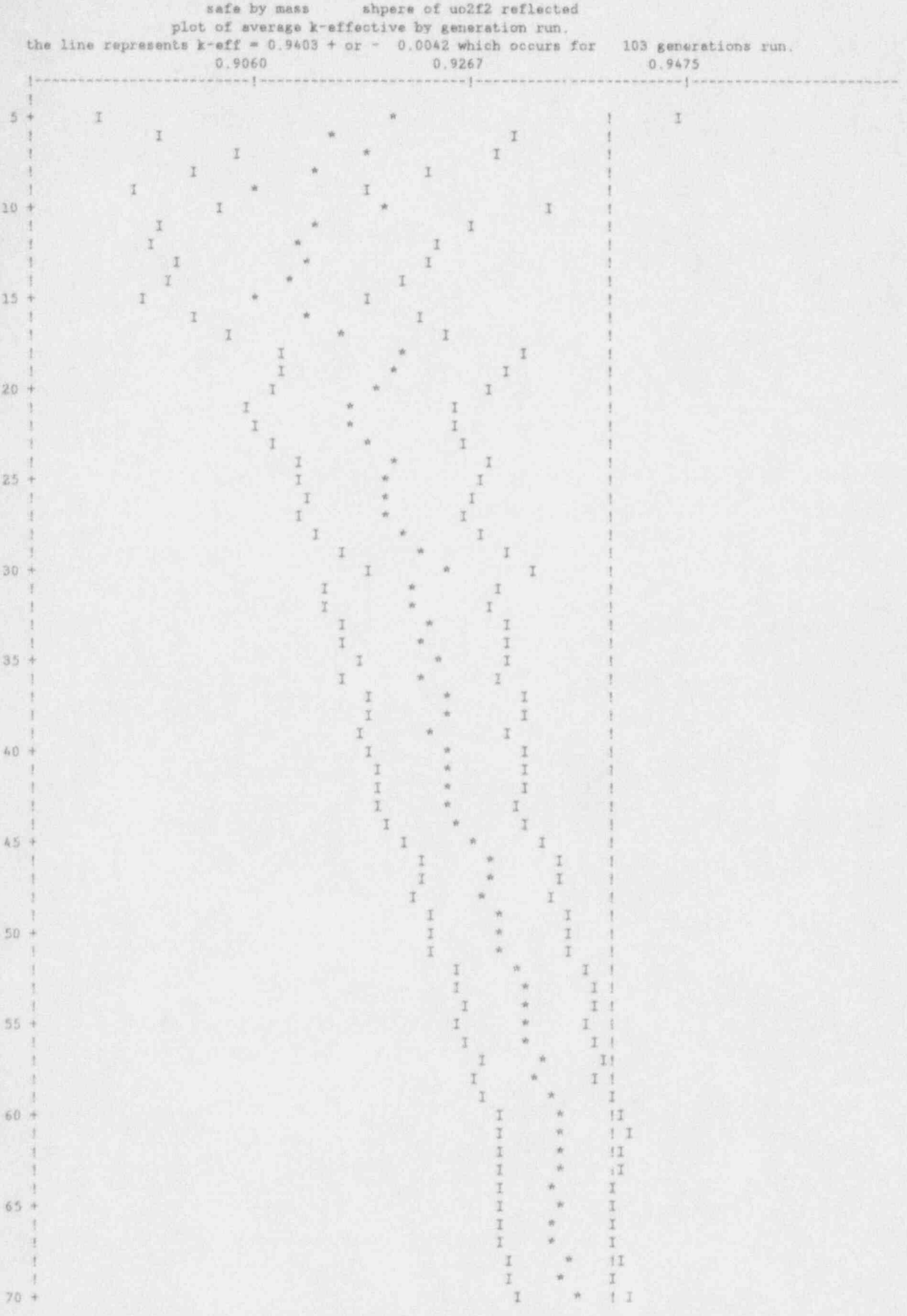
0.94037

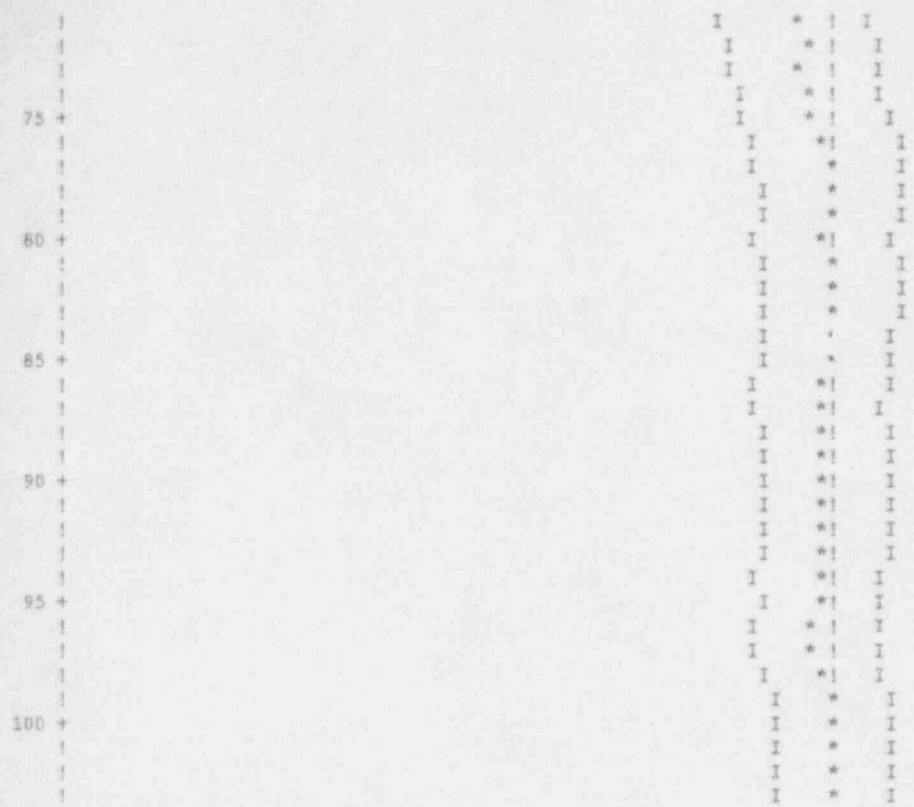
```
********************************************************************************
 #CSAS25
 SAFE BY MASS   SPHERICAL UO2F2                          UOFSPSFM.CJA
 27GROUPNDF4                  INFHOMMEDIUM
 SOLNUO2F2   1  883.72 0 1.0 293  92235 5.02  92238 94.98  END
 H2O         2  1.0 293 END
 END COMP
 SAFE BY MASS      SHPERE OF UO2F2 REFLECTED
 READ PARM  RUN=YES PLT=YES  TME=45 END PARM
 READ GEOM
 GLOBAL UNIT  1
 COM=!REFLECTED SHPERE OF UO2F2!
 SPHERE      1 1    19.249
 CUBE        2 1    54.249  -54.249
 END GEOM
 READ BNDS  ALL=VACUUM  END BNDS
 READ START  NST=6  TFX=0.0 TFY=0.0 TFZ=0.0  LNU=300  END START
 READ PLOT
 TTL='X - Y  SLICE AT Z = 0.0'
 PLT=NO PIC=MIXTURE XUL=-35 YUL=35 ZUL=0 XLR=35 YLR=-35 ZLR=0
 UAX=1 VAX=0 WAX=0 UDN=0 VDN=-1 WDN=0 NAX=130
 NCH='VFW' END
 END PLOT
 END DATA
 END
********************************************************************************
```

safe by mass shpere of uo2f2 reflected

lifetime = 1.86474E-04 + or - 1.65731E-06 generation time = 7.71665E-05 + or - 6.04294E-07

no. of initial generations skipped	average k-effective	deviation	67 per cent confidence interval	95 per cent confidence interval	99 per cent confidence interval	number of histories
3	0.94033	+ or - 0.00417	0.93616 to 0.94450	0.93198 to 0.94868	0.92781 to 0.95285	30000
4	0.94026	+ or - 0.00422	0.93604 to 0.94447	0.93183 to 0.94869	0.92761 to 0.95291	29700
5	0.94075	+ or - 0.00423	0.93652 to 0.94498	0.93229 to 0.94921	0.92807 to 0.95344	29400
6	0.94114	+ or - 0.00426	0.93688 to 0.94540	0.93263 to 0.94965	0.92837 to 0.95391	29100
7	0.94128	+ or - 0.00430	0.93698 to 0.94558	0.93269 to 0.94988	0.92839 to 0.95417	28800
8	0.94182	+ or - 0.00431	0.93751 to 0.94613	0.93321 to 0.95044	0.92890 to 0.95475	28500
9	0.94252	+ or - 0.00430	0.93823 to 0.94682	0.93393 to 0.95112	0.92963 to 0.95541	28200
10	0.94195	+ or - 0.00430	0.93765 to 0.94626	0.93334 to 0.95056	0.92904 to 0.95487	27900
11	0.94278	+ or - 0.00427	0.93851 to 0.94705	0.93424 to 0.95132	0.92997 to 0.95559	27600
12	0.94331	+ or - 0.00428	0.93902 to 0.94759	0.93474 to 0.95188	0.93046 to 0.95616	27300
17	0.94456	+ or - 0.00440	0.94016 to 0.94896	0.93576 to 0.95336	0.93136 to 0.95776	25800
22	0.94609	+ or - 0.00444	0.94164 to 0.95053	0.93720 to 0.95498	0.93275 to 0.95942	24300
27	0.94724	+ or - 0.00466	0.94258 to 0.95190	0.93791 to 0.95656	0.93325 to 0.96122	22800
32	0.94826	+ or - 0.00461	0.94365 to 0.95287	0.93903 to 0.95748	0.93442 to 0.96209	21300
37	0.94851	+ or - 0.00471	0.94380 to 0.95322	0.93910 to 0.95793	0.93439 to 0.96264	19800
42	0.95015	+ or - 0.00494	0.94521 to 0.95509	0.94028 to 0.96003	0.93534 to 0.96496	18300
47	0.94967	+ or - 0.00506	0.94460 to 0.95473	0.93954 to 0.95979	0.93447 to 0.96486	16800
52	0.94875	+ or - 0.00512	0.94362 to 0.95387	0.93850 to 0.95900	0.93338 to 0.96412	15300
57	0.94813	+ or - 0.00548	0.94265 to 0.95361	0.93718 to 0.95909	0.93170 to 0.96456	13800
62	0.94715	+ or - 0.00574	0.94141 to 0.95289	0.93567 to 0.95863	0.92993 to 0.96437	12300
67	0.94978	+ or - 0.00638	0.94340 to 0.95615	0.93702 to 0.96253	0.93064 to 0.96891	10900
72	0.94470	+ or - 0.00609	0.93861 to 0.95079	0.93253 to 0.95688	0.92644 to 0.96297	9300
77	0.94102	+ or - 0.00656	0.93446 to 0.94758	0.92790 to 0.95414	0.92134 to 0.96070	7800
82	0.94126	+ or - 0.00738	0.93388 to 0.94864	0.92650 to 0.95603	0.91912 to 0.96341	6300
87	0.94630	+ or - 0.00905	0.93726 to 0.95535	0.92821 to 0.96440	0.91917 to 0.97344	4800
92	0.94405	+ or - 0.01275	0.93130 to 0.95680	0.91856 to 0.96954	0.90581 to 0.98229	3300


safe by mass shpere of uo2f2 reflected
plot of average k-effective by generation run.
the line represents k-eff = 0.9403 + or - 0.0042 which occurs for 103 generations run.
0.9060
0.9267
0.9475


75
80
85
90
95
100

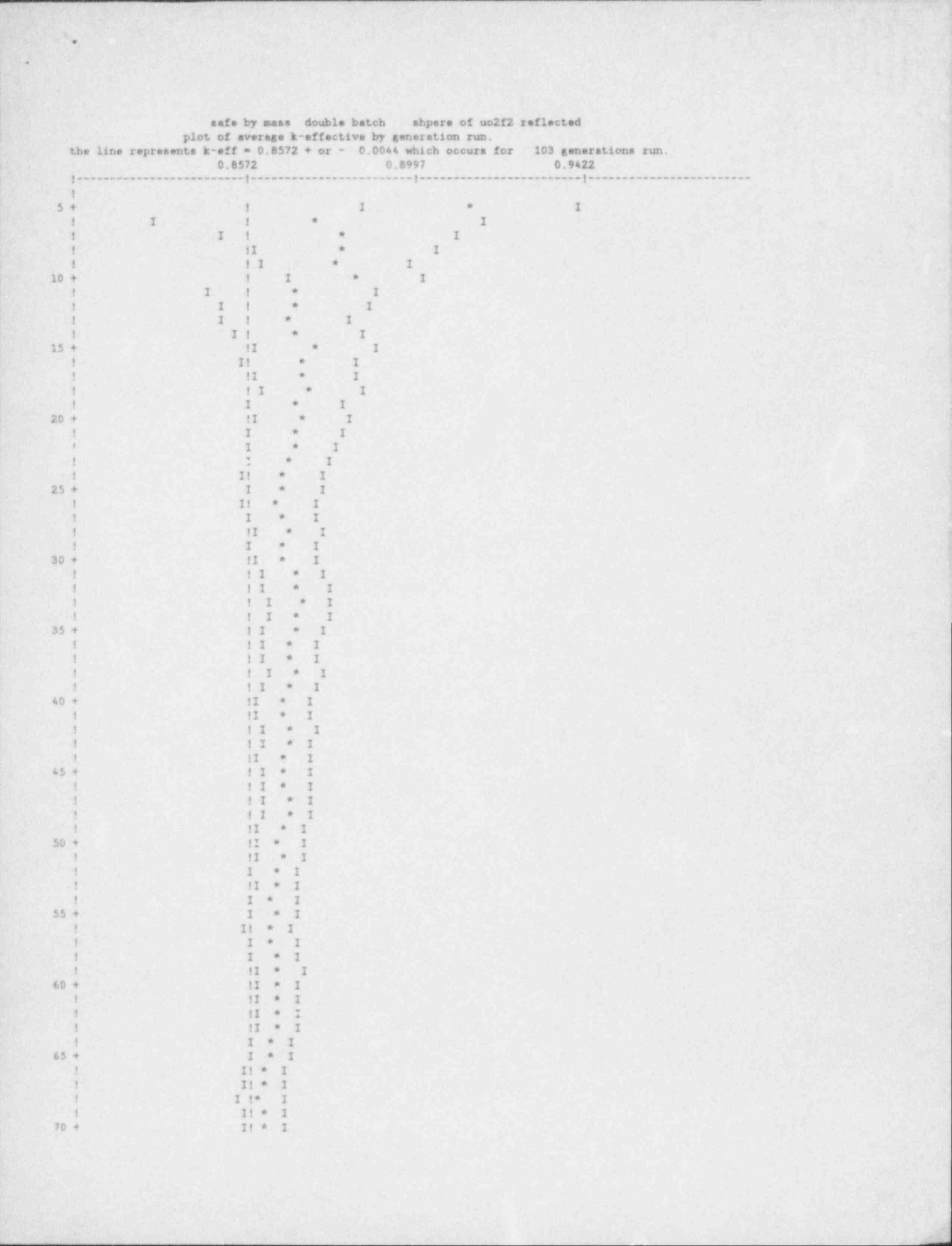
0.85773

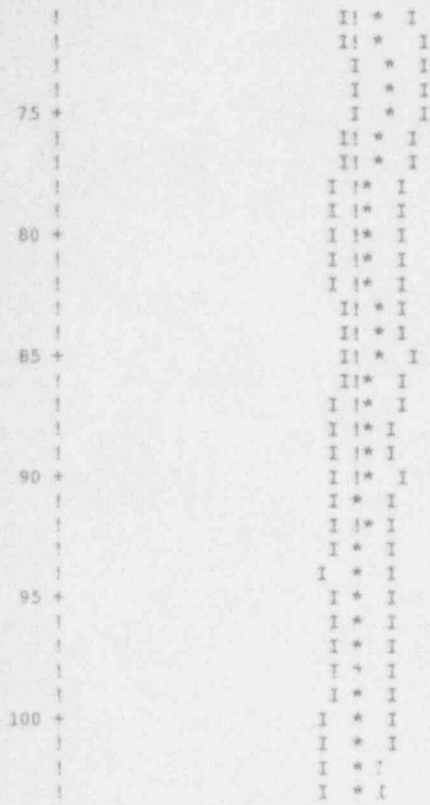
```
#CSAS25
SAFE BY MASS   DOUBLE BATCH  SPHERICAL UO2F2                UOFSPDBM.CJA
27GROUPNDF4                  INFHOMMEDIUM
SOLNUO2F2   1  883.72 0 1.0 293  92235 5.02  92238 94.98  END
H2O         2  1.0 293 END
END COMP
SAFE BY MASS  DOUBLE BATCH    SHPERE OF UO2F2 REFLECTED
READ PARM  RUN=YES PLT=YES  TME=45 END PARM
READ GEOM
GLOBAL UNIT  1
COM='REFLECTED SHPERE OF UO2F2'
SPHERE      1 1    16.255
CUBE        2 1    51.255  -51.255
END GEOM
READ BNDS  ALL=VACUUM  END BNDS
READ START  NST=6  TFX=0.0 TFY=0.0 TFZ=0.0  LNU=300  END START
READ PLOT
TTL='X - Y  SLICE AT Z = 0.0'
PLT=NO PIC=MIXTURE XUL=-35 YUL=35 ZUL=0 XLR=35 YLR=-35 ZLR=0
UAX=1 VAX=0 WAX=0 UDN=0 VDN=-1 WDN=0 NAX=130
NCH='VFW' END
END PLOT
END DATA
END
```

safe by mass double batch shpere of uo2f2 reflected

lifetime = 2.06937E-04 + or - 1.85748E-06 generation time = 8.12735E-05 + or - 6.76089E-07

no. of initial generations skipped	average k-effective	deviation	67 per cent confidence interval	95 per cent confidence interval	99 per cent confidence interval	number of histories
3	0.85723	+ or - 0.00438	0.85285 to 0.86160	0.84847 to 0.86598	0.84409 to 0.87036	30000
4	0.85637	+ or - 0.00434	0.85203 to 0.86070	0.84769 to 0.86504	0.84336 to 0.86938	29700
5	0.85605	+ or - 0.00437	0.85168 to 0.86042	0.84731 to 0.86479	0.84294 to 0.86916	29400
6	0.85665	+ or - 0.00437	0.85228 to 0.86102	0.84790 to 0.86540	0.84353 to 0.86977	29100
7	0.85622	+ or - 0.00440	0.85182 to 0.86062	0.84742 to 0.86502	0.84302 to 0.86942	28800
8	0.85589	+ or - 0.00443	0.85145 to 0.86032	0.84702 to 0.86475	0.84259 to 0.86918	28500
9	0.85577	+ or - 0.00448	0.85129 to 0.86024	0.84681 to 0.86472	0.84233 to 0.86920	28200
10	0.85515	+ or - 0.00448	0.85066 to 0.85963	0.84618 to 0.86411	0.84170 to 0.86859	27900
11	0.85614	+ or - 0.00442	0.85172 to 0.86056	0.84730 to 0.86498	0.84288 to 0.86940	27600
12	0.85596	+ or - 0.00447	0.85150 to 0.86043	0.84703 to 0.86490	0.84257 to 0.86936	27300
17	0.85477	+ or - 0.00459	0.85018 to 0.85936	0.84558 to 0.86396	0.84099 to 0.86855	25800
22	0.85443	+ or - 0.00478	0.84965 to 0.85920	0.84488 to 0.86398	0.84010 to 0.86876	24300
27	0.85432	+ or - 0.00505	0.84927 to 0.85937	0.84422 to 0.86442	0.83917 to 0.86947	22800
32	0.85199	+ or - 0.00518	0.84681 to 0.85717	0.84163 to 0.86235	0.83645 to 0.86753	21300
37	0.85123	+ or - 0.00553	0.84570 to 0.85676	0.84017 to 0.86229	0.83464 to 0.86782	19800
42	0.84981	+ or - 0.00565	0.84416 to 0.85546	0.83851 to 0.86111	0.83286 to 0.86676	18300
47	0.84883	+ or - 0.00604	0.84280 to 0.85487	0.83676 to 0.86091	0.83072 to 0.86694	16800
52	0.85043	+ or - 0.00632	0.84411 to 0.85676	0.83778 to 0.86308	0.83146 to 0.86940	15300
57	0.84984	+ or - 0.00668	0.84316 to 0.85652	0.83648 to 0.86320	0.82980 to 0.86988	13800
62	0.84642	+ or - 0.00704	0.83938 to 0.85346	0.83234 to 0.86050	0.82530 to 0.86753	12300
67	0.85031	+ or - 0.00752	0.84279 to 0.85783	0.83527 to 0.86535	0.82775 to 0.87287	10800
72	0.84598	+ or - 0.00774	0.83823 to 0.85372	0.83049 to 0.86146	0.82275 to 0.86920	9300
77	0.84729	+ or - 0.00832	0.83897 to 0.85561	0.83065 to 0.86393	0.82233 to 0.87225	7800
82	0.84655	+ or - 0.00977	0.83677 to 0.85632	0.82700 to 0.86609	0.81723 to 0.87586	6300
87	0.84621	+ or - 0.00940	0.83681 to 0.85560	0.82742 to 0.86500	0.81802 to 0.87439	4800
92	0.84168	+ or - 0.01283	0.82885 to 0.85451	0.81602 to 0.86734	0.80319 to 0.88017	3300


safe by mass double batch shpere of uo2f2 reflected
plot of average k-effective by generation run.
the line represents k-eff = 0.8572 + or - 0.0044 which occurs for 103 generations run.
0.8572
0.8997
0.9422


75
80
85
90
95
100