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MASTER

FEVER

A One-dimensional Few-group Depletion

Program for Reactor Analysis

U.S. Atomic Energy Commission
Contract AT(04-3)-314

November 28, 1962

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F E V E R

A One-dimensional Few-group Depletion

Program for Reactor Analysis

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ABSTRACT

This report describes the one-dimensional diffusion-theory depletion program FEVER, written in FORTRAN-II for a 32,000-word computer. The code allows for the representation of self-shielded burnable poisons and provides methods for automatically adjusting control poisons in various regions of the reactor according to some specified sequence. No intermediate tape manipulation is required during the calculations, since all program and data storage is contained in the fast memory of the computer. This report is intended to supply information oriented to meet the needs of the potential user of the program and also to serve as a documentation of the programming details.

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PREFACE

The primary incentive for the FEVER code development effort was the need to evaluate the effects of fuel depletion and control rod withdrawal upon the power distribution of the HTGR. For this purpose a computer code was required which would:

- Provide methods for adjustment of control poisons in the different regions of the reactor according to a specified sequence.
- Allow representation of self-shielded burnable poisons
- Contain input-output features which would facilitate use of the program and interpretation of the results.
- Be easily modified.
- Be available for use in a relatively short time.

The FEVER code was written in conformity with these objectives. The present report is intended as a guide to the user of the code, and contains little discussion of the formulation of the methods used, or of their justification in comparison with alternative approaches. However, it may be asserted that, within the limitations of its "few-group" theoretical model, the code has been found reliable as well as useful.

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I. INTRODUCTION

FEVER is a one-dimensional depletion calculation written in the FORTRAN-II language^{(1)*} for a 32,000-word computer. The present version was compiled for use with the IBM-7090 FORTRAN Monitor System.

Flux, power, and effective multiplication factors are computed by means of a group diffusion calculation limited to 150 mesh points in up to 20 regions and using a maximum of 4 energy groups. Slowing down may occur only to the next adjacent group, and the fission source may be in the highest energy group only.

The isotopic depletion is accomplished by finite difference approximations, using region average fluxes and nuclide concentrations rather than mesh-point values. This calculation will handle up to 25 isotopes in each region; the first 6 form a fixed chain from Th²³² to U²³⁶, the next 6 form a fixed chain from U²³⁸ to Pu²⁴², the next is a nonsaturating fission-product aggregate, and then 2 rapidly saturating fission products (Xe¹³⁵ and Sm¹⁴⁹) follow. The remaining 10 nuclides may be a combination of additional fission products; other depleting materials, such as self-shielded or unshielded burnable poisons; and nondepleting materials, such as control poisons, moderators, coolants, and structural materials.

The effects of lumped burnable poisons are simulated in the program by the application of concentration-dependent self-shielding factors to the cross sections of nuclides defined as lumped poisons. The magnitude of the shielding factor is determined from a power-series polynomial function of poison concentration. The coefficients of this polynomial are usually obtained from previous cell calculations and supplied as input data to the code.

*References are listed on page 41.

Options are available to adjust control poisons according to a specified sequence, and to calculate maximum K_{eff} at operating temperature and cold shutdown K_{eff} at shutdown temperature for each time step. It is also possible to investigate the xenon-override problem with the code.

Three modes of operation are possible:

1. Single diffusion calculation.
2. Straight burnup.
3. Burnup with control-poison search.

The reader is referred to Fig. 1 for aid in understanding the material in the next few paragraphs.

1. 1. SINGLE DIFFUSION CALCULATION

Few-group constants are computed and used in the diffusion calculation to obtain fluxes, power distribution, and effective multiplication factor. No burnup calculation is performed and execution is terminated at this point.

1. 2. STRAIGHT BURNUP

The first mode of operation is extended to do a burnup calculation after the diffusion calculation. This sequence is then repeated until the multiplication factor falls below a specified value or until a preselected time step is reached. At this point, the calculations cease and a summary of the results is printed. No attempt is made to obtain a "just critical" poison adjustment. The chief virtue of a calculation of this type is the reduced computing time. It is useful for survey-type burnup studies.

1. 3. BURNUP WITH CONTROL-POISON SEARCH

The second mode of operation is extended to do a control-poison search for a specified "control point" multiplication factor (usually 1.0) before proceeding to burnup calculations. Nuclides which have been

Fig. 1--Simplified flow diagram

defined by the input data as "control poisons" are adjusted automatically within any region, in the order specified, and within given concentration limits. Any region may undergo control-poison adjustment separately or simultaneously with other regions. If reactivity is less than required and the poison concentration is at the minimum limit for a particular region, the program proceeds forward in the control sequence list and attempts to attain criticality by working in the other remaining regions in the list. If reactivity is greater than required and the control-poison concentration is at the maximum limit for that region, the program reverses its movement through the control sequence list and attempts to attain a critical poison adjustment by working in regions used previously. Once the control-poison search has been satisfied, the program proceeds to the burnup calculation and then returns to the group diffusion routine. This sequence is repeated until it is no longer possible to obtain the specified multiplication factor by the control adjustment scheme given, until all control poison has been removed, or until a specified lifetime has been reached. A synopsis of the results for each time step is printed at the end of the problem.

1. 4. TYPES OF MATERIALS WHICH CAN BE CONSIDERED IN A FEVER CALCULATION

The nuclides handled by FEVER are divided into five categories, as follows:

1. A fixed group of 15 materials. This includes the two heavy-isotope chains (see Fig. 2, page 10), a nonsaturating fission-product aggregate, Xe^{135} , and Sm^{149} . These materials must be used in every problem. The last three, which are fission products, require that fission yield data be supplied for them.

2. "Special" materials. This group may include materials such as other fission products and homogeneously distributed burnable poisons. Fission yields must be supplied for each of these materials but may be zero if not appropriate.

3. Lumped poisons. A maximum of three materials in a region can be placed in the lumped-poison category. This group is used to treat nuclides for which it is desirable to have the self-shielding factor vary as a function of concentration. Coefficients of a power-series polynomial and certain geometric data must be supplied for each of these materials.

4. Control poisons. A maximum of two control poisons may be specified for a region. Since FEVER is a one-dimensional code, the insertion and withdrawal of control rods is simulated by varying only the atomic densities of materials defined as control poisons. For each material specified as a control poison, a maximum and minimum concentration limit must be given. It is also necessary to supply as input data a control adjustment scheme if control poisons are to be adjusted automatically.

5. Nonburnable materials. Moderators, coolants, and structural materials may be specified as nonburnable. Their cross sections are used when computing the few-group constants, but they are not depleted in the burnup calculation and concentrations remain constant with time. A maximum of ten may be used in any one region.

1.5. OUTPUT

Data generated and printed by the program for each time step include:

1. Control-poison concentrations for the "just critical" case.
2. Maximum K_{eff} at operating temperature with all control poison removed (if this option is selected).
3. Cold shutdown K_{eff} at shutdown temperature with xenon removed and all control poison fully inserted (if this option is selected).
4. Conversion ratio.
5. All nuclide concentrations by region.
6. Weight of heavy isotopes (total and by region).
7. Flux and power distributions.
8. Neutron balance (source, removal, leakage, and absorption rates per source neutron, and fractional absorptions and productions for all materials in the power-generating volume).

II. DISCUSSION OF THE PROGRAM AND OPTIONS

2.1. THE DIFFUSION CALCULATION

Multiplication factor, flux, and power distributions are obtained from a few-group multiregion diffusion routine which is actually a modified version of the diffusion code Program F-3. ⁽²⁾ This code was selected to serve as the basic neutronics portion of FEVER because it was immediately available and in a form which was not too difficult to modify for this application. The diffusion calculation solves the one-dimensional, group diffusion equations

$$-D_1 \nabla^2 \phi_1 + (\Sigma_{a_1} + \Sigma_{s_1} + D_1 B_1^2) \phi_1 = \frac{1}{\lambda} \sum_{i=1}^G \nu \Sigma_{f_i} \phi_i$$

and

$$-D_i \nabla^2 \phi_i + (\Sigma_{a_i} + \Sigma_{s_i} + D_i B_i^2) \phi_i = \Sigma_{s_{i-1}} \phi_{i-1}, \quad 2 \leq i \leq 4$$

as difference equations in slab or cylindrical geometry. Note that fission neutrons are born in the first or highest energy group only. The source in all other groups is generated by slowing down from the preceding group. Reference 2 gives a brief explanation of the procedure used for solving these equations:

"The method used to solve the second order differential equations, subject to specification of the albedo at each boundary, may be broken down into the following two steps:

"A) Continuity of the flux and current are set up at an internal lattice point, noting that the coefficients of the generalized diffusion equation will be different on the right-hand side of the lattice point than on the left-hand side.

"B) A recursion relation of the flux ratios at each lethargy is established. In order to retain an arbitrary constant with which to satisfy the outer boundary condition, flux ratios are computed starting at the inner boundary. Upon reaching the outer boundary and applying the boundary condition, the flux is computed from outer boundary to inner boundary."

Fluxes and the resulting multiplication factor are improved by iteration on Step (B) until two specified convergence criteria are satisfied. At this point, fluxes are averaged by region and normalized to the required power level.

Certain changes in the original diffusion program have been required to make it suitable for incorporation in FEVER. The routine now

1. Provides for up to four energy groups and twenty regions (originally three groups and ten regions).
2. Includes region- and group-dependent transverse bucklings.
3. Uses the sources from the previous converged calculations to begin the succeeding diffusion calculation.
4. Tests the reactivity convergence criterion only between an arbitrary number (4) of iterations.
5. Tests a "pointwise" convergence criterion after satisfying the "reactivity" convergence.

By delaying the reactivity test for a few iterations, an observed problem of occasional "false reactivity convergence" has been avoided. Addition of the pointwise criterion merely strengthens the reliability of the reactivity convergence, since it has been the practice to use a reactivity criterion much smaller than the pointwise criterion in the interests of conserving computer time. Under these conditions, the pointwise criterion is usually satisfied within very few additional iterations. Although stronger convergence tests are available, they have not been found necessary in the present application.

The use of sources from previously converged calculations greatly

reduces the number of iterations required to obtain convergence of the diffusion calculation where the source to be generated in the succeeding calculation is similar to the previous one. When this is not the case, the old source values usually provide an initial estimate which is just as satisfactory as a standard flat source guess. Therefore, each diffusion calculation is begun with whatever previous source data are available. It has been observed that this modification causes noticeable improvement in the FEVER computing times for certain types of cases.

The computational relationships of the diffusion calculation as they exist in FEVER are presented in Section 3. 1.

2. 2. THE NEUTRON BALANCE

A neutron balance is performed over the power-generating regions of the reactor. The computed reaction rates (source, removal, leakage, and absorption) per source neutron are printed after the results of the diffusion calculation (except for "noncritical" control search cases).

Group-dependent values of buckling are generated from the normal leakage obtained in the balance and a flux- and volume-weighted "average" diffusion coefficient. In many cases these buckling values are found useful in succeeding problems.

Fractional absorptions and productions are also computed in this routine for each group and material, over the power-generating regions. Since FEVER does not restrict the user to identify all given materials by the same material number in all regions, care should be exercised in interpreting the results when similar material identification numbers refer to different materials.

Another portion of the program (BURNUP) computes and prints out "fission fractions" of U^{233} , U^{235} , Pu^{239} , and Pu^{241} . These values cannot be compared exactly to the fractional productions because they are not weighted by the number of neutrons per fission.

The actual computational relationships used for the "neutron balance" and related items are found in Section 3.2 and those for "fission fractions" in Section 3.3.

2.3. BURNUP

Region-dependent nuclide concentrations are obtained from average region fluxes and concentrations rather than from individual mesh-point values. The computations are performed assuming a flux spectrum which is constant over the whole depletion time step. This time step may be broken into an arbitrary number of smaller time intervals so that the flux amplitude can be readjusted during the burnup calculation. Use of the small time intervals for burnup also makes it possible to use larger gross time steps between diffusion calculations without causing the isotopic difference approximation equations to "blow up" for nuclides having very large cross sections. One could have the program determine the optimum size time interval from the fluxes and cross sections involved. However, it is relatively easy for the user to choose a time interval which is suitable. This permits each case to be run with the same time intervals and makes comparisons between cases a little easier.

There are other problems in this connection which make it desirable that the user exercise a little discretion in choosing an appropriate time step. Large control-rod swings and heavy localized burnup are among these. In doubtful cases a few trial runs of the code to determine suitable time steps are recommended.

Burnable Materials

Three of the five material categories are considered burnable. That is, their concentrations vary with time. The fixed group of nuclides contains the two heavy-isotope chains shown in Fig. 2. Xenon-135, samarium-149, and a nonsaturating fission-product aggregate are also arbitrarily placed in

Chain 1 Chain 2

—————> Indicates neutron capture
 ↑
 Indicates β^- decay
 ↗
 Indicates combined neutron capture and β^- decay
 ↘
 Indicates neutron fission
 (all isotopes may experience fission, but those indicated normally produce most of the power)

Fig. 2--Heavy-isotope chains

this group. These materials are required for every region in the case, although they may have zero cross sections or concentrations.

The second group of burnable materials is referred to as the "special" material group. This group may contain individual saturating fission products, fission-product aggregates, homogeneously distributed burnable poisons, or any other material with time-dependent concentration which is not more appropriately placed in another category. Nuclides in this group may be formed by capture in a previous nuclide as well as by fission. They are depleted by absorption processes.

The third category of burnable nuclides includes the strongly self-shielded (lumped) poisons. As these nuclides are depleted, their self-shielding becomes weaker. This is accounted for by the use of self-shielding factors which are concentration-dependent functions (a power-series polynomial). These factors are re-evaluated at each small time step during the depletion calculation.

Materials which are defined as control poisons or as nonburnable nuclides are not taken into account during burnup. Their concentrations are assumed to be time-invariant.

The Source of the Burnup Equations

Computational relationships for the nuclides in the two heavy-isotope chains (see Fig. 2) were derived from the differential equations given below:

$$\frac{dN^{02}}{dt} = -N^{02} \sigma_a^{02} \phi$$

First Chain (Th²³² - U²³⁶)
Th²³²

(1)

$$\frac{dN^{13}}{dt} = N^{02} (\sigma_a^{02} - \sigma_f^{02}) \phi - N^{13} (\lambda^{13} + \sigma_a^{13} \phi)$$

Pa²³³

(2)

12

U²³³

$$\frac{dN^{23}}{dt} = -N^{23}\sigma_a^{23}\phi + N^{13}\lambda^{13} \quad (3)$$

U²³⁴

$$\frac{dN^{24}}{dt} = -N^{24}\sigma_a^{24}\phi + N^{13}(\sigma_a^{13} - \sigma_f^{13})\phi + N^{23}(\sigma_a^{23} - \sigma_f^{23})\phi \quad (4)$$

U²³⁵

$$\frac{dN^{25}}{dt} = -N^{25}\sigma_a^{25}\phi + N^{24}(\sigma_a^{24} - \sigma_f^{24})\phi \quad (5)$$

U²³⁶

$$\frac{dN^{26}}{dt} = -N^{26}\sigma_a^{26}\phi + N^{25}(\sigma_a^{25} - \sigma_f^{25})\phi \quad (6)$$

Second Chain (U²³⁸ - Pu²⁴²)U²³⁸

$$\frac{dN^{28}}{dt} = -N^{28}\sigma_a^{28}\phi \quad (7)$$

Np²³⁹

$$\frac{dN^{39}}{dt} = N^{28}(\sigma_a^{28} - \sigma_f^{28})\phi - N^{39}(\lambda^{39} + \sigma_a^{39}\phi) \quad (8)$$

Pu²³⁹

$$\frac{dN^{49}}{dt} = -N^{49}\sigma_a^{49}\phi + N^{39}\lambda^{39} \quad (9)$$

Pu²⁴⁰

$$\frac{dN^{40}}{dt} = -N^{40}\sigma_a^{40}\phi + N^{39}(\sigma_a^{39} - \sigma_f^{39})\phi + N^{49}(\sigma_a^{49} - \sigma_f^{49})\phi \quad (10)$$

$$\frac{dN^{41}}{dt} = -N^{41}(\sigma_a^{41}\phi + \lambda^{41}) + N^{40}(\sigma_a^{40} - \sigma_f^{40})\phi$$

Pu²⁴¹

(11)

$$\frac{dN^{42}}{dt} = -N^{42}\sigma_a^{42}\phi + N^{41}(\sigma_a^{41} - \sigma_f^{41})\phi$$

Pu²⁴²

(12)

Since the computer will not solve differential equations directly, these equations must be put into a form suitable for computation. This has been done by substituting

$$\frac{dN}{dt} \equiv \frac{N_{t+1} - N_t}{\Delta t}$$

and

$$N \equiv \frac{N_{t+1} + N_t}{2}$$

into the differential equation and doing the algebra to get N_{t+1} . This yields a relationship which can be used by the computer. The method is explained in detail in Ref. 3.

The equations for Pa²³³ and Np²³⁹ are exceptions to this procedure. The analytic solutions were used rather than the finite difference forms.

The standard equilibrium relationships are used for computing Xe¹³⁵ and Sm¹⁴⁹ concentrations because these nuclides saturate rapidly and can be conveniently handled in this way. This means that burnup of these materials is not considered explicitly and the concentrations present after the initial time step will always be returned to an equilibrium value.

The computational equation for "special" materials was obtained from the differential equation for a material that results from a fission yield and/or capture in a preceding nuclide and is depleted by absorption processes:

$$\frac{dN^s}{dt} = -N^s\sigma_a^s\phi + \Gamma^s\Sigma_f\phi + N^{s-1}\sigma_a^{s-1}\phi\delta^s.$$

Here Γ^s is the fission yield, s is the superscript referring to a nuclide or aggregate, and δ is an artificial factor which must have a value of 0.0 or 1.0 (if 1.0, this nuclide is formed by capture in a preceding material; if 0.0, this nuclide is not formed by capture). The special materials equation must be applicable to rapidly saturating nuclides, as well as others. Therefore, the analytic solution for this equation is obtained, assuming the second and third terms to be constants. This is a reasonable assumption because the solution is to be applied over relatively short time intervals and the constants are re-evaluated frequently. An "average" value of N^{s-1} , the atomic density of the preceding nuclide, is used when evaluating the resulting computational equation.

Lumped poisons are depleted using the analytic solution of

$$\frac{dN}{dt} = -N\sigma_a g \phi ,$$

with g , the concentration-dependent self-shielding factor, considered a constant which is re-evaluated for each small time interval.

All of the computational relationships used for burnup are given in Section 3.3.

2.4. LUMPED-POISON SELF-SHIELDING

Self-shielding factors used by FEVER remain constant throughout the calculation except for those applied to the cross sections of lumped poisons. Self-shielding factors for lumped poisons are obtained by evaluating a concentration-dependent power-series polynomial,

$$g_i = A_{0_i} + A_{1_i} \rho + A_{2_i} \rho^2 + A_{3_i} \rho^3 + A_{4_i} \rho^4 + A_{5_i} \rho^5 ,$$

where g is the self-shielding factor, A is the coefficient, ρ is the density of lumped poison (g/cm^3), and i is the energy-group index, whenever a lumped-poison cross section is required in the calculation.

The coefficients of the polynomial must be obtained in advance and

supplied to the code as input data. The usual procedure is to perform a few cell calculations with various poison concentrations. Using $g = \overline{\phi}^{\text{poison}} / \overline{\phi}^{\text{cell}}$, a curve of poison concentration versus self-shielding factor can be drawn from the results of the cell calculations, and the power-series coefficients can be derived from this curve. The polynomial then yields a variable self-shielding factor as the poison is depleted in the calculation.

In practice, the thermal energy group has a significantly different self-shielding for hot and cold conditions, but high energy groups are not influenced. For this reason, and because of computer storage considerations, provision is made to supply cold self-shielding coefficients (in addition to the hot coefficients) to only the two lowest energy groups. The program uses the hot coefficients for the upper groups. Section 3.4 gives the computational relationships for lumped self-shielding factors.

2.5. CONTROL-POISON ADJUSTMENT

Control poisons are adjusted in the following manner: A list of poison regions is given as input data. With each region mentioned in the list, a maximum and minimum insertion fraction is supplied. Any region may be mentioned in the list as often as desired. Each time a region appears in the control list, new maximum and minimum insertion fractions are given. In general, insertion fractions decrease from top to bottom of the list. The code makes its first poison adjustment in any region by choosing the mean value of the minimum and maximum permitted values.

Thereafter, a linear extrapolation (or interpolation) gives the next poison guess. Usually two or three tries are necessary to adjust poison so that criticality is within a factor of 10^{-3} . It is also possible to make simultaneous adjustments of two or more regions (bank control) by requesting this with the input data. In this case, poison adjustments are made as previously described, except that more than one region is involved.

A feature has been incorporated in the control adjustment procedure to reverse the movement through the control-region list under certain

conditions (see Section 1.3). This feature tends to simplify the required control specifications for many cases because it means that a detailed knowledge of the excess reactivity is not required prior to running the case. However, this feature also tends to limit the versatility of the adjustment scheme, so that certain conceivable control schemes cannot be simulated easily and may require restarting the case from the point of difficulty.

2.6. CROSS SECTIONS

A cross-section library containing a maximum of 120 blocks of microscopic cross sections is read into the computer before the first problem. The library must contain all of the cross-section data which will be required for the calculations which follow. This includes cross sections for shutdown temperature if cold shutdown multiplication is to be computed.

The assignment of cross-section data blocks to each material in each region is performed by means of the case input data and is completely arbitrary. This permits the use of different microscopic cross sections for a given material in certain zones where the spectrum differs markedly. The versatility is limited only by the maximum of 120 cross-section blocks.

The time-dependent macroscopic cross sections used by FEVER are defined by

$$\Sigma(t) = N(t) \sigma ,$$

where σ remains constant with time.

Actually, it would be better to define them as

$$\Sigma(t) = N(t) \sigma(t) ,$$

but this would require spectrum calculations and generation of group microscopic cross sections periodically during the calculation. No provision has been made to do this in the present version of the code.

2.7. PROGRAM OPTIONS

Auxiliary Calculations of Multiplication Factor

When performing reactor lifetime calculations, it is of interest to know not only the point at which the reactor can no longer be made critical, but also whether the reactor can be shut down and how much excess multiplication exists. An option is provided to obtain this information. At each time step the program will, if requested, first remove all control poison. This is accomplished by setting to zero the concentrations of all materials specified as control poison. The group constants are then recomputed and used in a diffusion calculation. The resulting multiplication is the maximum hot, unrodded K_{eff} . Next, the program sets the Xe^{135} concentration to zero and all control poisons to the maximum value specified. It is assumed that isotopes Pa^{233} and Np^{239} have not had sufficient time to decay to U^{233} and Pu^{239} . Shutdown-temperature cross sections are then used to compute the cold few-group constants to be used in a second diffusion calculation, resulting in cold shutdown multiplication.

The only data preserved from these auxiliary calculations are the multiplication factors, which are printed immediately and are also saved for the case synopsis. It is noted that the transverse buckling values supplied for the case are not modified for these special conditions, although it is recognized that this is not a strictly correct procedure.

Xenon Override

The xenon-override calculation is an extension of the maximum hot, unrodded multiplication option to include the effects of buildup and decay of Xe^{135} , I^{135} , U^{233} , Pa^{233} , Np^{239} , and Pu^{239} for a specified shutdown time. The hot maximum multiplication factor is computed for a specified number of small time intervals during which rapid changes in concentrations of these nuclides occur. It should be recognized that a calculation of this type can only give the time limits within which reactivity may not be sufficient to override the xenon poisoning. It is not possible to show that

start-up is impossible under these conditions (unless the cold maximum multiplication is also subcritical) because this would depend upon the manner in which the reactor is brought to power. A more sophisticated attack on this problem does not seem warranted for inclusion in the FEVER program.

Shutdown—Start-up

This option makes it possible to simulate the shutdown of the reactor for a specified length of time. It includes the effects of radioactive decay on the same isotopes as in the xenon-override calculation. The power level and the length of the burnup time step may be changed before each start-up. The case is then restarted automatically. The shutdown—start-up feature may be repeated as often as desired as long as the reactor can still be made critical.

Start-up after a shutdown begins with the reactor in the condition it was in after the isotopic decay had occurred. Equilibrium xenon is then built up for the new power level and the program continues in the usual manner. This option was included in order to study the effects of frequent shutdowns, which are likely to occur in the initial phases of power-reactor operation.

Plotting Option

An option is available to produce plots of power distribution as a part of the printed output. The additional computing time involved is practically negligible, but the plots are often very helpful when interpreting the results. Therefore, one should not hesitate to use the option when there is any possibility of its being beneficial.

These plots are as accurate as the spacing of the printed characters on the page and readily reveal the qualitative aspects of the curve. All data plotted by the code are printed to at least five-place accuracy elsewhere in the printout. The printed values should be used where quantitative results are required.

Card-punch Option

The most tedious job involved in restarting a case which has built up heavy isotopes in a previous run is that of transferring atomic densities to input data cards. This procedure can be simplified by requesting the restart punch option, which punches out cards containing these atom densities in a format acceptable to the code as input data (i. e. , Card 9: see Appendix C). These cards alone are not sufficient to restart a case. However, by using the punch-out cards and the data cards from the original case, it is relatively easy to prepare the restart case.

Since the usual purpose in terminating a case prematurely is to make changes which are not done automatically by the program, it is felt that the punching option provided should be suitable for most applications of the code.

2. 8. COMPUTING TIME

For production work on the IBM-7090, typical FEVER cases have run from 1 to 50 centihours, depending upon the nature of the problem attempted. The number of diffusion calculations required during execution of a case and the length of time each takes to converge are the controlling factors. A crude computing-time estimate can be made for some hypothetical "average" case by multiplying the expected number of diffusion calculations by 0.5 centihours. Much better estimates will be possible after a little experience with specific problems.

2. 9. PRINTOUT

An effort has been made to produce a printout which is as self-explanatory as possible. In most places where this result is not achieved, it is probable that anyone who has had the experience of preparing the input data will readily understand the printouts.

The time-step labeling will be explained here to eliminate any confusion.

Time steps have been labeled with integers. Real time in days at any point in the output may be determined by multiplying the integer time-step number by the burnup time interval. Thus, at time step 8 with a time interval of 25 days, the total reactor operating time would be 200 days. There is one exception to this procedure. When the time step number indicated is -1, the reactor has not been operated and the time is zero. The purpose here is to differentiate between -1 and 0 time steps. The calculation is ordinarily (but not necessarily) begun at -1 when no rapidly saturating Xe^{135} and Sm^{149} has been supplied as input data. At time step 0, equilibrium xenon and samarium will be built up, but the elapsed operating time is assumed to be negligible (zero) at this point.

III. COMPUTATIONAL RELATIONSHIPS

This section presents the computational relationships in a form similar to that in which they are coded. The nomenclature used in each subsection is indicated immediately following the equations because it is not entirely consistent throughout.

3. 1. THE DIFFUSION CALCULATION

Most of the diffusion-calculation relationships reported here have been extracted literally from Ref. 2. They are repeated for purposes of completeness, since the modified Program F-3 forms the neutronics part of the code. The equations given contain the relatively minor changes and additions made for the purpose of adapting this diffusion calculation for use as an integral part of FEVER.

Width of Regions and Position of Lattice Points

$$W_r = \frac{r_r - r_{r-1}}{I_r} \quad 1 \leq r \leq 20$$

$$r_p = r_{p-1} + W_r \quad 1 \leq p \leq 150$$

Geometric Coefficients

Slab, N27 = 1 :

$$\beta_p = \frac{r_{p+1} - r_p}{r_p - r_{p-1}}$$

$$\delta_p = \frac{(r_{p+1} - r_p)(r_p - r_{p-1})}{2}$$

$$\gamma_p = \beta_p \cdot \delta_p$$

Cylinder, N27 = 2 :

$$Y = \frac{r_p + r_{p+1}}{3r_p - r_{p+1}}$$

$$Z = \frac{r_p + r_{p-1}}{3r_p - r_{p-1}}$$

$$\beta_p = \frac{r_{p+1} - r_p}{r_p - r_{p-1}} \cdot \frac{1 + |Z|}{1 + |Y|}$$

$$\delta_p = 0.25 \left(\frac{r_{p+1} - r_p}{1 + |Z|} \right) (3r_p - r_{p-1}) - (r_p - r_{p-1}) |Z|$$

$$\gamma_p = 0.25 \left(\frac{r_{p+1} - r_p}{1 + \left| \frac{1}{Z} \right|} \right) (r_p + r_{p+1}) - (3r_p - r_{p+1}) \left| \frac{1}{Y} \right|$$

Recursion Coefficients and Absorption Parameters

$$Q_{i,p} = \Sigma_{s_{i,r}} + \Sigma_{a_{i,r}} + D_{i,r} K_{i,r}^2$$

$$a_{i,p} = D_{i,p+1} + \beta_p D_{i,p} + \gamma_p Q_{i,p+1} + \delta_p Q_{i,p}$$

$$b_{i,p} = \beta_p D_{i,p}$$

Boundary Coefficients and Flux

$$E_{i,p} = 1 + \frac{(r_p - r_{p-1})(1 - A_i^-)}{2D_{i,p}(1 + A_i^-)} ; \quad p = 1$$

$$G_{i,p} = 0.0 \quad ; \quad p = 1$$

$$C_{i,p} = \gamma_p F_p^+ + \delta_p F_p^- \quad ; \quad i = 1$$

$$C_{i,p} = \left(\gamma_p \Sigma_{s_{i-1,p+1}} + \delta_p \Sigma_{s_{i-1,p}} \right) \phi_{i-1,p} ; i = 2, \dots, N26 \leq 4$$

$$E_{i,p} = \frac{1}{D_{i,p}} \left(a_{i,p-1} - \frac{b_{i,p-1}}{E_{i,p-1}} \right) \quad ; \quad p = 2, \dots, N28 \leq 150$$

$$G_{i,p} = \frac{1}{D_{i,p}} \left(C_{i,p-1} + \frac{b_{i,p-1} G_{i,p-1}}{E_{i,p-1}} \right); \quad p = 2, \dots, N28$$

$$B_i = 1 + \frac{(r_{N28} - r_{N28-1})(1 - A_i^+)}{2D_{i,N28}(1 + A_i^+)}$$

$$\phi_{i,N28} = \frac{G_{i,N28}}{(B_i E_{i,N28} - 1)}$$

$$\phi_{i,p} = \frac{(G_{i,p+1} + \phi_{i,p+1})}{E_{i,p+1}}$$

Fission Density

$$F_p^+ = \sum_{i=1}^{N26} \nu \Sigma_{fi,p+1} \phi_{i,p} \quad ; \quad F_p^- = \sum_{i=1}^{N26} \nu \Sigma_{fi,p} \phi_{i,p}$$

Multiplication Factor

Slab, N27 = 1 :

$$k = \sum_{p=1}^{N29} \frac{(F_p^+ + F_{p+1}^-)(r_{p+1} - r_p)}{2}$$

Cylinder, N27 = 2 :

$$k = \sum_{p=1}^{N29} \frac{(r_p F_p^+ + r_{p+1} F_{p+1}^-)(r_{p+1} - r_p)}{2}$$

Fissionable Volume (Core)

Slab:

$$V = \sum_{p=1}^{N29} \left(\frac{F_p^+}{F_p^+} + \frac{F_{p+1}^-}{F_{p+1}^-} \right) \left(\frac{r_{p+1} - r_p}{2} \right)$$

Cylinder:

$$V = \sum_{p=1}^{N29} \left(\frac{F_p^+ r_p}{F_p^+} + \frac{F_{p+1}^- r_{p+1}}{F_{p+1}^-} \right) \left(\frac{r_{p+1} - r_p}{2} \right)$$

Average Flux in Core

Slab:

$$\bar{\phi}_i = \sum_{p=1}^{N29} \left(\frac{F_p^+ \phi_{i,p}}{F_p^+} + \frac{F_{p+1}^- \phi_{i,p+1}}{F_{p+1}^-} \right) \left(\frac{r_{p+1} - r_p}{2} \right)$$

Cylinder:

$$\phi_i = \sum_{p=1}^{N29} \left(\frac{F_p^+ r_p \phi_{i,p}}{F_p^+} + \frac{F_{p+1}^- r_{p+1} \phi_{i,p+1}}{F_{p+1}^-} \right) \left(\frac{r_{p+1} - r_p}{2} \right)$$

Convergence

Reactivity:

$$|k_j - k_{j-4}| < \epsilon_1$$

Pointwise, when reactivity criterion is satisfied :

$$\lambda_{j,p} = \frac{F_{j,p}^-}{F_{j-1,p}^-}$$

$$\epsilon_2 > \frac{\lambda_p^{\max} - \lambda_p^{\min}}{\lambda_p^{\max}} ;$$

if not converged,

$$F_p^+ = F_p^+ / k_j \quad F_p^- = F_p^- / k_j ;$$

if converged,

$$\bar{\phi}_i = \bar{\phi}_i / V \quad F_p^+ = VF_p^+ / k_j \quad F_p^- = VF_p^- / k_j$$

Nomenclature

A	Albedo
a, b	Recursion coefficient
B	Boundary coefficient
C	Source term
D	Diffusion coefficient
E, G	Solution of recursion equation
F	Fission density
I	Number of intervals in region
K^2	Buckling
k	Reactivity
Q	Absorption parameter
r	Radius of region or point
V	Core volume
W	Interval width in region
β	Geometrical coefficients
δ	
γ	
ϵ_1	Reactivity convergence criterion
ϵ_2	Pointwise convergence criterion
λ	Pseudo eigenvalue
ϕ	Flux
Σ_a	Absorber cross section
Σ_s	Scatter down cross section

$\nu\Sigma_f$	Fission cross section times neutrons per fission
i	Group index
p	Lattice point index
j	Iteration index
r	Region index
+ } - }	Indicates the side on which a discontinuous function is evaluated
N26	Number of energy groups
N27	Geometry indication
N28	Number of mesh points
N29	N28-1

3. 2. NEUTRON BALANCE

$$P = \frac{\sum_{i=1}^{N26} \sum_R \nu\Sigma_{fi} \phi_i^R V^R}{K_{eff}}$$

$$A_i = \frac{\sum_R \Sigma_{a_i}^R \phi_i^R V^R}{P}$$

$$L_{1_i} = \frac{\sum_R (DB^2)_i \phi_i^R V^R}{P}$$

$$O_i = \frac{\sum_R \Sigma_{out_i}^R \phi_i^R V^R}{P}$$

$$S_i = O_{i-1}, \quad i > 1$$

$$S_i = 1.0, \quad i = 1$$

$$L_{2_i} = S_i - A_i - L_{1_i} - O_i$$

Normal Buckling Computed from Normal Leakage in Neutron Balance

$$\bar{D}_i = \frac{\sum_R D_i^R \phi_i^R V^R}{\phi_{\text{core}} V_{\text{core}}}$$

$$\bar{\Sigma}_{L_i} = \frac{L_{2_i}^P}{\phi_{\text{core}} V_{\text{core}}}$$

$$\bar{K}_i^2 = \frac{\bar{\Sigma}_{L_i}}{D_i}$$

Fractional Absorption and Productions for Each Material

$$A_i^{*m} = \frac{\sum_R N_i^m g_i^m \sigma_{a_i}^m \phi_i^R V^R}{\sum_{i=1}^{N26} \sum_R \Sigma_{a_i}^R \phi_i^R V^R}$$

$$P_i^{*m} = \frac{\sum_R N_i^m g_i^m \nu \sigma_{f_i}^m \phi_i^R V^R}{\sum_{i=1}^{N26} \sum_R \nu \Sigma_{f_i}^R \phi_i^R V^R}$$

$$A_T^{*m} = \sum_{i=1}^{N26} A_i^{km}$$

Nomenclature

P	Total productions
A_i	Absorption per source neutron in group i
L_{1_i}	Transverse leakage per source neutron in group i
O_i	Outscatter per source neutron in group i
S_i	Source neutron per group i
L_{2_i}	Normal leakage per source neutron in group i

R	Power-generating regions
i	Group
$\bar{D}_i$	Average diffusion coefficient for group i
$\bar{\Sigma}_{L_i}$	Normal leakage cross section (computed from neutron balance in power-generating regions)
$\bar{K}_i^2$	Normal buckling over power-generating regions (computed from neutron balance in power-generating volume)
$\left. \begin{array}{l} \Sigma_{a_i} \\ \Sigma_{f_i} \\ \Sigma_{out_i} \end{array} \right\}$	Absorption, fission, outscatter cross sections
A_i^{*m}	Fractional absorptions for material m and group i in power-generating volume
P_i^{*m}	Fractional productions for material m and group i in power-generating volume

3.3. BURNUP: ISOTOPIC EQUATIONS

Th²³²

$$N_{t+1}^{Th^{232}} = N_t^{Th^{232}} \left[\frac{2 - \left(\sum_{i=1}^{N26} \sigma_{a_i}^{Th^{232}} g_{i1} \phi_1 \right) \Delta t}{2 + \left(\sum_{i=1}^{N26} \sigma_{a_i}^{Th^{232}} g_{i1} \phi_1 \right) \Delta t} \right]$$

Pa²³³

$$N_{t+1}^{Pa^{233}} = \frac{0.5 \left(N_{t+1}^{Th^{232}} + N_t^{Th^{232}} \right) \left[\sum_{i=1}^{N26} (\sigma_{a_i} - \sigma_{f_i})^{Th^{232}} g_{i1} \phi_1 \right]}{\left[\lambda^{Pa^{233}} + \sum_{i=1}^{N26} \sigma_{a_i}^{Pa^{233}} g_{i1} \phi_1 \right]} + \left\{ N_t^{Pa^{233}} - \frac{0.5 \left[N_{t+1}^{Th^{232}} + N_t^{Th^{232}} \right] \left[\sum_{i=1}^{N26} (\sigma_{a_i} - \sigma_{f_i})^{Th^{232}} g_{i1} \phi_1 \right]}{\left[\lambda^{Pa^{233}} + \sum_{i=1}^{N26} \sigma_{a_i}^{Pa^{233}} g_{i1} \phi_1 \right]} \right\} \exp - \left(\lambda^{13} + \sum_{i=1}^{N26} \sigma_{a_i}^{Pa^{233}} g_{i1} \phi_1 \right) \Delta t$$

U²³³

$$N_{t+1}^{U^{233}} = \frac{N_t^{U^{233}} \left[2 - \left(\sum_{i=1}^{N26} \sigma_{a_i}^{U^{233}} g_{i1} \phi_1 \right) \Delta t \right] + \left[N_{t+1}^{Pa^{233}} + N_t^{Pa^{233}} \right] \lambda^{Pa^{233}} \Delta t}{\left[2 + \left(\sum_{i=1}^{N26} \sigma_{a_i}^{U^{233}} g_{i1} \phi_1 \right) \Delta t \right]}$$

U²³⁴

$$N_{t+1}^{U^{234}} = \frac{N_t^{U^{234}} \left[2 - \left(\sum_{i=1}^{N26} \sigma_{a_i}^{U^{234}} g_{i1} \phi_1 \right) \Delta t \right] + \left[N_{t+1}^{U^{233}} + N_t^{U^{233}} \right] \left[\sum_{i=1}^{N26} (\sigma_{a_i} - \sigma_{f_i})^{U^{233}} g_{i1} \phi_1 \right] \Delta t + \left[N_{t+1}^{Pa^{233}} + N_t^{Pa^{233}} \right] \left[\sum_{i=1}^{N26} (\sigma_{a_i} - \sigma_{f_i})^{Pa^{233}} g_{i1} \phi_1 \right] \Delta t}{\left[2 + \left(\sum_{i=1}^{N26} \sigma_{a_i}^{U^{234}} g_{i1} \phi_1 \right) \Delta t \right]}$$

U²³⁵

$$N_{t+1}^{U^{235}} = \frac{N_t^{U^{235}} \left[2 - \left(\sum_{i=1}^{N26} \sigma_{a_i}^{U^{235}} g_{i1} \phi_1 \right) \Delta t \right] + \left[N_{t+1}^{U^{234}} + N_t^{U^{234}} \right] \left[\sum_{i=1}^{N26} (\sigma_{a_i} - \sigma_{f_i})^{U^{234}} g_{i1} \phi_1 \right] \Delta t}{\left[2 + \left(\sum_{i=1}^{N26} \sigma_{a_i}^{U^{235}} g_{i1} \phi_1 \right) \Delta t \right]}$$

U²³⁶

$$N_{t+1}^{U^{236}} = \frac{N_t^{U^{236}} \left[2 - \left(\sum_{i=1}^{N26} \sigma_{a_i}^{U^{236}} g_{i1} \phi_1 \right) \Delta t \right] + \left[N_{t+1}^{U^{235}} + N_t^{U^{235}} \right] \left[\sum_{i=1}^{N26} (\sigma_{a_i} - \sigma_{f_i})^{U^{233}} g_{i1} \phi_1 \right] \Delta t}{\left[2 + \left(\sum_{i=1}^{N26} \sigma_{a_i}^{U^{236}} g_{i1} \phi_1 \right) \Delta t \right]}$$

U²³⁸

$$N_{t+1}^{U^{238}} = \frac{N_t^{U^{238}} \left[2 - \left(\sum_{i=1}^{N26} \sigma_{a_i}^{U^{238}} g_{i1} \phi_1 \right) \Delta t \right]}{\left[2 + \left(\sum_{i=1}^{N26} \sigma_{a_i}^{U^{238}} g_{i1} \phi_1 \right) \Delta t \right]}$$

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N_p²³⁹

$$N_{t+1}^{N_p^{239}} = \frac{0.5 \left[N_{t+1}^{U^{238}} + N_t^{U^{238}} \right] \left[\sum_{i=1}^{N26} (\sigma_{a_i} - \sigma_{f_i})^{U^{238}} g_{i1} \phi_1 \right]}{\left[\lambda^{N_p^{239}} + \left(\sum_{i=1}^{N26} \sigma_{a_i}^{N_p^{239}} g_{i1} \phi_1 \right) \right]} + \left\{ N_t^{N_p^{239}} - \frac{0.5 \left[N_{t+1}^{U^{238}} + N_t^{U^{238}} \right] \left[\sum_{i=1}^{N26} (\sigma_{a_i} - \sigma_{f_i})^{U^{238}} g_{i1} \phi_1 \right]}{\left[\lambda^{N_p^{239}} + \left(\sum_{i=1}^{N26} \sigma_{a_i}^{N_p^{239}} g_{i1} \phi_1 \right) \right]} \right\} \exp \left[- \left(\lambda^{N_p^{239}} + \sum_{i=1}^{N26} \sigma_{a_i}^{N_p^{239}} g_{i1} \phi_1 \right) \Delta t \right]$$

Pu²³⁹

$$N_{t+1}^{Pu^{239}} = \frac{N_t^{Pu^{239}} \left[2 - \left(\sum_{i=1}^{N26} \sigma_{a_i}^{Pu^{239}} g_i \phi_1 \right) \Delta t \right] + \left(N_{t+1}^{Np^{239}} + N_t^{Np^{239}} \right) \lambda^{Np^{239}} \Delta t}{\left[2 + \left(\sum_{i=1}^{N26} \sigma_{a_i}^{Pu^{239}} g_i \phi_1 \right) \Delta t \right]}$$

Pu²⁴⁰

$$N_{t+1}^{Pu^{240}} = \frac{N_t^{40} \left[2 - \left(\sum_{i=1}^{N26} \sigma_{a_i}^{Pu^{240}} g_i \phi_1 \right) \Delta t \right] + \left(N_{t+1}^{Pu^{239}} + N_t^{Pu^{239}} \right) \left[\sum_{i=1}^{N26} (\sigma_{a_i} - \sigma_{f_i})^{Pu^{239}} g_i \phi_1 \right] \Delta t + \left(N_{t+1}^{Np^{239}} + N_t^{Np^{239}} \right) \left[\sum_{i=1}^{N26} (\sigma_{a_i} - \sigma_{f_i})^{Np^{239}} g_i \phi_1 \right] \Delta t}{\left[2 + \left(\sum_{i=1}^{N26} \sigma_{a_i}^{Pu^{240}} g_i \phi_1 \right) \Delta t \right]}$$

Pu²⁴¹

$$N_{t+1}^{Pu^{241}} = \frac{N_t^{Pu^{241}} \left\{ 2 - \left[\left(\sum_{i=1}^{N26} \sigma_{a_i}^{Pu^{241}} g_i \phi_1 \right) + \lambda^{Pu^{241}} \right] \Delta t \right\} + \left(N_{t+1}^{Pu^{240}} + N_t^{Pu^{240}} \right) \left[\sum_{i=1}^{N26} (\sigma_{a_i} - \sigma_{f_i})^{Pu^{240}} g_i \phi_1 \right] \Delta t}{\left\{ 2 + \left[\left(\sum_{i=1}^{N26} \sigma_{a_i} g_i \phi_1 \right) + \lambda^{Pu^{241}} \right] \Delta t \right\}}$$

Pu²⁴²

$$N_{t+1}^{Pu^{242}} = \frac{N_t^{Pu^{242}} \left[2 - \left(\sum_{i=1}^{N26} \sigma_{a_i}^{Pu^{242}} g_i \phi_1 \right) \Delta t \right] + \left(N_{t+1}^{Pu^{241}} + N_t^{Pu^{241}} \right) \left[\sum_{i=1}^{N26} (\sigma_{a_i} - \sigma_{f_i})^{Pu^{241}} g_i \phi_1 \right] \Delta t}{\left[2 + \left(\sum_{i=1}^{N26} \sigma_{a_i}^{Pu^{242}} g_i \phi_1 \right) \Delta t \right]}$$

Nonsaturating Fission Product

$$N_{t+1}^{FP} = N_t^{FP} + \Gamma^{FP} \left(\sum_{i=1}^{N26} \Sigma_{f_i} \phi_1 \right) \Delta t ,$$

where

$$\Sigma_{f_1} = \sum_{L=1}^{12} N_t^L \sigma_{f_1}^L g_1 \quad L = \text{all heavy nuclides}$$

$$Z^F = \frac{\bar{N}^F \sum_{i=1}^{N26} \phi_1 \sigma_{f_1}^F}{\sum_F \bar{N}^F \sum_{i=1}^{N26} \phi_1 \sigma_{f_1}^F}$$

$$\Gamma^{FP} = \sum_F Z^F \Gamma_F^{FP} \quad F = U^{233}, U^{235}, Pu^{239}, Pu^{241} \quad (1)$$

Xe¹³⁵

$$N_{t+1}^{Xe^{135}} = \frac{\Gamma^{Xe^{135}} \left(\sum_{i=1}^{N26} \Sigma_{f_1} \phi_1 \right)}{P^{Xe^{135}} + \lambda^{Xe^{135}} + \sum_{i=1}^{N26} \sigma_{a_1}^{Xe^{135}} g_1 \phi_1}$$

where Γ^{Xe} is obtained from (1).

I¹³⁵

$$N_{t+1}^{I^{135}} = \frac{N_{t+1}^{Xe} \left(P^{Xe^{135}} + \lambda^{Xe^{135}} + \sum_{i=1}^{N26} \sigma_{a_1}^{Xe^{135}} g_1 \phi_1 \right)}{\lambda^{I^{135}}}$$

Note: I¹³⁵ concentration is used only in xenon override calculations.

Sm¹⁴⁹

$$N_{t+1}^{Sm^{149}} = \frac{\Gamma^{Sm^{149}} \left(\sum_{i=1}^{N26} \Sigma_{f_{i1}} \right)}{\sum_{i=1}^{N26} \sigma_{a_i}^{Sm} g_{i1} \phi_1}$$

Special Materials

$$N_{t+1}^S = \frac{\Gamma^S \sum_{i=1}^{N26} \Sigma_{f_{i1}} \phi_1 + \frac{1}{2} \left(N_{t+1}^{S-1} + N_t^{S-1} \right) \sum_{i=1}^{N26} \sigma_{a_i}^{S-1} \phi_1 \delta^S}{\sum_{i=1}^{N26} \sigma_{a_i}^S \phi_1} + \left[N_t^S \frac{\Gamma^S \sum_{i=1}^{N26} \Sigma_{f_{i1}} \phi_1 + \frac{1}{2} \left(N_{t+1}^{S-1} + N_t^{S-1} \right) \sum_{i=1}^{N26} \sigma_{a_i}^{S-1} \phi_1 \delta^S}{\sum_{i=1}^{N26} \sigma_{a_i}^S \phi_1} \right] \exp \left(-\Delta t \sum_{i=1}^{N26} \sigma_{a_i}^S \phi_1 \right)$$

where Γ^S is obtained from Eq (1)

Lumped Poison

$$N_{t+1}^L = N_t^L \exp \left(-\Delta t \sum_{i=1}^{N26} \sigma_{a_i}^L g_{i1} \phi_1 \right)$$

where g_{i1} is re-evaluated each time it is used

Conversion Ratio

$$\begin{aligned} X^R &= \left[(N_t^U \lambda)^{Pa^{233}} + (N_t^U \lambda)^{Np^{239}} + N_t^U \sum_{i=1}^{N26} \phi_1 (\sigma_{a_i}^{U^{234}} - \sigma_{f_i}^{U^{234}}) + N_t^{Pu^{240}} \sum_{i=1}^{N26} \phi_1 (\sigma_{a_i}^{Pu^{240}} - \sigma_{f_i}^{Pu^{240}}) \right] V^R \\ Y^R &= \left[N_t^U \sum_{i=1}^{N26} \phi_1 \sigma_{a_i}^{U^{233}} + N_t^U \sum_{i=1}^{N26} \phi_1 \sigma_{a_i}^{U^{235}} + N_t^{Pu^{239}} \sum_{i=1}^{N26} \phi_1 \sigma_{a_i}^{Pu^{239}} + N_t^{Pu^{241}} \sum_{i=1}^{N26} \phi_1 \sigma_{a_i}^{Pu^{241}} \right. \\ &\quad \left. + N_t^{Pa^{233}} \left(\frac{\lambda}{\lambda + \sum_{i=1}^{N26} \phi_1 \sigma_{a_i}} \right) \sum_{i=1}^{N26} \phi_1 \sigma_{a_i}^{Pa^{233}} + N_t^{Np^{239}} \left(\frac{\lambda}{\lambda + \sum_{i=1}^{N26} \phi_1 \sigma_{a_i}} \right) \sum_{i=1}^{N26} \phi_1 \sigma_{a_i}^{Np^{239}} \right] V^R \end{aligned}$$

$$C^R = \frac{X^R}{Y^R}$$

$$C = \frac{\sum_{R=1}^{N20} X^R}{\sum_{R=1}^{N20} Y^R}$$

Nomenclature

t	Time index
Δt	Time step in seconds between t and t + 1
N	Atomic density
σ_a	Microscopic absorption cross section
σ_f	Microscopic fission cross section
g	Self-shielding factor
ϕ	Flux
λ	Disintegration constant
i	Group index
N26	Number of groups
Γ	Yield from fission: superscript indicates product and subscript indicates fuel material

Z^F	Fission fraction for material F
FP	Superscript indicates fission product
L	Superscript indicates some nuclide, L-1 nuclide assigned the material just preceding L
Σ_f	Total macroscopic fission cross section
F	Subscript or superscript indicating U ²³³ , U ²³⁵ , Pu ²³⁹ , Pu ²⁴¹
$P^{Xe^{135}}$	Xenon removal probability (by some process other than absorption or radioactive decay)
δ	An artificial factor: if $\delta = 0.0$, this nuclide is not produced by capture in preceding material; if $\delta = 1.0$, material is created by neutron capture in preceding nuclide
S	Superscript referring to special material
X	Rate of production of fissionable material
Y	Rate of destruction of fissionable material
C	Conversion ratio
V	Volume
R	Superscript indicates region

3. 4. LUMPED SELF-SHIELDING FACTOR

$$V^L = S^L \cdot \pi(R_2^2 - R_1^2) \cdot H^L / 4.0$$

$$W^L = \frac{N^L A_w^L V^{reg}}{A_v}$$

$$\rho^L = \frac{W^L}{V^L}$$

$$N^L = \frac{\rho^L V^L A_v}{A_w V^{reg}}$$

$$g_i^L = A_{0_i} + A_{1_i} \rho^L + A_{2_i} (\rho^L)^2 + A_{3_i} (\rho^L)^3 + A_{4_i} (\rho^L)^4 + A_{5_i} (\rho^L)^5$$

Nomenclature

V	Volume
S	Number of lumped poison rods
H	Height of poison rod
N	Atomic density
ρ	Density of poison (g/cm ³)
A_v	Avogadro number
A_w	Atomic weight
L	Superscript referring to lumped nuclide
$A_0 \cdots A_5$	Self-shielding polynomial coefficients
g	Self-shielding factor
i	Subscript referring to energy group
W	Weight (g)
R_1	Inner radius of lumped poison rod
R_2	Outer radius of lumped poison rod

3.5. FEW-GROUP CONSTANTS

$$\Sigma_{T_i} = \sum_{L=1}^M N^L \sigma_{T_i}^L g_i^L$$

$$\Sigma_{A_i} = \sum_{L=1}^M N^L \sigma_{A_i}^L g_i^L$$

$$\nu \Sigma_{f_i} = \sum_{L=1}^M N^L (\nu \sigma_{f_i})^L g_i^L$$

$$\Sigma_s = \sum_{L=1}^M N^L \sigma_{s_i}^L g_i^L$$

$$D_i = \frac{B_i}{3.0 \Sigma_{T_i}}$$

Nomenclature

Σ	Macroscopic cross section
σ	Microscopic cross section
g	Self-shielding factor
N	Atom density
M	Total number of materials
L	Material superscript
ν	Neutrons per fission
A	Absorption cross section
T	Total cross section
f	Fission cross section
D	Diffusion coefficient
B	Diffusion coefficient adjustment factor (usually 1.0)
i	Group index
s	Scattering cross section

3. 6. MISCELLANEOUS

Weight of Materials (g)

$$G_R^L = N^L V^{\text{reg}} \frac{A_w^L}{A_v} ,$$

$$G_T^L = \sum_{R=1}^{N20} G_R^L .$$

Control-rod Insertion Fraction

$$I_R^L = \frac{N^L}{N_{\text{max}}^L} .$$

Control-poison Adjustment

Initial poison guess (at start-up, immediately after switching to a new control region, or after burnup):

$$N^P = N_{\text{max}}^P \frac{(I_{\text{max}} + I_{\text{min}})}{2.0} .$$

Linear interpolation after initial guess: .

$$N^P = \frac{K_{\text{crit}} - K_2}{K_1 - K_2} (N_1 - N_2) + N_2 .$$

Nomenclature

G	Grams
N	Atom density
V	Volume
A_w	Atomic weight
A_v	Avogadro number
L	Material superscript

T	Subscript referring to total reactor
N20	Total number of regions
I	Control poison insertion fraction
P	Control poison material superscript
K	Multiplication factor
1	Subscript referring to previous value
2	Subscript referring to latest value
R	Indicates region

3. 7. ABSOLUTE FLUX

$$\Sigma_{f_i}^R = \sum_{L=1}^{12} N^L \frac{\nu_i^L \sigma_{f_i}^L g_i}{\nu_i^L}$$

$$\Sigma_{f_i}^{\text{core}} = \sum_{R=1}^{N20} \Sigma_{f_i}^R V_f^R$$

$$F = \frac{K \cdot P \times 10^{-24}}{V^{\text{core}} \sum_{i=1}^{N26} \phi_i^{\text{core}} \Sigma_{f_i}^{\text{core}}}$$

$$\phi_i^{\text{core}} = \phi_i^{\text{core}} F$$

Nomenclature

Σ_f	Macroscopic fission cross section
σ_f	Microscopic fission cross section
ν	Neutrons per fission
R	Region superscript
L	Material superscript
i	Group superscript (N26 = total number of groups)
F	Flux normalizing factor

K	Fissions per watt-second
P	Power (w)
V	Volume
V_f	Volume fraction
$\bar{\phi}'$	Average flux (arbitrary normalization)
$\bar{\phi}$	Average absolute flux (neutrons per barn-cm)

3. 8. RADIOACTIVE DECAY DURING SHUTDOWN

$$N_{t+1}^{Xe^{135}} = \left[N_t^{Xe^{135}} + \frac{\lambda^{I^{135}} N_t^{I^{131}}}{\lambda^{Xe^{135}} - \lambda^{I^{131}}} \left\{ \exp[(\lambda^{Xe^{135}} - \lambda^{I^{135}})\Delta t] - 1 \right\} \right] \times \exp(-\lambda^{Xe^{135}} \Delta t)$$

$$N_{t+1}^{I^{131}} = N_t^{I^{131}} \exp(-\lambda^{I^{135}} \Delta t)$$

$$N_{t+1}^{Pa^{233}} = N_t^{Pa^{233}} \exp(-\lambda^{Pa^{233}} \Delta t)$$

$$N_{t+1}^{Np^{239}} = N_t^{Np^{239}} \exp(-\lambda^{Np^{239}} \Delta t)$$

$$N_{t+1}^{U^{233}} = N_t^{U^{233}} + N_t^{Pa^{233}} \left[1 - \exp(-\lambda^{Pa^{233}} \Delta t) \right]$$

$$N_{t+1}^{Pu^{239}} = N_t^{Pu^{239}} + N_t^{Np^{239}} \left[1 - \exp(-\lambda^{Np^{239}} \Delta t) \right]$$

Nomenclature

N	Atomic density
λ	Disintegration constant
t	Time-step index
Δt	Time in seconds between t and t + 1

IV. CONCLUSION

This report describes the FEVER code as of January 1, 1962, at which time the code had been in productive use for several months, and may be considered complete in its initial form. It should be possible for the reader to modify or supplement the code in any manner desired, on the basis of the information presented in the text and appendices of this report.

REFERENCES

1. International Business Machine Corporation, "Reference Manual 709/7090 FORTRAN Programming System," C28-6054-2, January, 1961.
2. Keppler, J. G., and W. L. Orr, "Three Group Neutron Diffusion Calculation (Program F-3, IBM-704)," General Electric Company, Report XDC 58-7-18, May, 1958.
3. Hoffman, G. W., "One-dimension Few-group Burnout Code-Isotopic Density Equations," Westinghouse Atomic Power Division, Report WAPD-TM-2, April, 1956.

Appendix A

VALUES OF INTERNAL CONSTANTS

A few constants are used internally in FEVER, and the values are given below for reference:

<u>Constant</u>	<u>Value</u>
π	3.14159
Avogadro number, atoms/mole . . .	0.60247×10^{24}
Atomic weights, g/mole:	
Th ²³²	232.111
Pa ²³³	233.114
U ²³³	233.112
U ²³⁴	234.114
U ²³⁵	235.117
U ²³⁶	236.120
U ²³⁸	238.125
Np ²³⁹	239.123
Pu ²³⁹	239.127
Pu ²⁴⁰	240.129
Pu ²⁴¹	241.131
Pu ²⁴²	242.134
Disintegration constants, sec ⁻¹ :	
$\lambda_{\text{Pa}^{233}}$	0.292794×10^{-6}
$\lambda_{\text{Np}^{239}}$	0.344316×10^{-5}
$\lambda_{\text{Pu}^{241}}$	1.66362×10^{-9}
$\lambda_{\text{Xe}^{135}}$	2.1×10^{-5}
$\lambda_{\text{I}^{135}}$	2.87×10^{-5}

Appendix B

PROGRAMMER INFORMATION

B.1. GENERAL REMARKS

FEVER has been programmed for use on an IBM-7090, using the 709/7090 FORTRAN Monitor System.⁽¹⁾ It should be possible to compile and operate the program without much difficulty on any 32K machine for which FORTRAN is available.

All subroutines have been written entirely in the FORTRAN language (except for the standard library subroutines). Most of the variables used have been placed in common storage by means of COMMON statements. EQUIVALENCE statements are not used except in subroutine PLOT, which has explicit arguments and does not use COMMON statements.

The program is completely core-contained and does not require the use of chains or intermediate tapes. All tape manipulation is concerned directly with either input or output. One tape is required for input, another for printout, and a third can be used if card-punch output is desired to be performed off line.

The entire program consists of the 22 FORTRAN subprograms listed below, and the library subroutines which they call. All FORTRAN variables are defined by comments included with the FORTRAN source-deck listing.

B. 2. SUBROUTINES

Main Program (Control)

Purpose: Controls the sequence of the calculations. Also initializes tape designations and reads xenon override data.

Storage requirements: 245 locations

Subroutines called:

AVRAGE	INPUTA
BURNUP	INPUTB
CRPULL	START
DCALC	SYNOPS
DENOUT	(FIL)
DOGWRK	(FPT)
DPRIN	(RTN)
EXTRA	(STH)
FINAL	(TSH)
INIT	

Subroutine INPUTA

Purpose: Reads and prints cross section and miscellaneous data library. These data ordinarily do not change from case to case; therefore, the routine is usually entered only once for a series of cases.

Storage requirements: 387 locations

Subroutines called:

(FIL)	(STH)
(RTN)	(TSH)

Subroutine INIT

Purpose: Initializes data in storage from previous problem.

Storage requirements: 126 locations

Subroutines called: None

Subroutine INPUTB

Purpose: Reads and prints case input data, computes region volumes and initial atomic density of lumped poisons.

Storage requirements: 2022 locations

Subroutines called:

HEAD	(STH)
(FIL)	(TSH)
(RTN)	

Subroutine HEAD (KZZZ)

Purpose: Reads and prints case identification card.

Storage requirements: 63 locations

Subroutines called:

(FIL)	(STH)
(RTN)	(TSH)

Subroutine DOGWRK

Purpose: Computes few-group constants.

Storage requirements: 335 locations

Subroutines called: LUMP

Subroutine LUMP

Purpose: Obtains lumped poison self-shielding factors.

Storage requirements: 356 locations

Subroutines called: None

Subroutine DCALC⁽²⁾

Purpose: Calculates relative flux, power, and effective multiplication factor.

Storage requirements: 1188 locations

Subroutines called: None

Subroutine DENOUT

Purpose: Computes grams of materials and control-poison insertion fractions; prints regional atomic densities, grams of materials, and control-poison insertion.

Storage requirements: 793 locations

Subroutines called:

LUMP

(FIL)

(STH)

Subroutine DPRIN

Purpose: Normalizes relative power and average fast-group flux over power-generating regions to 1.0; prints region-dependent few-group constants and position-dependent flux and power.

Storage requirements: 396 locations

Subroutines called:

HEAD

(STH)

(FIL)

Subroutine AVRAGE

Purpose: Computes average core and region fluxes; prints absolute fluxes (per barn-cm); renormalizes source.

Storage requirements: 710 locations

Subroutines called:

ABSPHI PLOT

BAL (FIL)

HEAD (STH)

Subroutine ABSPHI

Purpose: Computes absolute flux normalization factor and core and region average fluxes.

Storage requirements: 213 locations

Subroutines called: None

Subroutine BAL

Purpose: Computes neutron balance per source neutron and fractional absorptions and productions over the power-generating regions.

Storage requirements: 619 locations

Subroutines called:

(HEAD)

(FIL)

(STH)

Subroutine CRPULL

Purpose: Adjusts control poison concentrations by linear interpolation or extrapolation of previous data. If these data are not available, a guess is made that control poison concentration lies midway between the maximum and minimum limits specified.

Storage requirements: 303 locations

Subroutines called:

(FIL)

(STH)

Subroutine BURNUP

Purpose: Computes depletion and build-up of isotopes, conversion ratio, and distribution of fissions from U^{233} , U^{235} , Pu^{239} , and Pu^{241} ; prints conversion ratio and fission distribution by region.

Storage requirements: 1779 locations

Subroutines called:

ABSPHI (FIL)
EXP (STH)
LUMP

Subroutine SYNOPS

Purpose: Stores synopsis of lifetime data and prints at end of case.

Storage requirements: 414 locations

Subroutines called:

HEAD (FIL)
RESTAR (STH)

Subroutine EXTRA

Purpose: Adjusts xenon and control-poison atomic densities and makes appropriate exits to compute maximum hot multiplication without control poison, and cold shutdown multiplication without xenon and control poisons fully inserted. Also does xenon override calculations. Prints maximum hot and cold shutdown multiplication factors and xenon override results. Also stores multiplication factors for synopsis.

Storage requirements: 530 locations

Subroutines called:

DCALC (FIL)
DECAY (STH)
DOGWRK

Subroutine PLOT (X, Y, N, N1, N2, NOUT)

Purpose: Prints plots of power distribution, K_{eff} versus time, and U^{233} and U^{235} distribution at end of life.

Storage requirements: 585 locations

Subroutines called:

(FIL)
(STH)

Subroutine DECAY

Purpose: Computes depletion or build-up by radioactive decay of I^{135} , Xe^{135} , Pa^{233} , U^{235} , Nb^{239} , and Pu^{239} .

Storage requirements: 113 locations

Subroutines called: EXP

Subroutine SHUFL

Purpose: Reads and prints data for shutdown-start-up case.

Storage requirements: 131 locations

Subroutines called:

DECAY	(RTN)
INIT	(STH)
(FIL)	(TSH)

Subroutine RESTAR

Purpose: Punches atomic density cards for use in a continuation case.

Storage requirements: 121 locations

Subroutines called:

(FIL)
(SCH)

Subroutine FINAL

Purpose: Prepares to terminate case by calling the necessary subroutines which complete the calculation and produce the final print.

Storage requirements: 182 locations

Subroutines called:

AVRAGE	PLOT
DENOUT	SHUFL
DPRIN	SYNOPS
EXTRA	(FIL)
HEAD	(STH)

B. 3. FLOW DIAGRAMS

Rather than present a detailed flow chart which will give the programmer no more insight into the program than may be obtained from the FORTRAN listing, it is felt that a better procedure is to supply a simpler flow diagram to indicate the over-all logic and leave the details to the FORTRAN listing which follows.

A very simplified flow diagram is shown in the text (see Fig. 1) and is a good place to begin. Figure 3 shows a few more of the details that may be of interest to the programmer in familiarizing himself with FEVER. A study of the main program will show that almost all of the basic program logic is controlled by this routine.

B. 4. FORTRAN SOURCE-DECK LISTING

The source-deck listing given is complete except for the removal of COMMON and DIMENSION statements from the subroutines in order to conserve space.

Comment cards included in the listing indicate the place where these statements are missing. The statements omitted should be identical to the COMMON and DIMENSION statements that are shown in the main program.

Fig. 3--Subroutine flow diagram

```

C      CONTROL
C
C      MAIN PROGRAM TO DETERMINE FLOW OF CALCULATIONS
C
C
C
C
C      SYMBOL DEFINITIONS
C
C
C
C
C      FIXED POINT, NON-SUBSCRIPTED
C
C      I      INTERNAL SUBSCRIPT - GENERAL USE
C      ICE    INTERNAL VARIABLE
C              0= NORMAL HOT OPERATING ATOM DENSITIES
C              1= HOT REACTOR, NO CONTROL POISON
C              2= COLD REACTOR, NO XENON AND ALL
C                CONTROL RODS FULLY INSERTED
C
C      IE     ENERGY GROUP SUBSCRIPT
C      IEA    ENERGY SUBSCRIPT, COLD LUMPED POISON COEFFICIENT
C      IEE    ENERGY SUBSCRIPT, COLD SELF-SHIELDING
C      IL     MATERIAL SUBSCRIPT (CROSS SECTION VARIABLES)
C      IP     MESH POINT SUBSCRIPT
C      IPAGE  INTERNAL VARIABLE - FOR PAGE SPACING
C      IR     REGION SUBSCRIPT
C      IRR    CONTROL REGION SEQUENCE
C      J1-J15 EXPLICIT BLOCK NUMBERS - SUBSCRIPT
C      JINT   NUMBER OF TIME INTERVALS FOR OVERRIDE CALCULATION
C      JN     LARGE BURNUP TIME STEP NUMBER
C      JNN    INTERNAL BURNUP ITERATION NUMBER
C      JNSTOP MAXIMUM BURNUP TIME STEPS (MAX JN)
C      JNUM   NUMBER OF INTERNAL BURNUP ITERATIONS (JNN)
C            PER LARGE TIME STEP
C      JS     SEARCH ITERATION NUMBER FOR A SINGLE REGION OR SET
C            OF REGIONS
C      JSER   CONTROL WORD  0=00 CONTROL POISON SEARCH
C                        1=00 STRAIGHT BURNUP
C                        2=00 SINGLE DIFFUSION CALCULATION
C      JSIM   INTERNAL VARIABLE - CONTROL REGION SELECTION
C      JSMAX  MAXIMUM CONTROL SEARCH ITERATIONS FOR A SINGLE
C            REGION OR A SINGLE SET OF REGIONS
C      JSPEC  ARTIFICIAL INDEX REFERRING TO BURNUP TIME STEP
C      JSS    CUMULATIVE TOTAL CONTROL POISON SEARCH ITERATION NO.
C      JSSMAX MAXIMUM CUMULATIVE TOTAL CONTROL SEARCH ITERATIONS
C      K     MATERIAL SUBSCRIPT, CONTROL OR LUMPED POISON
C      KINIT  INTERNAL VARIABLE - 1 NO EFFECT
C                        0 CAUSES PRINT OF INITIAL
C                          ATOM DENSITIES
C      KSER   0 - NEXT PROBLEM USES SAME CROSS SECTIONS AS THIS ONE
C            1 - READ NEW CROSS SECTION DATA FOR NEXT PROBLEM
C      KSIM   INTERNAL VARIABLE - CONTROL REGION SELECTION
C      KSS    NUMBER OF ENTRIES IN CONTROL ADJUSTMENTS LIST
C      L     MATERIAL SUBSCRIPT (ATOM DENSITIES)
C      LBUMP  INTERNAL VARIABLE - CONTROL POISON ADJUSTMENT
C      LL     DIFFUSION CALC INTERNAL ITERATION SUBSCRIPT
C      LSER   INTERNAL VARIABLE - PREVENTS TEST OF CONTROL
C            ADJUSTMENT CONVERGENCE CRITERION IMMEDIATELY

```

C		AFTER BURNUP
C	LSIM	NUMBER OF CONTROL REGIONS TO BE ADJUSTED
C		SIMULTANEOUSLY
C	MAT	INTERNAL VARIABLE - NUMBER OF MATERIALS IN A REGION
C	MATERS	INTERNAL VARIABLE - NUMBER OF MATERIALS
C	N20	NUMBER OF REGIONS
C	N26	NUMBER OF ENERGY GROUPS
C	N26A	INTERNAL VARIABLE - NUMBER OF GROUPS OF LUMPED
C		POISON COEFFICIENTS
C	N27	GEOMETRY 1-SLAB
C		2-CYLINDER
C	N28	POINT NUMBER OF OUTER MESH POINT
C	N29	N28-1
C	N31	NUMBER OF LAST DIFFUSION CALCULATION ITERATION
C	N42	NEXT TO LAST MESH POINT OF A REGION
C	N43	LAST MESH POINT OF PREVIOUS REGION
C	N71	NUMBER OF POWER GENERATING REGIONS
C	NBUMP	INTERNAL VARIABLE - CONTROL POISON ADJUSTMENT
C	NCONTR	INTERNAL VARIABLE - NUMBER OF CONTROL MATERIALS
C	NDOW	TIME STEP NUMBER FOR FIRST OVERRIDE CALCULATION
C	NITX	INTERNAL VARIABLE - IN CONTROL POISON ADJUSTMENT
C	NK	INTERNAL VARIABLE - FIRST MATERIAL NUMBER OF A SET
C	NL	INTERNAL VARIABLE - LAST MATERIAL NUMBER OF A SET
C	NLB	NUMBER OF CROSS SECTION DATA BLOCKS IN LIBRARY
C	NLT	NO. OF SETS OF SPECIAL DATA TO BE READ INTO LIBRARY
C	NLUMPS	INTERNAL VARIABLE - NUMBER OF LUMPED POISON MATERIALS
C	NUTH	INTERNAL VARIABLE - NUMBER OF SPECIAL MATERIALS
C	NPL0T	CONTROL WORD 0-OMIT
C		1-PLOT POWER DISTRIBUTION
C	NREAD	NUMBER OF ATOM DENSITY CARDS TO BE READ
C	NRSTRT	CONTROL WORD 0 - OMIT
C		X - PUNCH ATOM DENSITIES STARTING AT
C		TIME STEP X
C	NS	INPUT TAPE NUMBER
C	NSHUF1	CONTROL WORD
C		0-NO EFFECT
C		1-SHUT DOWN AND START UP (NO FUEL RELOAD)
C		2-XENON OVERRIDE CALCULATION
C	NSPEC	CONTROL WORD 0 - DO HOT MAX K-EFFECTIVE AND
C		COLD SHUTDOWN K-EFF. CALCULATIONS
C		1 - OMIT
C	NSWIT	INTERNAL VARIABLE (CONTROL REGION)
C		0 - CONTINUE ADJUSTING SAME REGION SET
C		1 - SET JS=0, ADJUST NEW CONTROL SET
C	NT	OUTPUT TAPE NUMBER
C	NTYPE	DUMMY VARIABLE
C	NXE	CONTROL WORD 0 - BUILD UP XENON BEFORE CONTINUING
C		1 - ALL INITIAL ATOM DENSITIES INPUTED
C	NXXX	OVERRIDE CALCULATION OCCURS EVERY NXXX TIME STEPS
C	M1,2,3	SAME AS NY (IF CONSTANT FROM REGION TO REGION)
C		
C		
C		FIXED POINT, SUBSCRIPTED
C	N41(IR)	POINT NUMBER OF LAST POINT IN REGION IR
C	NBURN(I)	REGION NUMBER OF A POWER GENERATING REGION
C	NC(IR)	NUMBER OF CONTROL MATERIALS IN A GIVEN REGION
C	NCOL(L,IR)	COLD CROSS SECTION BLOCK NUMBER FOR MATERIAL L,

C			REGION IR
C	NHOT(L,IR)	HOT CROSS SECTION BLOCK NUMBER FOR MATERIAL L,	REGION IR
C	NLUM(IR)	NUMBER OF LUMPED POISONS IN REGION IR	
C	NMAT(IR)	TOTAL NUMBER OF MATERIALS IN REGION IR	
C	N0(IR)	NUMBER OF SPECIAL MATERIALS IN REGION IR	
C		(SPECIAL FISSION PRODUCTS OR BURNABLE)	
C	NP0IS(IRR)	REGION NUMBER OF A CONTROL POISONS REGION	
C	NVALS(IR)	NUMBER OF INTERVALS IN REGION IR	
C	NX(K,IR)	SPECIAL DATA IDENT NO. FOR SPECIAL MATERIALS	
C	NY(K,IR)	SPECIAL DATA IDENT NO. FOR MATERIAL 13,14,15	

FLOATING POINT, NON-SUBSCRIPTED

C	ABLE	INTERNAL VARIABLE IN DIFFUSION CALCULATION (GEOM.)
C	ADJ	CONTROL POISON ADJUSTMENT FACTOR
C	BAKER	INTERNAL VARIABLE IN DIFFUSION CALC. (GEOMETRIC)
C	CON	CHANGE IN K-EFF. FOR 2 CONSECUTIVE ITERATIONS
C	CONEIG	POINTWISE CONVERGENCE CRITERION
C	CORE	CORE VOLUME
C	CRT	AVERAGE CONVERSION RATIO FOR POWER GENERATING REGION
C	CONK	EIGENVALUE CONVERGENCE CRITERION
C	DELDAY	LARGE BURNUP TIME STEP IN DAYS
C	DELSEC	SMALL BURNUP TIME STEP IN SECONDS
C	DENOM	INTERNAL VARIABLE - FLUX AVERAGING
C	DENSP0	FISSION DENSITY AT CENTER OF CORE
C	EIGL	MAXIMUM POINT EIGENVALUE
C	EIGM	MINIMUM POINT EIGENVALUE
C	ERR	POINT EIGENVALUE MAXIMUM DIFFERENCE FRACTION
C	FEEBAR	AVERAGE FAST FLUX
C	FIWATT	FISSIONS PER WATT-SEC
C	FUNC	ABSOLUTE FLUX PROPORTIONALITY FACTOR
C	HCORE	HEIGHT OF CORE
C	ODEN1	ATOM DENSITY OF MATERIAL 1 ON LAST SMALL TIME STEP
C	ODEN2	ATOM DENSITY OF MATERIAL 2 ON LAST SMALL TIME STEP
C	ODEN3	ATOM DENSITY OF MATERIAL 3 ON LAST SMALL TIME STEP
C	ODEN4	ATOM DENSITY OF MATERIAL 4 ON LAST SMALL TIME STEP
C	ODEN5	ATOM DENSITY OF MATERIAL 5 ON LAST SMALL TIME STEP
C	ODEN6	ATOM DENSITY OF MATERIAL 6 ON LAST SMALL TIME STEP
C	ODEN7	ATOM DENSITY OF MATERIAL 7 ON LAST SMALL TIME STEP
C	ODEN8	ATOM DENSITY OF MATERIAL 8 ON LAST SMALL TIME STEP
C	ODEN9	ATOM DENSITY OF MATERIAL 9 ON LAST SMALL TIME STEP
C	ODEN10	ATOM DENSITY OF MATERIAL 10 ON LAST SMALL TIME STEP
C	ODEN11	ATOM DENSITY OF MATERIAL 11 ON LAST SMALL TIME STEP
C	ODEN12	ATOM DENSITY OF MATERIAL 12 ON LAST SMALL TIME STEP
C	ODEN13	ATOM DENSITY OF MATERIAL 13 ON LAST SMALL TIME STEP
C	PI	A CONSTANT = 3.14159
C	POWER	OPERATING POWER IN WATTS
C	RAD	RADIUS OF CENTER MESH POINT
C	RPXE	XENON REMOVAL PROBABILITY
C	SERCON	CONTROL POISON SEARCH CONVERGENCE CONSTANT
C	SERK1	K-EFFECTIVE FOR LAST CONTROL SEARCH
C	SERK2	K-EFFECTIVE FOR PRESENT CONTROL SEARCH
C	SPEC	K-EFFECTIVE AT A GIVEN BURNUP TIME STEP
C	SUM	INTERNAL VARIABLE IN DIFFUSION CALC. (REACTIVITY)
C	SUM1	INTERNAL VARIABLE IN DIFFUSION CALC.
C	THETA	SOURCE ACCELERATION EXTRAPOLATION FACTOR
C	VALL	INTERNAL VARIABLE - NUMBER OF INTERVALS
C	VOLUME	POWER GENERATING VOLUME

C	X4	INTERNAL VARIABLE - (BURNUP CALCULATION)
C	X10	INTERNAL VARIABLE - (BURNUP CALCULATION)
C	XBUG	MATERIAL EXPANSION FACTOR
C	XDOWN	TIME IN HOURS FOR XENON OVERRIDE CALCULATION
C	XMAX	CURRENT VALUE OF MAXIMUM INSERTION FRACTION
C	XMIN	CURRENT VALUE OF MINIMUM INSERTION FRACTION
C	XRAD	INTERNAL GEOMETRIC FACTOR
C	XYZ	INTERNAL VARIABLE - (BURNUP CALCULATION)
C	Y1	INTERNAL VARIABLE - (BURNUP CALCULATION)
C	Y2	INTERNAL VARIABLE - (BURNUP CALCULATION)
C	Y3	INTERNAL VARIABLE - (BURNUP CALCULATION)
C	Y4	INTERNAL VARIABLE - (BURNUP CALCULATION)
C	Y5	INTERNAL VARIABLE - (BURNUP CALCULATION)
C	Y6	INTERNAL VARIABLE - (BURNUP CALCULATION)
C	Y7	INTERNAL VARIABLE - (BURNUP CALCULATION)
C	Y8	INTERNAL VARIABLE - (BURNUP CALCULATION)
C	Y9	INTERNAL VARIABLE - (BURNUP CALCULATION)
C	Y10	INTERNAL VARIABLE - (BURNUP CALCULATION)
C	Y11	INTERNAL VARIABLE - (BURNUP CALCULATION)
C	Y12	INTERNAL VARIABLE - (BURNUP CALCULATION)
C	Y131	INTERNAL VARIABLE - (BURNUP CALCULATION)
C	Y132	INTERNAL VARIABLE - (BURNUP CALCULATION)
C	Y133	INTERNAL VARIABLE - (BURNUP CALCULATION)
C	Y134	INTERNAL VARIABLE - (BURNUP CALCULATION)
C	Y135	INTERNAL VARIABLE - (BURNUP CALCULATION)
C	Y136	INTERNAL VARIABLE - (BURNUP CALCULATION)
C	Y14	INTERNAL VARIABLE - (BURNUP CALCULATION)
C	Y15	INTERNAL VARIABLE - (BURNUP CALCULATION)
C	Y16	INTERNAL VARIABLE - (BURNUP CALCULATION)
C	Y17	INTERNAL VARIABLE - (BURNUP CALCULATION)
C	Z2	INTERNAL VARIABLE - (BURNUP CALCULATION)
C	Z4	INTERNAL VARIABLE - (BURNUP CALCULATION)
C	Z5	INTERNAL VARIABLE - (BURNUP CALCULATION)
C	Z6	INTERNAL VARIABLE - (BURNUP CALCULATION)
C	Z8	INTERNAL VARIABLE - (BURNUP CALCULATION)
C	Z10	INTERNAL VARIABLE - (BURNUP CALCULATION)
C	Z11	INTERNAL VARIABLE - (BURNUP CALCULATION)
C	Z12	INTERNAL VARIABLE - (BURNUP CALCULATION)
C	Z16	INTERNAL VARIABLE - BURNUP CALCULATION
C	ZF1,2,3,4	FISSION FRACTION OF U233,U235,PU239,PU241 RESP.
C	ZJN	FLOATING POINT JN (TIME STEP NUMBER)
C	ZJNUM	FLOATING POINT JNUM
C	ZKFIND	CONTROL POINT OR SHUTDOWN K-EFFECTIVE (USUALLY=1.0)

FLOATING POINT, SUBSCRIPTED

C	A0(IE,K,IR)	LUMPED POISON SELF-SHIELDING COEFFICIENT
C	A1(IE,K,IR)	LUMPED POISON SELF-SHIELDING COEFFICIENT
C	A2(IE,K,IR)	LUMPED POISON SELF-SHIELDING COEFFICIENT
C	A3(IE,K,IR)	LUMPED POISON SELF-SHIELDING COEFFICIENT
C	A4(IE,K,IR)	LUMPED POISON SELF-SHIELDING COEFFICIENT
C	A5(IE,K,IR)	LUMPED POISON SELF-SHIELDING COEFFICIENT
C	ABC(IE,IP)	ABSORPTION PARAMETER
C	ABSIG(IE,IL)	MICRO ABSORPTION CROSS SECTION
C	AL1(IE)	LEFT ALBEDO
C	AL2(IE)	RIGHT ALBEDO
C	AW(K,IR)	ATOMIC WEIGHT OF LUMPED POISON

C	AWT(L)	ATOMIC WEIGHT OF HEAVY ISOTOPE, L
C	B1(IE)	BOUNDARY COEFFICIENT
C	BET(IP)	GEOMETRICAL CONSTANT
C	BUG(IE)	DIFFUSION COEFFICIENT CORRECTION FACTOR
C	CEE(IE,IP)	SOURCE TERM
C	CFRAC(K,IR)	CONTROL POISON INSERTION FRACTION
C	CR(IR)	REGIONAL CONVERSION RATIO
C	DEL(IP)	GEOMETRICAL CONSTANT
C	DEN(L,IR)	ATOMIC DENSITY (FOR MAT. L AND REG. IR)
C	DENIGD(IR)	IODINE ATOM DENSITY
C	DENSM(IP)	FISSION DENSITY
C	DENSP(IP)	FISSION DENSITY
C	DIFL(IE,IR)	DIFFUSION COEFFICIENT
C	DIFM(IE,IP)	DIFFUSION COEFFICIENT
C	DILP(K,IR)	INNER DIAMETER-LUMPED POISON ROD OR TUBE
C	DOLP(K,IR)	OUTER DIAMETER-LUMPED POISON ROD OR TUBE
C	DIRAC(KFU)	SPECIAL MATERIAL ABSORPTION TERM COEFFICIENT
C	EIG(IP)	POINT EIGENVALUE
C	FEE(IE,IP)	POINT FLUX
C	FEE0(IE)	CENTRAL POINT FLUX
C	FISCO(IE)	AVERAGED FISSION CROSS SECTION OVER POWER-GEN. REG.
C	FISIG(IE,IL)	MICRO FISSION CROSS SECTION TIMES NLVTS/FISSION
C	FISMAC(IE,IR)	REGION MACRO FISSION CROSS SECTION (BY GROUP)
C	GAM(IP)	GEOMETRICAL CONSTANT
C	GM(L)	GRAMS OF ISOTOPE L IN A REGION
C	GS(L)	TOTAL GRAMS OF ISOTOPE L IN POWER GENERATING REGIONS
C	HLP(K,IR)	HEIGHT OF LUMPED POISON ROD
C	DUSIG(IE,IL)	MICRO DOWN SCATTER
C	PINMAX(IRR)	MAXIMUM CONTROL POISON INSERTION FRACTION
C	PINMIN(IRR)	MINIMUM CONTROL POISON INSERTION FRACTION
C	POIS1(K,IR)	INTERNAL VARIABLE - CONTROL POISON ON PAST SEARCH
C	POIS2(K,IR)	INTERNAL VARIABLE - CONTROL POISON ON PRESENT SEARCH
C	POISL(K,IR)	MAXIMUM CONTROL POISON ATOM DENSITY
C	POISM(K,IR)	MINIMUM CONTROL POISON ATOM DENSITY
C	RADP(IP)	MESH POINT RADIUS
C	RADR(IR)	REGION OUTER RADIUS
C	REACT(LL)	K-EFFECTIVE
C	RECUR1(IE,IP)	RECURSION COEFFICIENT
C	RECUR2(IE,IP)	RECURSION COEFFICIENT
C	RHO(K,IR)	GRAMS/CC - LUMPED POISON ROD
C	RODS(K,IR)	NUMBER OF LUMPED POISON RODS IN A REGION
C	RPHI(IE)	AVERAGE CORE FLUX
C	RPHI1V(IE,IR)	AVERAGE REGION FLUX
C	SC(IEE,K,IR)	COLD LUMPED POISON SELF-SHIELDING
C	SIG(IE,IP)	POINT SCATTER-OUT CROSS SECTION
C	SIGA(IE,IR)	REGION ABSORPTION CROSS SECTION
C	SIGNU(IE,IP)	MULTIPLICATION CROSS SECTION
C	SIGS(IE,IR)	REGION DOWN SCATTER CROSS SECTION
C	SOT(IP)	STORAGE BLOCK - CONVERGENCE ACCELERATION
C	SOU(IP)	STORAGE BLOCK - CONVERGENCE ACCELERATION
C	SPECK(I)	STORAGE BLOCK - HOT MAX + COLD SHUTDOWN K-EFFECTIVE
C	SS(IE,L,IR)	SELF-SHIELDING FACTOR (HOT)
C	TIME(I)	STORAGE BLOCK - TIME
C	TOSIG(IE,IL)	MICRO TOTAL CROSS SECTION DATA BLOCK
C	TOTL(IE,IR)	REGION MACRO TOTAL CROSS SECTION
C	TRANS(IE,IR)	REGION PERPENDICULAR BUCKLING
C	TRIC(IE,IR)	REGION MACRO FISSION TIMES NEUTRONS/FISSION
C	VALS(IR)	NUMBER OF INTERVALS IN A REGION

```

C      VFREG(IR)      VOLUME FRACTION OF A REGION
C      VLP(K,IR)      VOLUME OF LUMPED POISON ROD
C      VOL(IR)        REGION VOLUME
C      WIDTH(IR)      WIDTH OF A REGION
C      WLP(K,IR)      WEIGHT OF LUMPED POISON K IN REGION IR
C      XENON(IR)      XENON ATOMIC DENSITY
C      XNU(IE,IL)     NEUTRONS PER FISSION
C      YIELD1(KFU)     YIELD OF ISOTOPE FROM FISSION OF U-233
C      YIELD2(KFU)     YIELD OF ISOTOPE FROM FISSION OF U-235
C      YIELD3(KFU)     YIELD OF ISOTOPE FROM FISSION OF PU-239
C      YIELD4(KFU)     YIELD OF ISOTOPE FROM FISSION OF PU-241
C      YF(K)          WEIGHTED FISSION YIELD OF FISSION PROD OR SPECIAL MAT.
C      ZIP1(IE,IP)    SOLUTION OF RECURSION RELATIONSHIP
C      ZIP2(IE,IP)    SOLUTION OF RECURSION RELATIONSHIP
C
C
C
C
C

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```

COMMON      FISIG      ,TOSIG      ,ABSIG      ,GUSIG ,XNU,NS,IT,NW,
1  N26      ,NLB      ,BUG ,M1      ,M2      ,M3      ,SERCON ,
2  THETA    ,CONEIG   ,CONK      ,J1      ,J9      ,KINIT ,
3  I        ,IPAGE    ,JS      ,J2      ,J10     ,KSER   ,
4  IL       ,IR       ,JSER    ,J3      ,J11     ,KSIM   ,
5  ICE      ,IRR      ,JSIM    ,J4      ,J12     ,L       ,
6  IE       ,JN       ,JSMAX   ,J5      ,J13     ,LBUMP  ,
7  IEA      ,JNN      ,JSPEC   ,J6      ,J14     ,LL      ,
8  IEE      ,JNSTOP   ,JSS     ,J7      ,J15     ,LSER   ,
9  IP       ,JNUM     ,JSSMAX  ,J8      ,K       ,LSIM   ,
COMMON      N43      ,NPLUT   ,NLUM     ,NHOT    ,FIWATT ,
1  MAT      ,N71      ,NREAD   ,NMAT    ,CRT     ,FUNC   ,
2  MATERS   ,N100     ,NRSTRT  ,N0      ,DELDAY  ,HCRK   ,
3  N20      ,NBUMP    ,NSPEC   ,NPOIS   ,DELSLC  ,ODEN1  ,
4  N26A     ,NCONTR   ,NSWIT   ,NVALS   ,DENUM   ,ODEN2  ,
5  N27      ,NITX     ,NTYPE   ,ABLL    ,DENSP0  ,ODEN3  ,
6  N28      ,NK       ,N41     ,ADJ     ,EIGL    ,ODEN4  ,
7  N29      ,NL       ,NBURN   ,BAKER   ,EIGM    ,ODEN5  ,
8  N31      ,NLUMPS   ,NC      ,CON     ,ERR     ,ODEN6  ,
9  N42      ,N0TH     ,NCOL    ,CORE    ,FLBAR   ,ODEN7  ,
COMMON      RPXE     ,X10     ,Y6      ,Y134    ,Z6      ,
1  ODEN8    ,SENSP0   ,XYZ     ,Y7      ,Y135    ,Z8      ,
2  ODEN9    ,SERK1    ,XRAD    ,Y8      ,Y136    ,Z10     ,
3  ODEN10   ,SERK2    ,XMIN    ,Y9      ,Y14     ,Z11     ,
4  ODEN11   ,SPEC     ,XMAX    ,Y10     ,Y15     ,Z12     ,
5  ODEN12   ,SUM      ,Y1      ,Y11     ,Y16     ,Z16     ,
6  ODEN13   ,SUM1     ,Y2      ,Y12     ,Y17     ,ZJNUM   ,
7  PI       ,VALL     ,Y3      ,Y131    ,Z2      ,ZKFIND  ,
8  POWER    ,VOLUME   ,Y4      ,Y132    ,Z4      ,ZJN     ,
9  RAD      ,X4      ,Y5      ,Y133    ,Z5      ,NLT     ,
COMMON      AW       ,DENSP   ,FISMAC   ,POIS1   ,RODS    ,
1  A0       ,AWF     ,DIFL    ,GAM     ,POIS2   ,RPHI    ,
2  A1       ,B1      ,DIFM    ,GM      ,POISL   ,RPHIAV  ,
3  A2       ,BET     ,DILP    ,GS      ,POISM   ,SC       ,
4  A3       ,CEE     ,DIRAC   ,HLP     ,RADP    ,NQUIT   ,
5  A4       ,CFRAC   ,DOLP    ,KSS     ,RADR    ,        ,
6  A5       ,CR      ,EIG     ,NX      ,REACT   ,SIG      ,
7  ABC      ,DEL     ,FEE     ,NY      ,RECUR1  ,SIGA     ,
8  AL1      ,DEN     ,FEE0    ,PINMAX  ,RECUR2  ,SIGNU    ,
9  AL2      ,DENSM   ,FISCO   ,PINMIN  ,RHU     ,SIGS

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COMMON      SOT      ,TIME      ,VALS      ,YIELD1      ,NST0      ,
1  WIDTH      ,SOU      ,TOTL      ,VFREG      ,ZIP1      ,YIELD2      ,
2  WLP      ,SPECK      ,TRANS      ,VLP      ,ZIP2      ,YIELD3      ,
3  XENON      ,SS      ,TRIC      ,VOL      ,PI      ,YIELD4      ,
4  NSYN      ,DIP      ,STORE      ,NXE      ,DLLK      ,YT      ,
5  KX      ,KFU      ,ZF1      ,ZF2      ,ZF3      ,ZF4      ,
COMMON      DENIN      ,NSHUF      ,NSH      ,DENI0D      ,
COMMON      TDOWN      ,XDOWN      ,JINT      ,NDOW      ,NXXX      ,
DIMENSION   FISIG(4,120) ,TOSIG(4,120) ,ABSIG(4,120) ,
1  USIG(4,120) ,XNU(4,120) ,BUG(4)
DIMENSION   N41(20)      ,AW(3,20)      ,DENSP(150) ,GAM(150) ,
1  A0(6,3,20) ,NBURN(20) ,AWT(12)      ,DIFL(4,20) ,GM(12) ,
2  A1(6,3,20) ,NC(20)      ,BL(4)      ,DIFM(4,150) ,GS(12) ,
3  A2(6,3,20) ,NCOL(25,20) ,BEI(150) ,DILP(3,20) ,
4  A3(6,3,20) ,NHOT(25,20) ,CLE(4,150) ,DIRAC(15) ,RADR(20) ,
5  A4(6,3,20) ,NLUM(20) ,CFRAC(2,20) ,DOLP(3,20) ,RPHI(4) ,
6  A5(6,3,20) ,NMAT(20) ,CR(20) ,EIG(150) ,SOT(150) ,
7  ABC(4,150) ,NG(20) ,DLL(150) ,FEF(4,150) ,SOU(150) ,
8  AL1(4) ,NPOIS(50) ,DEN(25,20) ,FELU(4) ,VALS(20) ,
9  AL2(4) ,NVALS(20) ,DENSM(150) ,FISCO(4) ,YIELD1(15)
DIMENSION   FISMAT(4,20) ,POIS1(2,20) ,R0DS(3,20) ,YIELD2(15) ,
1  SIGS(4,20) ,HLP(3,20) ,POIS2(2,20) ,RPHI1V(4,20) ,YIELD3(15) ,
2  SPECK(50) ,YIELD4(15) ,POISL(2,20) ,SC(2,3,20) ,
3  SS(4,25,20) ,PINMAX(50) ,POISM(2,20) ,NX(10,20) ,
4  TIME(50) ,PINMIN(50) ,RECUR1(4,150) ,NY(3,20) ,
5  TOTL(4,20) ,RAOP(150) ,RECUR2(4,150) ,SIG(4,150) ,
6  TRANS(4,20) ,REACT(2) ,RH0(3,20) ,SIGA(4,20) ,
7  TRIC(4,20) ,SIGNU(4,150) ,VFREG(20) ,VLP(3,20) ,
8  VOL(20) ,WLP(3,20) ,YT(10) ,ZIP2(4,150) ,
9  WIDTH(20) ,XENON(20) ,ZIP1(4,150)
DIMENSION   DIP(25,20) ,STORE(7,25) ,NST0(25)
DIMENSION   DENIN(25) ,DENI0D(20)
2  FORMAT (E12.4,3I4)
500 FORMAT (65H1 EXCEEDED MAXIMUM PERMITTED TOTAL OF CONTROL POISON AD
XJUSTMENTS )
501 FORMAT (72H1 EXCEEDED MAXIMUM PERMITTED CONTROL POISON ADJUSTMENTS
X FOR SOME REGION )

C
C
C      INITIALIZATION OF TAPE DESIGNATIONS
      NS=5
      NT=6
49  IF(NSH) 50,50,51
51  NSH=0
      LSER=1
      GO TO 70
50  CALL INPUTA

C
C      START A NEW PROBLEM
C
99  IF(NSH) 100,100,101
101 NSH=0
      LSER=1
      GO TO 70
100 CALL INIT
      NBUMP=3
      CALL INPUTB
C

```



```

C      READ OVERRIDE DATA
      IF (NSHUFL-2) 250,240,250
240 READ INPUT TAPE NS,2,XDOWN,JINT,NDOW,NXXX
250 CONTINUE
C
  70 CALL DGGWRK
      CALL DCALC
199 DELK=ZKFIND-REACT(2)
200 CONTINUE
      IF (LSER-1) 29,1,29
  29 IF(JSER) 30,30,1
30  IF (NBUMP) 31,31,1
31  IF(JS-JSMAX) 3,1,1
    1 CALL DENOUT
      CALL DPRIN
      CALL AVRAGE
      KINIT=1
    3 IF (JSER-1) 6,5,7
    5 IF (JN-JNSTOP) 8,7,7
    7 CALL FINAL
      IF (KSER) 99,99,49
    8 IF (REACT(2)-ZKFIND) 7,7,10
10  NSYN=0
      CALL SYNOPS
      CALL EXTRA
      CALL BURNUP
      LSER=1
      GO TO 70
    6 IF(LSER) 11,11,12
11  CONTINUE
      IF (ABSF(ZKFIND-REACT(2))-SERC0N) 13,13,14
13  CALL DENOUT
      CALL DPRIN
      CALL AVRAGE
      NSYN=0
      CALL SYNOPS
      JS=0
      CALL EXTRA
      CALL BURNUP
      LSER=1
      GO TO 70
12  CONTINUE
      IF (JN-JNSTOP) 14,7,7
14  CALL CRPULL
      LSER=0
      IF(NSWIT-1) 18,7,18
18  IF (JSS-JSSMAX) 15,17,17
15  IF (JS-JSMAX) 70,77,77
17  WRITE OUTPUT TAPE NI,500
      GO TO 7
77  WRITE OUTPUT TAPE NT,501
      GO TO 7
      END

```

SUBROUTINE INPUTA

C
C
C
C
C
C
C

READS AND PRINTS LIBRARY DATA

.....
 COMMON AND DIMENSION CARDS OMITTED. THEY SHOULD BE IDENTICAL TO
 THOSE IN MAIN PROGRAM.


```

1  FORMAT (48H1      FEVER LIBRARY CONTAINS THE FOLLOWING DATA  //
X 72H NU*FISSION  TRANSPORT  ABSORPTION SCATTER OUT NEUTS/FISSION
X DILUTION )
2  FORMAT (10H0BLOCK NO.  14)
3  FORMAT (60H
X      1PE12.4/(1P5E12.4))
4  FORMAT (1814)
5  FORMAT (1P6E12.5)
6  FORMAT (1P5E12.5)
7  FORMAT(46H1      FEVER LIBRARY CONTAINS THE FOLLOWING DATA //2HOSPEC
1IAL DATA      CAPTURE  -----FISSION YIELDS-----
2- //73H SET IDENT.NO      FACTOR      FROM U233      FROM U235      FROM PU23
39  FROM PU241 /(18,1PE16.4,1P4E12.4))
8  FORMAT(1H0//7X 41H CRITERION FOR-      CONVERGENCE CRITERION //7X
X20H EIGENVALUE----- 1PE16.4/7X 20H POINT----- 1PE16.4
X/7X 20H CONTROL SEARCH----- 1PE16.4//)
  IPAGE=0
  WRITE OUTPUT TAPE NT,1
  READ INPUT TAPE NS,4,N26,NLB,NLT,M1,M2,M3
  READ INPUT TAPE NS,6,(BUG(IL),IE=1,4)
  READ INPUT TAPE NS,5,CONK,CONELG,SERCON
  DO 40 IR=1,20
    NY(1,IR)=M1
    NY(2,IR)=M2
40  NY(3,IR)=M3
    DO 100 IL=1,NLB
      READ INPUT TAPE NS,3,XBUG,(FISIG(IE,IL),TOSIG(IE,IL),ABSIG(IE,IL),
X      COSIG(IE,IL),XNU(IE,IL),IL=1,N26)
50  CONTINUE
    IPAGE=IPAGE+3+N26
    IF (IPAGE-48) 58,55,55
55  IPAGE=0
    WRITE OUTPUT TAPE NT,1
58  WRITE OUTPUT TAPE NT,2,IL
    WRITE OUTPUT TAPE NT,3,XBUG,(FISIG(IE,IL),TOSIG(IE,IL),
X      ABSIG(IE,IL),
X      COSIG(IE,IL),XNU(IE,IL),IE=1,N26)
    DO 70 IE=1,N26
      FISIG(IE,IL)=FISIG(IE,IL)*XBUG
      TOSIG(IE,IL)=TOSIG(IE,IL)*XBUG
      ABSIG(IE,IL)=ABSIG(IE,IL)*XBUG
      COSIG(IE,IL)=COSIG(IE,IL)*XBUG
70  CONTINUE
100 CONTINUE
    READ INPUT TAPE NS,6,(DIRAC(K),YIELD1(K),YIELD2(K),YIELD3(K),
X      YIELD4(K),K=1,NLT)
    WRITE OUTPUT TAPE NT,7,(K,DIRAC(K),YIELD1(K),YIELD2(K),YIELD3(K),
X      YIELD4(K),K=1,NLT)
    WRITE OUTPUT TAPE NT,8,CONK,CONELG,SERCON
  RETURN
  END

```

SUBROUTINE INIT

```

C
C      INITIALIZES DATA IN STORAGE FROM LAST PROBLEM
C
C      .....
C      COMMON AND DIMENSION CARDS OMITTED. THEY SHOULD BE IDENTICAL TO
C      THOSE IN MAIN PROGRAM.
C      .....
C
      CRT=0.0
      CORE=1.0E+4
      JN=-1
      JS=0
      JSS=0
      LSER=0
      NIIX=0
      NSWIT=0
      IF (NSHUFL-1) 2,3,3
2  CONTINUE
      JSIM=0
      KSIM=0
      NBUMP=0
      LBUMP=0
3  CONTINUE
      KINIT=0
      JSPEC=0
      NQUIT=0
      DO 10 L=1,25
      STORE(L,L)=0.0
      NSTO(L)=0
      IF (NSHUFL) 4,4,10
4  DO 5 IR=1,20
      NHOT(L,IR)=0
      NCOL(L,IR)=0
5  DEN(L,IR)=0.0
10 CONTINUE
      DO 15 I=1,50
      SPECK(I)=0.0
      TIME(I)=0.0
      IF(NSHUFL-1) 14,15,15
14 NP0IS(I)=0
15 CONTINUE
      AWT(1)=232.111
      AWT(2)=233.114
      AWT(3)=233.112
      AWT(4)=234.114
      AWT(5)=235.117
      AWT(6)=236.120
      AWT(7)=238.125
      AWT(8)=239.123
      AWT(9)=239.127
      AWT(10)=240.129
      AWT(11)=241.131
      AWT(12)=242.134
      RETURN
      END

```

SUBROUTINE INPUTB

```

C
C   READS CASE INPUT DATA
C
C   .....
C   COMMON AND DIMENSION CARDS OMITTED. THEY SHOULD BE IDENTICAL TO
C   THOSE IN MAIN PROGRAM.
C   .....
C
2  FORMAT (18I4)
3  FORMAT (6E12.5)
4  FORMAT (1I2,5E12.5)
5  FORMAT (9I4,E36.5)
6  FORMAT (1H1 28X5HFEVER//)
7  FORMAT (3I4,5E12.5)
701 FORMAT(18H0  PROBLEM TYPE--- 26X 10HNUMBER OF A6,6HS--- 12)
702 FORMAT(1H+ 16X 22H CONTROL SEARCH BURNUP )
703 FORMAT(1H+ 16X 22H BURNUP(NO CONTR.POIS) )
704 FORMAT(1H+ 16X 22H SINGLE DIFFUSION SHOT )
705 FORMAT(12H0  GEOMETRY-A6,26X20HNUMBER OF GROUPS----14)
706 FORMAT(1H+ 16X 5H SLAB )
707 FORMAT(1H+17X8HCYLINDER)
708 FORMAT(1H07X64HCORE HEIGHT      POWER(WATTS)      FISS/WATT-SEC  XE
1REMOVAL FRACT//1P4E18.5//73HOMIN OR SEARCH KEFF  TIME STEP(DAYS)
2  MAX TIME STEPS  SMALL/LARGE STEPS//1P2E18.5,113,117)
713 FORMAT(18H0 MATERIAL SUMMARY/2H0 A6,9X 5HTOTAL8X 39HSPECIAL      LU
XMPED POIS  CONTROL POIS //)
714 FORMAT(16,4I14)
715 FORMAT (1H1A6,119,3I26//10H MATERIAL 9X3HHOT 6X4HCOLD 3(13X3HH016
XX4HCOLD)/5X4HNO. 4(7X19HBLOCK NO. BLOCK NO.))//)
717 FORMAT (17,114,110,3(116,110))
718 FORMAT(23H1 SPECIAL MATERIAL DATA//2XA6,30H MATERIAL      CAPTUR
XE      3A6,18H FISSION YIELDS 3A6/25X 7HPRODUCT 7X54HFROM U233
X  FROM U235      FROM PU239      FROM PU241 //)
719 FORMAT(16,18,13X A6,1P4E15.5)
720 FORMAT(20H1 LUMPED POISON DATA/72HOREG MAT  R0DS      I.D.
X0.D.      LENGTH  ATOMIC WT  DENSITY//)
722 FORMAT (213,1P6E11.4)
723 FORMAT (72HOREG MAT COEFF 0      COEFF 1      COEFF 2      COEFF 3      C
X0EFF 4      COEFF 5 //)
724 FORMAT(70H0      MAX TOTAL ADJ.      MAX ADJ (ONE REG)      NO.REG.ADJ.S
1MULTANEOUSLY //111,121,125/68H0 ORDER OF USE  CONTROL REG  MA
2X INSERT.FRACT  MIN INSERT.FRACT //(18,116,5X1P2E18.5))
729 FORMAT(43H0 GROUP      LEFT ALBEDO      RIGHT ALBEDO//(16,1P2E18.
X5))
1724 FORMAT(21H1 CONTROL POISON DATA//3XA6,48H MATERIAL  MAX ATOM DEN
XSITY  MIN ATOM DENSITY//)
1725 FORMAT (17,19,1P2E19.5)
B   W1=404040404040
B   W2=512527314645
B   W3=702562606060
B   W4=454660606060
    PI=3.14159
    CALL HEAD(1)
    WRITE OUTPUT TAPE NT,6
    CALL HEAD(3)
    READ INPUT TAPE NS,5,N20,N27,JSER,NSPEC,NPLOT,NXE,NRSTRT,KSER,
X    NSHUFL,      RAD

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```

      IF(NXE)30,35,30
30  JN=0
35  CONTINUE
      READ INPUT TAPE NS,3,(AL1(IE),IE=1,N26)
      READ INPUT TAPE NS,3,(AL2(IE),IE=1,N26)
800  CONTINUE
      WRITE OUTPUT TAPE NT,701,W2,N20
      IF (JSER-1) 802,803,804
802  WRITE OUTPUT TAPE NT,702
      GO TO 805
803  WRITE OUTPUT TAPE NT,703
      GO TO 805
804  WRITE OUTPUT TAPE NT,704
805  WRITE OUTPUT TAPE NT,705,W1,N26
      GO TO (806,807),N27
806  WRITE OUTPUT TAPE NT,706
      GO TO 1808
807  WRITE OUTPUT TAPE NT,707
1808 CONTINUE
      DO 100 IR=1,N20
      DO 50 L=1,25
      DO 40 IE=1,N26
      40  SS(IE,L,IR)=1.0
      50  CONTINUE
100  READ INPUT TAPE NS,4,NVALS(IR),KADR(IR),(TRANS(IE,IR),IE=1,N26)
      READ INPUT TAPE NS,2,N71,(NBURN(I),I=1,N71)
      WRITE OUTPUT TAPE NT,713,W2
C    REGION DATA
      DO 150 IR=1,N20
      READ INPUT TAPE NS,2,NMAT(IR),N0(IR),NLUM(IR),NC(IR),NREAD1,NREAD,
X      NCH1,NCH2,NCH3,NCH4,NCH5,M1,M2,M3
812  WRITE OUTPUT TAPE NT,714,IR,NMAT(IR),N0(IR),NLUM(IR),NC(IR)
      IF (M1+M2+M3) 406,406,402
402  NY(1,IR)=M1
      NY(2,IR)=M2
      NY(3,IR)=M3
      M1=0
      M2=0
      M3=0
406  IF(NCH1) 400,102,400
400  MATERS=NMAT(IR)
      DO 405 L=1,MATERS
      NH0T(L,IR)=NH0T(L,NCH1)
      NC0L(L,IR)=NC0L(L,NCH1)
      DEN(L,IR)=DEN(L,NCH1)
      DO 403 IE=1,N26
403  SS(IE,L,IR)=SS(IE,L,NCH1)
405  CONTINUE
102  IF(NREAD1) 103,106,103
103  DO 105 LR=1,NREAD1
105  READ INPUT TAPE NS,2,L,(NH0T(L,IR),NC0L(L,IR))
106  IF(NREAD) 108,109,108
108  DO 110 LR=1,NREAD
110  READ INPUT TAPE NS,7,L,(NH0T(L,IR),NC0L(L,IR),DEN(L,IR),
X      (SS(IE,L,IR),IE=1,N26))
109  IF(N0(IR)) 111,114,111
111  N0TH=N0(IR)
      IF(NCH2) 410,112,410

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```

410 DO 411 K=1,N0TH
411 NX(K,IR)=NX(K,NCH2)
    GO TO 113
112 READ INPUT TAPE NS,2,(NX(K,IR),K=1,N0TH)
113 CONTINUE
114 IF(NLUM(IR)) 115,121,115
115 NLUMPS=NLUM(IR)
    DO 120 K=1,NLUMPS
    IF(NCH3) 420,430,420
420 R0DS(K,IR)=R0DS(K,NCH3)
    DILP(K,IR)=DILP(K,NCH3)
    D0LP(K,IR)=D0LP(K,NCH3)
    HLP(K,IR)= HLP(K,NCH3)
    AW(K,IR)= AW(K,NCH3)
    RH0(K,IR)= RH0(K,NCH3)
    VLP(K,IR)= VLP(K,NCH3)
    GO TO 435
430 READ INPUT TAPE NS,3,R0DS(K,IR),DILP(K,IR),D0LP(K,IR),HLP(K,IR),
X      AW(K,IR),RH0(K,IR)
435 VLP(K,IR)=R0DS(K,IR)*PI*(D0LP(K,IR)**2-DILP(K,IR)**2)*HLP(K,IR)/4.
    IF(NCH4) 440,450,440
440 DO 445 IE=1,6
    A0(IE,K,IR)=A0(IE,K,NCH4)
    A1(IE,K,IR)=A1(IE,K,NCH4)
    A2(IE,K,IR)=A2(IE,K,NCH4)
    A3(IE,K,IR)=A3(IE,K,NCH4)
    A4(IE,K,IR)=A4(IE,K,NCH4)
    A5(IE,K,IR)=A5(IE,K,NCH4)
445 CONTINUE
    GO TO 120
450 IF(NSPEC) 117,116,117
116 N26A=N26+2
    GO TO 118
117 N26A=N26
118 CONTINUE
    READ INPUT TAPE NS,3,(A0(IE,K,IR),A1(IE,K,IR),A2(IE,K,IR),
X      A3(IE,K,IR),A4(IE,K,IR),A5(IE,K,IR),IE=1,N26A)
120 CONTINUE
121 CONTINUE
    IF(NC(IR))160,150,160
160 NC0NTR=NC(IR)
    DO 175 K=1,NC0NTR
    IF(NCH5) 161,170,161
161 P0ISM(K,IR)=P0ISM(K,NCH5)
    P0ISL(K,IR)=P0ISL(K,NCH5)
    GO TO 175
170 READ INPUT TAPE NS,3,P0ISM(K,IR),P0ISL(K,IR)
175 CONTINUE
150 CONTINUE
C   BURNUP DATA
    IF (JSER-1) 152,152,209
152 READ INPUT TAPE NS,3,DELDAY,POWER,H0CORE,ZKFIND,FIWATT,RPXE
    READ INPUT TAPE NS,2,JNS10P,JNUM
C   CONTROL SEARCH DATA
    IF (JSER-1) 155,210,210
155 READ INPUT TAPE NS,2,JSMAX,JSSMAX,LSIM,KSS,(NP0IS(IRR),IRR=1,KSS)
    READ INPUT TAPE NS,3,(PINMIN(IRR),IRR=1,KSS)
    READ INPUT TAPE NS,3,(PINMAX(IRR),IRR=1,KSS)

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```

200 CONTINUE
201 GO TO 210
209 HCCORE=1.0
    FIWATT=3.38E+10
    POWER=1.0
210 CONTINUE
    DO 250 IR=1,N20
        IF(N27-1) 205,205,225
205 IF(IR-1) 206,206,211
206 VOL(1)=(RADR(1)-RAD)*PI*HCCORE**2
    GO TO 215
211 VOL(IR)=(RADR(IR)-RADR(IR-1))*PI*HCCORE**2
215 GO TO 250
225 IF(IR-1) 226,226,230
226 VOL(1)=(RADR(1)**2-RAD**2)*PI*HCCORE
    GO TO 235
230 VOL(IR)=(RADR(IR)**2-RADR(IR-1)**2)*PI*HCCORE
235 CONTINUE
250 CONTINUE
    VOLUME =0.0
    DO 300 I=1,N71
        IR=NBURN(I)
300 VOLUME=VOLUME+VOL(IR)
    DO 350 I=1,N71
        IR=NBURN(I)
350 VFREG(IR)=VOL(IR)/VOLUME
600 CONTINUE
    DO 620 IR=1,N20
        IF(NLUM(IR)) 605,620,605
605 NLUMPS=NLUM(IR)
    DO 610 K=1,NLUMPS
        L=K+NO(IR)+15
610 DEN(L,IR)=RH0(K,IR)*VLP(K,IR)*.60247/(AW(K,IR)*VOL(IR))
620 CONTINUE
C
C     PRINT OUT INPUT DATA
C
808 IF (JUSER-1) 809,809,811
809 WRITE OUTPUT TAPE NT,708,HCCORE,POWER,FIWATT,RPXE, ZKFIND,DELDAY,
X          JNSTOP,JNUM
811 CONTINUE
    WRITE OUTPUT TAPE NT,729,(IE,AL1(IE),AL2(IE),IE=1,N26)
    DO 817 IR=1,N20,4
        IR1=IR+1
        IR2=IR+2
        IR3=IR+3
        WRITE OUTPUT TAPE NT,715,W2,IR,IR1,IR2,IR3
1813 MATERS=XMAXOF(NMAT(IR),NMAT(IR1),NMAT(IR2),NMAT(IR3))
813 DO 814 L=1,MATERS
814 WRITE OUTPUT TAPE NT,717,L,NHOT(L,IR),NCOL(L,IR), NHOT(L,IR1),
X          NCOL(L,IR1)
X , NHOT(L,IR2),NCOL(L,IR2),NHOT(L,IR3),NCOL(L,IR3)
817 CONTINUE
    IPAGE=0
    WRITE OUTPUT TAPE NT,718,W2,W1,W1,W1,W1,W1,W1
    DO 819 IR=1,N20
    DO 815 L=13,15
        KFU=NY(L-12,IR)

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```

      IF (DIRAC(KFU)) 1907,1908,1907
1907 DZZZ=W3
      GO TO 815
1908 DZZZ=W4
      815 WRITE OUTPUT TAPE NT,719,IR,L,DZZZ      ,YIELD1(KFU),YIELD2(KFU),
      X      YIELD3(KFU),YIELD4(KFU)
      IPAGE=IPAGE+3
      IF(N0(IR)) 816,819,816
      816 N0TH=N0(IR)
      IPAGE=IPAGE+N0TH
      IF(45-IPAGE) 1817,1817,1818
1817 WRITE OUTPUT TAPE NT,718,W2,W1,W1,W1,W1,W1,W1
      IPAGE =N0TH
1818 DO 818 K=1,N0TH
      L=K+15
      KFU=NX(K,IR)
      IF (DIRAC(KFU)) 1707,1708,1707
1707 DZZZ=W3
      GO TO 818
1708 DZZZ=W4
      818 WRITE OUTPUT TAPE NT,719,IR,L,DZZZ      ,YIELD1(KFU),YIELD2(KFU),
      X      YIELD3(KFU),YIELD4(KFU)
      819 CONTINUE
      IPAGE =0
      820 WRITE OUTPUT TAPE NT,720
      DO 823 IR=1,N20
      IF(NLUM(IR)) 821,823,821
      821 NLUMPS=NLUM(IR)
      DO 822 K=1,NLUMPS
      L=15+N0(IR)+K
      822 WRITE OUTPUT TAPE NT,722,IR,L,R0DS(K,IR),DILP(K,IR),DOLP(K,IR),
      X      HLP(K,IR),AW(K,IR),RH0(K,IR)
      823 CONTINUE
      WRITE OUTPUT TAPE NT,723
      DO 826 IR=1,N20
      IF (NSPEC) 905,905,910
      905 IEE=N26+2
      GO TO 915
      910 IEE=N26
      915 CONTINUE
      IF(NLUM(IR)) 824,826,824
      824 NLUMPS=NLUM(IR)
      DO 825 K=1,NLUMPS
      L=15+N0(IR)+K
      825 WRITE OUTPUT TAPE NT,722,(IR,L,A0(IE,K,IR),A1(IE,K,IR),A2(IE,K,IR)
      X      ,A3(IE,K,IR),A4(IE,K,IR),A5(IE,K,IR),IE=1,IEL)
      826 CONTINUE
      WRITE OUTPUT TAPE NT,1724,W2
      DO 829 IR=1,N20
      IF(NC(IR)) 827,829,827
      827 NC0NTR=NC(IR)
      DO 828 K=1,NC0NTR
      L=15+N0(IR)+NLUM(IR)+K
      828 WRITE OUTPUT TAPE NT,1725,IR,L,POISL(K,IR),POISM(K,IR)
      829 CONTINUE
      IF (JSER) 830,830,831
      830 WRITE OUTPUT TAPE NT,724,JSSMAX,JSMAX,LSIM,(IRR,NPOIS(IRR),
      X      PINMAX(IRR),PINMIN(IRR),IRR=1,KSS)
      831 RETURN
      END

```


SUBROUTINE HEAD(KZZZ)

```

C
C   READS AND PRINTS CASE IDENTIFICATION CARD
C
C   .....
C   COMMON AND DIMENSION CARDS OMITTED. THEY SHOULD BE IDENTICAL TO
C   THOSE IN MAIN PROGRAM.
C   .....
C
      GO TO (1,2,3),KZZZ
11  FORMAT (72H
      X
      )
12  FORMAT (1H1)
      1 READ INPUT TAPE NS,11
        GO TO 4
      2 WRITE OUTPUT TAPE NT,12
      3 WRITE OUTPUT TAPE NT,11
      4 RETURN
      END

```

SUBROUTINE DOGWRK

```

C
C   COMPUTE GROUP CONSTANTS
C
C   .....
C   COMMON AND DIMENSION CARDS OMITTED. THEY SHOULD BE IDENTICAL TO
C   THOSE IN MAIN PROGRAM.
C   .....
C
DO 300 IR=1,N20
  IF (NLUM(IR)) 50,60,50
50  VK=16+N0(IR)
  NL=15+N3(IR)+NLUM(IR)
  CALL LUMP
60  DO 200 IE=1,N26
    DIFL(IE,IR)=0.0
    TOTL(IE,IR)=0.0
    SIGA(IE,IR)=0.0
    TRIC(IE,IR)=0.0
    SIGS(IE,IR)=0.0
    MAT=NMAT(IR)
70  DO 100 L=1,MAT
    IF (1-ICE) 80,85,85
80  IL=NCOL(L,IR)
    IF (NLUM(IR)) 500,90,500
500 IF (NK-L) 501,501,90
501 IF (L-NL) 502,502,90
502 IF (N26-2-IE) 503,90,90
503 K=L-NK+1
504 IEE=IE+2-N26
    GO TO 95
85 IL=NHOT(L,IR)
90 IEE=IE
    Q=DEN(L,IR)*SS(IEE,L,IR)
    TOTL(IE,IR)=TOTL(IE,IR)+ Q      *TUSIG(IL,IL)
    SIGA(IE,IR)=SIGA(IE,IR)+ Q      *ABSIG(IE,IL)
    TRIC(IE,IR)=TRIC(IE,IR)+ Q      *FISIG(IL,IL)
    SIGS(IE,IR)=SIGS(IE,IR)+ Q      *JUSIG(IE,IL)
    DIFL(IE,IR)=BUG(IE)*(1.0/(3.0*TOTL(IL,IR)))
    GO TO 100
95 CONTINUE
    Q=DEN(L,IR)*SC(IEE,K,IR)
    TOTL(IE,IR)=TOTL(IE,IR)+ Q      *TUSIG(IE,IL)
    SIGA(IE,IR)=SIGA(IE,IR)+ Q      *ABSIG(IE,IL)
    TRIC(IE,IR)=TRIC(IE,IR)+ Q      *FISIG(IE,IL)
    SIGS(IE,IR)=SIGS(IE,IR)+ Q      *JUSIG(IE,IL)
    DIFL(IE,IR)=BUG(IE)*(1.0/(3.0*TOTL(IE,IR)))
100 CONTINUE
200 CONTINUE
300 CONTINUE
    RETURN
    END

```

SUBROUTINE LUMP

```

C
C      ADJUST LUMPED POISON SELF SHIELDING FACTORS
C
C      .....
C      COMMON AND DIMENSION CARDS OMITTED. THEY SHOULD BE IDENTICAL TO
C      THOSE IN MAIN PROGRAM.
C      .....
C
      NK=NK
      NL=NL
      IR=IR
      DO 100 L=NK,NL
      K=L-N0(IR)-15
      WLP(K,IR)=DEN(L,IR)*AW(K,IR)*VOL(IR)/.60247
      RH0(K,IR)=WLP(K,IR)/VLP(K,IR)
      DO 50 IE=1,N26
      IF (1-ICE) 502,510,510
502 IF (N26-2-IE) 504,510,510
504 IEE=IE+2-N26
      IEA=IE+2
      GO TO 95
510 IEE=IE
      90 CONTINUE
      SS(IE,L,IR)=A0(IEE,K,IR)+A1(IEE,K,IR)*RH0(K,IR)+
X          A2(IEE,K,IR)*RH0(K,IR)**2+A3(IEE,K,IR)*RH0(K,IR)**3+
X          A4(IEE,K,IR)*RH0(K,IR)**4+A5(IEE,K,IR)*RH0(K,IR)**5
      GO TO 50
      95 SC(IEE,K,IR)=A0(IEA,K,IR)+A1(IEA,K,IR)*RH0(K,IR)+
1          A2(IEA,K,IR)*RH0(K,IR)**2+A3(IEA,K,IR)*RH0(K,IR)**3+
2          A4(IEA,K,IR)*RH0(K,IR)**4+A5(IEA,K,IR)*RH0(K,IR)**5
      50 CONTINUE
      100 CONTINUE
      RETURN
      END

```

SUBROUTINE DCALC

```

C
C      CALCULATION OF FLUX, POWER AND MULTIPLICATION
C
C      .....
C      COMMON AND DIMENSION CARDS OMITTED. THEY SHOULD BE IDENTICAL TO
C      THOSE IN MAIN PROGRAM.
C      .....
C
      N27=N27
      DO 7000 IR=1,N20
1000  VALS(IR)=NVALS(IR)
      WIDTH(1)=(RADR(1)-RAD)/VALS(1)
      DO 7001 IR=2,N20
1001  WIDTH(IR)=(RADR(IR)-RADR(IR-1))/VALS(IR)
2500  CONTINUE
6010  CONTINUE
6002  CONTINUE
      VALL=VALS(1)
      N41(1)=VALL+.001
      IF(N20-2)5000,5002,5002
5002  DO1008 IR=2,N20
      VALL=VALL+VALS(IR)
      N41(IR)=VALL+.001
1008  CONTINUE
5000  CONTINUE
      VALL=VALL+.001
      N28=VALL
      DENSP(N28)=0.0
      DO1009 IE=1,N26
      DIFM(IE,1)=DIFL(IE,1)
      SIG(IE,1)=SIGS(IE,1)
      ABC(IE,1)=SIG(IE,1)+SIGA(IE,1)+DIFM(IE,1)*TRANS(IE,1)
      SIGNU(IE,1)=TRIC(IE,1)
1009  CONTINUE
      RADP(1)=RAD+WIDTH(1)
      IR=1
      DO1013 IP=2,N28
      RADP(IP)=RADP(IP-1)+WIDTH(IR)
      IF(N41(IR)-IP)1015,1015,1016
1015  CONTINUE
      DO1020 IE=1,N26
      DIFM(IE,IP)=DIFL(IE,IR)
      SIG(IE,IP)=SIGS(IE,IR)
      ABC(IE,IP)=SIG(IE,IP)+SIGA(IE,IR)+DIFM(IE,IP)*TRANS(IE,IR)
      SIGNU(IE,IP)=TRIC(IE,IR)
1020  CONTINUE
      IR=IR+1
      GOT01013
1016  CONTINUE
      DO1050 IE=1,N26
      DIFM(IE,IP)=DIFL(IE,IR)
      SIG(IE,IP)=SIGS(IE,IR)
      ABC(IE,IP)=SIG(IE,IP)+SIGA(IE,IR)+DIFM(IE,IP)*TRANS(IE,IR)
      SIGNU(IE,IP)=TRIC(IE,IR)
1050  CONTINUE
1013  CONTINUE
      N29=N28-1

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IF(N27-1)8011,1051,1053
1051 BET(1)=(RADP(2)-RADP(1))/(RADP(1)-RAD)
DEL(1)=(RADP(2)-RADP(1))*(RADP(1)-RAD)/2.
GAM(1)=BET(1)*DEL(1)
D01052IP=2,N29
BET(IP)=(RADP(IP+1)-RADP(IP))/(RADP(IP)-RADP(IP-1))
DEL(IP)=(RADP(IP+1)-RADP(IP))*(RADP(IP)-RADP(IP-1))/2.
GAM(IP)=BET(IP)*DEL(IP)
1052 CONTINUE
G0T01055
1053 CONTINUE
ABLE=(RADP(1)+RADP(2))/(3.*RADP(1)-RADP(2))
BAKER=(RADP(1)+RAD)/(3.*RADP(1)-RAD)
BET(1)=((RADP(2)-RADP(1))/(RADP(1)-RAD))*(1.+ABSF(BAKER))/(1.+ABSF
1(ABLE))
DEL(1)=.25*((RADP(2)-RADP(1))/(1.+ABSF(ABLE)))*((3.*RADP(1)-RAD)-(
1RADP(1)+RAD)*ABSF(BAKER))
GAM(1)=.25*((RADP(2)-RADP(1))/(1.+ABSF(1./ABLE)))*((RADP(1)+RADP(2
1))- (3.*RADP(1)-RADP(2))*ABSF(1./ABLE))
D01054IP=2,N29
ABLE=(RADP(IP)+RADP(IP+1))/(3.*RADP(IP)-RADP(IP+1))
BAKER=(RADP(IP)+RADP(IP-1))/(3.*RADP(IP)-RADP(IP-1))
BET(IP)=(RADP(IP+1)-RADP(IP))/(RADP(IP)-RADP(IP-1))*(1.+ABSF(BAKER
1))/(1.+ABSF(ABLE))
DEL(IP)=.25*((RADP(IP+1)-RADP(IP))/(1.+ABSF(ABLE)))*((3.*RADP(IP)-
1RADP(IP-1))-(RADP(IP)+RADP(IP-1))*ABSF(BAKER))
GAM(IP)=.25*((RADP(IP+1)-RADP(IP))/(1.+ABSF(1./ABLE)))*((RADP(IP)+
1RADP(IP+1))- (3.*RADP(IP)-RADP(IP+1))*ABSF(1./ABLE))
1054 CONTINUE
1055 CONTINUE
LL=1
D01060IE=1,N26
ZIP1(IE,1)=1.+(RADP(1)-RAD)*(1.-AL1(IE))/(2.*DIFM(IE,1)*(1.+AL1(IE
1)))
ZIP2(IE,1)=0.0
IFDVIDECHECK1060,1060
1060 CONTINUE
D01066IP=1,N29
D01066IE=1,N26
RECUR1(IE,IP)=DIFM(IE,IP+1)+BET(IP)*DIFM(IE,IP)+GAM(IP)*ABC(IE,IP+
11)+DEL(IP)*ABC(IE,IP)
RECUR2(IE,IP)=BET(IP)*DIFM(IE,IP)
1066 CONTINUE
4000 CONTINUE
D01065IP=1,N29
1061 IF(KINIT) 8012,99,1062
99 IF(LL-1) 8012,98,1062
98 CONTINUE
CEE(1,IP)=1.0/C0RE
CEE(2,IP)=1.0/C0RE
IF(N26-3) 1065,1059,1059
1059 CEE(3,IP)=1.0/C0RE
IF(N26-3) 1065,1065,1069
1069 CEE(4,IP)=1.0/C0RE
G0T01065
1062 CONTINUE
CEE(1,IP)=GAM(IP)*DENSP(IP)+DEL(IP)*DENSM(IP)
CEE(2,IP)=(GAM(IP)*SIG(1,IP+1)+DEL(IP)*SIG(1,IP))*FEE(1,IP)

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      IF(N26-3) 1065,1064,1064
1064  CONTINUE
      CEE(3,IP)=(GAM(IP)*SIG(2,IP+1)+DEL(IP)*SIG(2,IP))*FEE(2,IP)
      IF(N26-3) 1065,1065,1068
1068  CEE(4,IP)=(GAM(IP)*SIG(3,IP+1)+DEL(IP)*SIG(3,IP))*FEE(3,IP)
1065  CONTINUE
4002  CONTINUE
      DO1067IP=2,N28
      DO1067IE=1,N26
      ZIP1(IE,IP)=(1./DIFM(IE,IP))*(RECUR1(IE,IP-1)-RECUR2(IE,IP-1)/ZIP1
1(IE,IP-1))
      ZIP2(IE,IP)=(1./DIFM(IE,IP))*(CEE(IE,IP-1)+RECUR2(IE,IP-1)*ZIP2(IE
1,IP-1)/ZIP1(IE,IP-1))
1067  CONTINUE
4001  CONTINUE
      DO1070IE=1,N26
      B1(IE)=1.+(RADP(N28)-RADP(N29))*(1.-AL2(IE))/(2.*DIFM(IE,N28)*(1.+
1AL2(IE)))
      FEE(IE,N28)=ZIP2(IE,N28)/(B1(IE)*ZIP1(IE,N28)-1.)
1070  CONTINUE
      IP=N29
1071  CONTINUE
      DO1074IE=1,N26
1074  FEE(IE,IP)=(ZIP2(IE,IP+1)+FEE(IE,IP+1))/ZIP1(IE,IP+1)
      IP=IP-1
3006  IF(IP-1)1075,1071,1071
1075  CONTINUE
      DENSP0=0.0
      DO1800IE=1,N26
      FEE0(IE)=(ZIP2(IE,1)+FEE(IE,1))/ZIP1(IE,1)
1800  DENSP0=DENSP0+SIGNU(IE,1)*FEE0(IE)
      DO1076IP=1,N29
      SUM=0.0
      SUM1=0.0
      DO1077IE=1,N26
      SUM=SUM+SIGNU(IE,IP+1)*FEE(IE,IP)
      SUM1=SUM1+SIGNU(IE,IP)*FEE(IE,IP)
1077  CONTINUE
      DENSP(IP)=SUM
      DENSM(IP)=SUM1
1076  CONTINUE
      DENSM(N28)=SIGNU(1,N28)*FEE(1,N28)+SIGNU(2,N28)*FEE(2,N28)+SIGNU(3
1,N28)*FEE(3,N28)
      2 +SIGNU(4,N28)*FEE(4,N28)
      IF(N27-1)8015,1078,1080
1078  SUM=(DENSP0+DENSM(1))*(RADP(1)-RAD)/2.
      DO1079IP=1,N29
      SUM=(DENSP(IP)+DENSM(IP+1))*(RADP(IP+1)-RADP(IP))/2.+SUM
1079  CONTINUE
      GOT01091
1080  SUM=(RAD*DENSP0+RADP(1)*DENSM(1))*(RADP(1)-RAD)/2.
      DO1081IP=1,N29
      SUM=(RADP(IP)*DENSP(IP)+RADP(IP+1)*DENSM(IP+1))*(RADP(IP+1)-RADP(I
1P))/2.+SUM
1081  CONTINUE
1091  CONTINUE
      REACT(2)=SUM
      IF(LL-1) 8016,1086,1282

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```

1086 LL=LL+1
C
    DO 1168 IP=1,N28
    S0U(IP)=DENSM(IP)
1168 S0T(IP)=DENSP(IP)
C
    GOT04000
1282 NH=NH+1
    IF(NH-4) 1083,1283,1283
1283 NH=0
1082 C0N=ABS(React(2)-React(1))
    IF(C0NK-C0N) 1083,1083,1085
1083 DO1084 IP=1,N28
    DENSP(IP)=DENSP(IP)/React(2)
    DENSM(IP)=DENSM(IP)/React(2)
    S0T(IP)=DENSP(IP)
1084 S0U(IP)=DENSM(IP)
    IF (NH) 1221,1220,1221
1220 React(1)=React(2)
1221 LL=LL+1
    IF(LL-500) 4000,4000,1090
1090 NITX=1
    RETURN
1085 N31=2
    React(1)=React(2)
    LL=LL+1
3600 CONTINUE
    DO 3610 IP=1,N28
3610 EIG(IP)=DENSM(IP)/S0U(IP)
    EIGL=0.0
    EIGM=1.0E+25
    DO 3670 IP=1,N28
    IF(EIG(IP)) 3670,3670,3630
3630 IF(EIG(IP)-EIGL) 3650,3650,3640
3640 EIGL=EIG(IP)
3650 IF(EIG(IP)-EIGM) 3660,3670,3670
3660 EIGM=EIG(IP)
3670 CONTINUE
    ERR=(EIGL-EIGM)/EIGL
    IF(ERR-C0NEIG) 3680,3690,3690
3680 GO TO 1318
3690 CONTINUE
    DO 3710 IP=1,N28
3700 CONTINUE
    S0U(IP)=DENSM(IP)/React(2)
    S0T(IP)=DENSP(IP)/React(2)
    DENSM(IP)=S0U(IP)
    DENSP(IP)=S0T(IP)
3710 CONTINUE
    GO TO 4000
1318 IF(N27-1) 8011,1319,1321
1319 C0RE=(DENSP0/DENSP0+DENSM(1)/DENSM(1))*(RADP(1)-RAD)/2.
    FEEBAR=(DENSP0*FEE0(1)/DENSP0+DENSM(1)*FEE(1,1)/DENSM(1))*(RADP(1)
    1-RAD)/2.
    DO 1802 IP=1,N29
    C0RE=C0RE+(DENSP(IP)/DENSP(IP)+DENSM(IP+1)/DENSM(IP+1))*(RADP(IP+1)
    1-RADP(IP))/2.
    FEEBAR=FEEBAR+(DENSP(IP)*FEE(1,IP)/DENSP(IP)+DENSM(IP+1)*FEE(1,IP+

```

```

11)/DENSM(IP+1))*(RADP(IP+1)-RADP(IP))/2.
  IFDIVIDECHECK1802,1802
1802  CONTINUE
  GO TO 1317
1321  CORE=(DENSP0*RAD/DENSP0+DENSM(1)*RADP(1)/DENSM(1))*(RADP(1)-RAD)/2
1.
  FEEBAR=(DENSP0*RAD*FEE0(1)/DENSP0+DENSM(1)*RADP(1)*FEE(1,1)/DENSM(
11))*(RADP(1)-RAD)/2.
  IFDIVIDECHECK1801,1801
1801  CONTINUE
  DO 1905 IP=1,N29
  CORE=CORE+(DENSP(IP)*RADP(IP)/DENSP(IP)+DENSM(IP+1)*RADP(IP+1)/DEN
ISM(IP+1))*(RADP(IP+1)-RADP(IP))/2.
  FEEBAR=FEEBAR+(DENSP(IP)*RADP(IP)*FEE(1,IP)/DENSP(IP)+DENSM(IP+1)*
1RADP(IP+1)*FEE(1,IP+1)/DENSM(IP+1))*(RADP(IP+1)-RADP(IP))/2.
  IF DIVIDE CHECK 1905,1905
1905  CONTINUE
1317  CONTINUE
  RETURN
8011  CONTINUE
8012  CONTINUE
8013  CONTINUE
8014  CONTINUE
8015  CONTINUE
8016  CONTINUE
8017  CONTINUE
8018  CONTINUE
8019  CONTINUE
8043  NTYPE = 1
  RETURN
  END

```


SUBROUTINE DENDUT

```

C
C PRINT OUT ATOM DENSITIES AND SELF SHIELDING FACTORS, CALCULATION OF
C WEIGHTS OF MATERIALS AND CONTROL POISON INSERTION
C
C .....
C COMMON AND DIMENSION CARDS OMITTED. THEY SHOULD BE IDENTICAL TO
C THOSE IN MAIN PROGRAM.
C .....
C
1 FORMAT(1H158X9H TIME STEP I4///4H0 A6,I4//58H0 MATERIAL ATOM DE
  XNSITY GROUP SELF SHIELDING FACTORS //)
3 FORMAT(18,4X,1P5E12.5)
5 FORMAT(1H1 15X,40HSTATUS OF CONTROL POISONS -- TIME STEP I3///13
  XX,A6,41H MATERIAL ATOM DENSITY INSERTION FRACT //)
6 FORMAT(8X,2I9,1P2E16.5)
11 FORMAT(11H1 TIME STEP I4,37X16HATOMIC DENSITIES)
12 FORMAT(2H0 A6,8I13/10H0 MATERIAL)
13 FORMAT(16,6X,1P8E13.5)
14 FORMAT(16,6X,1P4E13.5)
601 FORMAT(11H1 TIME STEP I4,31X28HWEIGHTS OF MATERIALS (GRAMS))
602 FORMAT(3H0 A6,10X6H1H-232 9X6H1A-233 9X5HU-233 10X5HU-234 10X5HU-
  X235 10X5HU-236//)
603 FORMAT(3H0 A6,10X5HU-238 9X6HNP-239 9X6HPU-239 9X6HPU-240 9X6HPU-
  X241 9X6HPU-242//)
604 FORMAT(17,5X,1P6E15.5)
605 FORMAT(11H1 TIME STEP I4,22X,63HLUMPED POISON DATA - DENSITY AND
  X HOT,COLD SELF SHIELDING (SS)/3H0 A6,25H MATERIAL GRAMS/CC
  X4(13H HOT SS GRP I1) 2(13H COLD SS GRP I1)//)
607 FORMAT(16,110,4X,1P7E14.5)
608 FORMAT(8H TOTAL,4X,1P6E15.5)
B W2=512527314645
  IF (KINIT) 50,50,40
50 DO 300 IR=1,N20
  MAT=NMAT(IR)
  WRITE OUTPUT TAPE NT,1,JN,W2,IR
  DO 100 L=1,MAT
100 WRITE OUTPUT TAPE NT,3,L,DEN(L,IR),(SS(IE,L,IR),IL=1,I126)
300 CONTINUE
  GO TO 95
40 IF (LSER) 400,400,54
54 WRITE OUTPUT TAPE NT,11,JN
  DO 90 IR=1,N20,8
  IRB=IR+7
  IF(16-IRB) 55,60,60
55 IRB=N20
  MATERS=XMAXOF(NMAT(IR),NMAT(IR+1),NMAT(IR+2),NMAT(IR+3))
60 WRITE OUTPUT TAPE NT,12,W2,(IRA,IRA=IR,IRB)
  IF(IRB-16) 61,61,62
61 CONTINUE
  MATERS=XMAXOF(NMAT(IR),NMAT(IR+1),NMAT(IR+2),NMAT(IR+3),NMAT(IR+4),
  X,NMAT(IR+5),NMAT(IR+6),NMAT(IR+7))
62 CONTINUE
  DO 70 L=1,MATERS
  IF(16-IRB) 64,66,66
64 WRITE OUTPUT TAPE NT,14,L,(DEN(L,IRA),IRA=IR,20)
  GO TO 70
66 WRITE OUTPUT TAPE NT,13,L,(DEN(L,IRA),IRA=IR,IRB)

```

```

70 CONTINUE
90 CONTINUE
C
C   GRAMS OF MATERIALS
C
95 WRITE OUTPUT TAPE NT,601,JN
   WRITE OUTPUT TAPE NT,602,W2
289 DO 290 L=1,12
290 GS(L)=0.0
   DO 620 IR=1,N20
   DO 615 L=1,6
   GM(L)=DEN(L,IR)*VOL(IR)*AWT(L)/.60247
615 GS(L)=GS(L)+GM(L)
620 WRITE OUTPUT TAPE NT,604,IR,(GM(L),L=1,6)
   WRITE OUTPUT TAPE NT,608,(GS(L),L=1,6)
   WRITE OUTPUT TAPE NT,603,W2
   DO 630 IR=1,N20
   DO 625 L=7,12
   GM(L)=DEN(L,IR)*VOL(IR)*AWT(L)/.60247
625 GS(L)=GS(L)+GM(L)
630 WRITE OUTPUT TAPE NT,604,IR,(GM(L),L=7,12)
   WRITE OUTPUT TAPE NT,608,(GS(L),L=7,12)
   NG1=N26-1
   WRITE OUTPUT TAPE NT,605,JN,W2,(IE,IE=1,4),NG1,N26
C
C   COMPUTE COLD LUMPED SELF SHIELDING FOR PRINTOUT
C
   ICE=2
   DO 670 IR=1,N20
   IF(NLUM(IR)) 635,670,635
635 NK=16+N0(IR)
   NL=15+N0(IR)+NLUM(IR)
   CALL LUMP
640 NLUMPS=NLUM(IR)
   DO 650 K=1,NLUMPS
   L=15+N0(IR)+K
650 WRITE OUTPUT TAPE NT,607,IR,L,RH0(K,IR),(SS(IE,L,IR),IE=1,4),
      X                               (SC(IE,K,IR),IE=1,2)
670 CONTINUE
   ICE=0
400 CONTINUE
   WRITE OUTPUT TAPE NT,5,JN,W2
C
C   CONTROL ROD INSERTION FRACTION
C
   DO 450 IR=1,N20
   IF(IRC(IR)) 405,450,405
405 VK=16+N0(IR)+NLUM(IR)
   NL=NK-1+NL(IR)
   DO 420 L=NK,NL
   K=L-NK+1
   CFRAC(K,IR)=DEN(L,IR)/POISL(K,IR)
420 WRITE OUTPUT TAPE NT,6,IR,L,DEN(L,IR),CFRAC(K,IR)
450 CONTINUE
1000 CONTINUE
   RETURN
   END

```

SUBROUTINE DPRINT

```

C
C   PRINT DIFFUSION CALCULATION DATA
C
C   .....
C   COMMON AND DIMENSION CARDS OMITTED. THEY SHOULD BE IDENTICAL TO
C   THOSE IN MAIN PROGRAM.
C   .....
C
      4 FORMAT(53X 12H TIME STEP 14)
      5 FORMAT(11H0 21X 23H DIFFUSION CALCULATION ///)
    1341 FORMAT (1H1)
    1500 FORMAT (2I10,1PE16.5)
    1501 FORMAT(42H0 REGIONAL DATA)
    1502 FORMAT (35H0 REGION INTERVALS POSITION//)
    1503 FORMAT(44H0 GROUP CONSTANTS)
    1504 FORMAT (80H0 REGION GROUP BUCKLING DIFFUSION ABSORPTION
      X FISSION SCATTER OUT )
    1505 FORMAT (2I6,1PE15.5,1P4E13.5)
    1506 FORMAT (1H )
    1602 FORMAT (78H1 POINT POSITION POWER DIST. FLUX 1 FLUX 2
      X FLUX 3 FLUX 4 //)
    1599 FORMAT (1I6,1PE13.5,1P5E12.4)
    1900 FORMAT(120,1PE22.5)
    1901 FORMAT(11H0 29X 12H K-EFFECTIVE //)
      FEEBAR=FEEBAR/CORE
      DENSP0=CORE*DENSP0/REACT(2)
      D01850IP=1,N28
      DENSM(IP)=CORE*DENSM(IP)/REACT(2)
      DENSP(IP)=CORE*DENSP(IP)/REACT(2)
      D01850IE=1,N26
      FEE(IE,IP)=FEE(IE,IP)/FEEBAR
      IF(IP-1) 1850,1849,1850
    1849 FEE0(IE)=FEE0(IE)/FEEBAR
    1850 CONTINUE
    8008 CONTINUE
      CALL HEAD(2)
    1873 WRITE OUTPUT TAPE NT,5
      WRITE OUTPUT TAPE NT,4,JN
    1874 CONTINUE
    1318 WRITE OUTPUT TAPE NT,1501
      WRITE OUTPUT TAPE NT,1502
    1319 CONTINUE
      D01320IK=1,N20
    1322 WRITE OUTPUT TAPE NT,1500,IK,NVALS(IK),RADR(IK)
    1320 CONTINUE
    1315 WRITE OUTPUT TAPE NT,1503
      WRITE OUTPUT TAPE NT,1504
      IPAGE=0
      JPAGE=40-N20
    1316 CONTINUE
      D01509IK=1,N20
    1308 WRITE OUTPUT TAPE NT,1506
    1309 CONTINUE
      IPAGE=IPAGE+N26+1
      IF(IPAGE-JPAGE) 1350,1350,1340
    1340 JPAGE=46
      IPAGE=0

```

```

        WRITE OUTPUT TAPE NT,1341
        WRITE OUTPUT TAPE NT,1504
        WRITE OUTPUT TAPE NT,1506
1350 DO 1510 IE=1,N26
1312 WRITE OUTPUT TAPE NT,1505,IR,IE,TRANS(IE,IR),DIFL(IE,IR),
      1      SIGA(IE,IR),TRIC(IE,IR),SIGS(IE,IR)
1510 CONTINUE
1509 CONTINUE
      IPAGE=0
1904 WRITE OUTPUT TAPE NT,1901
1905 CONTINUE
1907 WRITE OUTPUT TAPE NT,1900,LL ,REACT(N31)
1910 CONTINUE
1604 WRITE OUTPUT TAPE NT,1602
      IPAGE=0
1606 DO 1610 IP=1,N28
      IPAGE=IPAGE+1
      IF(IPAGE-50) 1611,1611,1609
1609 IPAGE=0
      WRITE OUTPUT TAPE NT,1602
1608 CONTINUE
1611 WRITE OUTPUT TAPE NT,1599,IP,RADP(IP),DENSM(IP),FEE(1,IP),FEE(2,IP
      X      ),FEE(3,IP),FEE(4,IP)
      IF(DENSM(IP)-DENSP(IP)) 1616,1610,1616
1616 WRITE OUTPUT TAPE NT,1506
      WRITE OUTPUT TAPE NT,1599,IP,RADP(IP),DENSP(IP),FEE(1,IP),FEE(2,IP
      X      ),FEE(3,IP),FEE(4,IP)
      IPAGE=IPAGE+1
1610 CONTINUE
      IPAGE=0
      RETURN
      END

```

SUBROUTINE AVRAGE

```

C
C   COMPUTE AVERAGE FLUX, POWER, AND PRINT SAME
C
C   .....
C   COMMON AND DIMENSION CARDS OMITTED. THEY SHOULD BE IDENTICAL TO
C   THOSE IN MAIN PROGRAM.
C   .....
C
3000 FORMAT(1H1 39X 21H AVERAGE CORE FLUXES //)
3002 FORMAT (24H      ALL POWER PRODUCERS 1P4E12.4)
3003 FORMAT(1H0 38X 22H AVERAGE REGION FLUXES //)
3005 FORMAT ( 120,1PE16.4,1P3E12.4)
3024 FORMAT(15X 57H REGION      FLUX 1      FLUX 2      FLUX 3      FL
XUX 4 //)
3086 FORMAT (60H1  DIFFUSION CALCULATION NOT CONVERGED AFTER 500 ITERAT
XIONS  /1H1 /1H1 )
6304 FORMAT(1H0 32X 32H POWER DISTRIBUTION AT TIME STEP 13)
8001 CONTINUE
XRAD=0.0
DO 2110 IR=1,N20
DO 2110 IE=1,N26
RPHI(IE)=0.0
2110 RPHIAV(IE,IR)=0.0
DO 2115 IE=1,N26
GO TO (2111,2112),N27
2111 RPHIAV(IE,1)=(FEE0(IE)+FEE(IE,1))*(RADP(1)-RAD)/2.0
RPHI(IE)=(DENSP0*FEE0(IE)/DENSP0+DENSM(1)/DENSM(1)*FEE(IE,1))*
1(RADP(1)-RAD)/2.0
XRAD=(DENSP0/DENSP0+DENSM(1)/DENSM(1))*(RADP(1)-RAD)/2.0
GO TO 2115
2112 RPHIAV(IE,1)=(RAD*FEE0(IE)+RADP(1)*FEE(IE,1))*(RADP(1)-RAD)/2.0
RPHI(IE)=(DENSP0*RAD*FEE0(IE)/DENSP0+DENSM(1)*RADP(1)*FEE(IE,1)/
1DENSM(1))*(RADP(1)-RAD)/2.0
XRAD=(DENSP0*RAU/DENSP0+DENSM(1)*RADP(1)/DENSM(1))*(RADP(1)-RAD)
1/2.0
IF DIVIDE CHECK 2115,2115
2115 CONTINUE
CONTINUE
DO 4119 IP=1,N29
GO TO (4118,4117),N27
4117 XRAD=XRAD+(DENSP(IP)*RADP(IP)/DENSP(IP)+DENSM(IP+1)*RADP(IP+1)/
1DENSM(IP+1))*(RADP(IP+1)-RADP(IP))/2.0
GO TO 4119
4118 XRAD=XRAD+(DENSP(IP)/DENSP(IP)+DENSM(IP+1)/DENSM(IP+1))
1*(RADP(IP+1)-RADP(IP))/2.0
4119 CONTINUE
DO 4150 IE=1,N26
DO 4150 IP=1,N29
GO TO (4120,4140),N27
4120 RPHI(IE)= (DENSP(IP)*FEE(1L,IP)/DENSP(IP)+DENSM(IP+1)*FEE(IE,IP+1)
1/DENSM(IP+1))
2*(RADP(IP+1)-RADP(IP))/2.0 + RPHI(IE)
GO TO 4150
4140 RPHI(IE)= (DENSP(IP)*FEE(IE,IP)*RADP(IP)/DENSP(IP)+
1DENSM(IP+1)*FEE(IE,IP+1)*RADP(IP+1)/DENSM(IP+1))
2*(RADP(IP+1)-RADP(IP))/2.0 + RPHI(IE)
4150 CONTINUE

```

```

      DO 4160 IE=1,N26
4160  RPHI(IE)=RPHI(IE)/XRAD
      DO 2100 IR=1,N20
      IF (IR-1) 2005,2005,2010
2005  N42=N41(IR)-1
      N43=1
      GO TO 2030
2010  N42=N41(IR)-1
      N43=N41(IR-1)
2030  GO TO (2040,2050),N27
2040  DO 2045 IE=1,N26
      DO 2045 IP=N43,N42
2045  RPHIAV(IE,IR)=RPHIAV(IE,IR)+(FEE(IE,IP)+FEE(IE,IP+1))*
      1 (RADP(IP+1)-RADP(IP))/2.0
      GO TO 2100
2050  DO 2055 IE=1,N26
      DO 2055 IP=N43,N42
2055  RPHIAV(IE,IR)=RPHIAV(IE,IR)+(FEE(IE,IP)*RADP(IP)+FEE(IE,IP+1)*
      1 RADP(IP+1))*(RADP(IP+1)-RADP(IP))/2.0
2100  CONTINUE
      DO 2200 IR=1,N20
      GO TO(2120,2140),N27
2120  DO 2130 IE=1,N26
      IF (IR-1) 2122,2122,2124
2122  RPHIAV(IE,1)=RPHIAV(IE,1)/(RADR(1)-RAD)
      GO TO 2130
2124  RPHIAV(IE,IR)=RPHIAV(IE,IR)/(RADR(IR)-RADR(IR-1))
2130  CONTINUE
      GO TO 2151
2140  DO 2150 IE=1,N26
      IF (IR-1) 2142,2142,2144
2142  RPHIAV(IE,1)=RPHIAV(IE,1)/((RADR(1)**2-RAD**2)/2.0)
      GO TO 2150
2144  RPHIAV(IE,IR)=RPHIAV(IE,IR)/((RADR(IR)**2-RADR(IR-1)**2)/2.0)
2150  CONTINUE
2151  CONTINUE
2200  CONTINUE
      IF (JSER-1) 2220,2220,3020
2220  CALL ABSPHI
3020  WRITE OUTPUT TAPE NT,3000
3064  WRITE OUTPUT TAPE NT,3024
3070  WRITE OUTPUT TAPE NT,3002,(RPHI(IE),IE=1,N26)
      WRITE OUTPUT TAPE NT,3003
3074  WRITE OUTPUT TAPE NT,3024
3080  DO 3032 IR=1,N20
3032  WRITE OUTPUT TAPE NT,3005,(IR,(RPHIAV(IE,IR),IE=1,N26))
      IF (JSER-1) 1650,1651,1651
1650  CONTINUE
      IF (ABSF(ZKFIND-REACT(2))-SERCON) 1651,1651,1652
1651  CALL BAL
1652  CONTINUE
1690  IF (NPLT) 1700,1700,1750
1700  CALL HEAD(2)
      WRITE OUTPUT TAPE NT,6304,JN
      CALL PLOT (RADP,DENSM,N28,100,40,NT)
1750  CONTINUE
      IF(NITX) 3090,3090,3085
3085  WRITE OUTPUT TAPE NT,3086

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```
3090 CONTINUE
      DENSP0=DENSP0*REACT(N31)/CORE
      DO 2000 IP=1,N28
        DENSM(IP)=DENSM(IP)*REACT(N31)/CORE
2000  DENSP(IP)=DENSP(IP)*REACT(N31)/CORE
      DO 2003 IE=1,N26
        DO 2001 IP=1,N28
2001  FEE(IE,IP)=FEE(IE,IP)*FEEBAR
2003  FEE0(IE)=FEE0(IE)*FEEBAR
      RETURN
      END
```

SUBROUTINE BURNUP

C
C
C
C
C
C
C

DEPLETION AND BUILDUP CALCULATION

.....
 COMMON AND DIMENSION CARDS OMITTED. THEY SHOULD BE IDENTICAL TO
 THOSE IN MAIN PROGRAM.


```

    DIMENSION    UDEN(10)
1  FORMAT (13H1    TIME STEP 13//72H    REGION    -----FRACT
    XION OF FISSIONS FROM----- /19X,6H U-233,9X,6H U-235,
    X8X,7H PU-239,8X,7H PU-241 //)
2  FORMAT (110,1PE17.5,1P3E15.5)
3  FORMAT (42H0    REGION CONVERSION RATIO  REG VOLUME //)
4  FORMAT (110,1PE17.5,1PE15.5)
5  FORMAT (12H    AVERAGE 1PE15.5,24H  POWER GENERATING VOL= 1PE12.5
    X )
    JN=JN+1
    WRITE OUTPUT TAPE NT,1,JN
    ZJNUM=JNUM
    IF(JN) 15,15,20
15  DELSEC=0.0
    GO TO 25
20  DELSEC=DELDAY*8.64E+4/ZJNUM
24  JNN=0
25  JNN=JNN+1
    XXP=0.0
    YYP=0.0
    CALL ABSPHI
    IR=0
30  IR=IR+1
    J1=NH0T(1,IR)
    J2=NH0T(2,IR)
    J3=NH0T(3,IR)
    J4=NH0T(4,IR)
    J5=NH0T(5,IR)
    J6=NH0T(6,IR)
    J7=NH0T(7,IR)
    J8=NH0T(8,IR)
    J9=NH0T(9,IR)
    J10=NH0T(10,IR)
    J11=NH0T(11,IR)
    J12=NH0T(12,IR)
    J13=NH0T(13,IR)
    J14=NH0T(14,IR)
    J15=NH0T(15,IR)
    Y1=0.0
    Y2=0.0
    Z2=0.0
    Y3=0.0
    X4=0.0
    Y4=0.0
    Z4=0.0
    Y5=0.0
    Z5=0.0
    X6=0.0
    Y6=0.0

```



```

Z6=0.0
Y7=0.0
Y8=0.0
Z8=0.0
Y9=0.0
X10=0.0
Y10=0.0
Z10=0.0
Y11=0.0
Z11=0.0
X12=0.0
Y12=0.0
Z12=0.0
Y131=0.0
Y132=0.0
Y133=0.0
Y134=0.0
Y135=0.0
Y136=0.0
Y14=0.0
Y15=0.0
XXX=0.0
YYY=0.0
DO 50 IE=1,N26
101 Y1=Y1+RPHIAV(IE,IR)*ABSIG(IE,J1)*SS(IE,1,IR)
    Y2=Y2+RPHIAV(IE,IR)*ABSIG(IE,J2)*SS(IE,2,IR)
102 Z2=Z2+RPHIAV(IE,IR)*((ABSIG(IE,J1)-FISIG(IE,J1)/XNU(IE,J1))*
    1      SS(IE,1,IR)
103 Y3=Y3+RPHIAV(IE,IR)*ABSIG(IE,J3)*SS(IE,3,IR)
    X4=X4+RPHIAV(IE,IR)*ABSIG(IE,J4)*SS(IE,4,IR)
    Y4=Y4+RPHIAV(IE,IR)*((ABSIG(IE,J3)-FISIG(IE,J3)/XNU(IE,J3))*
    1      SS(IE,3,IR)
104 Z4=Z4+RPHIAV(IE,IR)*((ABSIG(IE,J2)-FISIG(IE,J2)/XNU(IE,J2))*
    1      SS(IE,2,IR)
    Y5=Y5+RPHIAV(IE,IR)*ABSIG(IE,J5)*SS(IE,5,IR)
105 Z5=Z5+RPHIAV(IE,IR)*((ABSIG(IE,J4)-FISIG(IE,J4)/XNU(IE,J4))*
    1      SS(IE,4,IR)
    X6=X6+RPHIAV(IE,IR)*((ABSIG(IE,J6)-FISIG(IE,J6)/XNU(IE,J6))*
    1      SS(IE,6,IR)
    Y6=Y6+RPHIAV(IE,IR)*ABSIG(IE,J6)*SS(IE,6,IR)
106 Z6=Z6+RPHIAV(IE,IR)*((ABSIG(IE,J5)-FISIG(IE,J5)/XNU(IE,J5))*
    1      SS(IE,5,IR)
107 Y7=Y7+RPHIAV(IE,IR)*ABSIG(IE,J7)*SS(IE,7,IR)
    Y8=Y8+RPHIAV(IE,IR)*ABSIG(IE,J8)*SS(IE,8,IR)
108 Z8=Z8+RPHIAV(IE,IR)*((ABSIG(IE,J7)-FISIG(IE,J7)/XNU(IE,J7))*
    1      SS(IE,7,IR)
109 Y9=Y9+RPHIAV(IE,IR)*ABSIG(IE,J9)*SS(IE,9,IR)
    X10=X10+RPHIAV(IE,IR)*ABSIG(IE,J10)*SS(IE,10,IR)
    Y10=Y10+RPHIAV(IE,IR)*((ABSIG(IE,J9)-FISIG(IE,J9)/XNU(IE,J9))
    1      *SS(IE,9,IR)
110 Z10=Z10+RPHIAV(IE,IR)*((ABSIG(IE,J8)-FISIG(IE,J8)/XNU(IE,J8))*
    1      SS(IE,8,IR)
    Y11=Y11+RPHIAV(IE,IR)*ABSIG(IE,J11)*SS(IE,11,IR)
111 Z11=Z11+RPHIAV(IE,IR)*((ABSIG(IE,J10)-FISIG(IE,J10)/XNU(IE,J10))
    1      *SS(IE,10,IR)
    X12=X12+RPHIAV(IE,IR)*((ABSIG(IE,J12)-FISIG(IE,J12)/XNU(IE,J12))*
    1      SS(IE,12,IR)
    Y12=Y12+RPHIAV(IE,IR)*ABSIG(IE,J12)*SS(IE,12,IR)

```

```

112 Z12=Z12+RPHIAV(IE,IR)*(ABSIG(IE,J11)-FISIG(IE,J11)/XNU(IE,J11))
1      *SS(IE,11,IR)
114 Y14=Y14+RPHIAV(IE,IR)*ABSIG(IE,J14)*SS(IE,14,IR)
115 Y15=Y15+RPHIAV(IE,IR)*ABSIG(IE,J15)*SS(IE,15,IR)
50 CONTINUE
    Y131=Y1-Z2
    Y132=Y3-Y4
    Y133=Y5-Z6
    Y134=Y7-Z8
    Y135=Y9-Y10
113 Y136=Y11-Z12
    ODEN1=DEN(1,IR)
    DEN(1,IR)=(DEN(1,IR)*(2.0-DELSEC*Y1)/(2.0+DELSEC*Y1)
    ODEN2=DEN(2,IR)
    DEN(2,IR)=.5*(DEN(1,IR)+ODEN1)*Z2/(.292794E-6 +Y2) +(ODEN2-
1      .5*(DEN(1,IR)+ODEN1)*Z2/(.292794E-6 +Y2))*EXP(-
2      -(0.292794E-6+Y2)*DELSEC)
    ODEN3=DEN(3,IR)
    DEN(3,IR)=(DEN(3,IR)*(2.0-DELSEC*Y3)+(DEN(2,IR)+ODEN2)*.292794E-6
1      *DELSEC)/(2.0+DELSEC*Y3)
    ODEN4=DEN(4,IR)
    DEN(4,IR)=(DEN(4,IR)*(2.0-DELSEC*X4)+(DEN(3,IR)+ODEN3)*Y4*DELSEC
1      +(DEN(2,IR)+ODEN2)*Z4*DELSEC)/(2.0+DELSEC*X4)
    ODEN5=DEN(5,IR)
    DEN(5,IR)=(DEN(5,IR)*(2.0-DELSEC*Y5)+(DEN(4,IR)+ODEN4)*Z5*DELSEC)
1      /(2.0+DELSEC*Y5)
    ODEN6=DEN(6,IR)
    DEN(6,IR)=(DEN(6,IR)*(2.0-DELSEC*Y6)+(DEN(5,IR)+ODEN5)*Z6*DELSEC)
1      /(2.0+DELSEC*Y6)
    ODEN7=DEN(7,IR)
    DEN(7,IR)=(DEN(7,IR)*(2.0-DELSEC*Y7)/(2.0+DELSEC*Y7)
    ODEN8=DEN(8,IR)
    DEN(8,IR)=.5*(DEN(7,IR)+ODEN7)*Z8/(.344316E-5 +Y8) +(ODEN8-
1      .5*(DEN(7,IR)+ODEN7)*Z8/(.344316E-5 +Y8))*EXP(-
2      -(0.344316E-5 +Y8)*DELSEC)
    ODEN9=DEN(9,IR)
    DEN(9,IR)=(DEN(9,IR)*(2.0-DELSEC*Y9)+(DEN(8,IR)+ODEN8)*.344316E-5
1      *DELSEC)/(2.0+DELSEC*Y9)
    ODEN10=DEN(10,IR)
    DEN(10,IR)=(DEN(10,IR)*(2.0-DELSEC*X10)+(DEN(9,IR)+ODEN9)*DELSEC*
1      Y10+(DEN(8,IR)+ODEN8)*DELSEC*Z10)/(2.0+X10*DELSEC)
    ODEN11=DEN(11,IR)
    DEN(11,IR)=(DEN(11,IR)*(2.0-DELSEC*(1.66362E-9+Y11))+
1      (DEN(10,IR)+ODEN10)*Z11*DELSEC)/(2.0+DELSEC*(1.66362E-9
2      +Y11))
    ODEN12=DEN(12,IR)
    DEN(12,IR)=(DEN(12,IR)*(2.0-DELSEC*Y12)+(DEN(11,IR)+ODEN11)*
1      Z12*DELSEC)/(2.0+DELSEC*Y12)
    ODEN13=DEN(13,IR)
    XYZ=(DEN(1,IR)+ODEN1)*Y131/2.0+(DEN(3,IR)+ODEN3)*Y132/2.0+
1      (DEN(5,IR)+ODEN5)*Y133/2.0+(DEN(7,IR)+ODEN7)*Y134/2.0+
2      (DEN(9,IR)+ODEN9)*Y135/2.0+(DEN(11,IR)+ODEN11)*Y136/2.0+
3      (DEN(2,IR)+ODEN2)*(Z2-Z4)/2.0+(DEN(4,IR)+ODEN4)*(X4-Z5)/2.0+
4      (DEN(6,IR)+ODEN6)*(Y6-X6)/2.0+(DEN(8,IR)+ODEN8)*(Y8-Z10)/2.0+
5      (DEN(10,IR)+ODEN10)*(X10-Z11)/2.0+(DEN(12,IR)+ODEN12)*(Y12-
6      X12)/2.0
    XYZT=(DEN(3,IR)+ODEN3)*Y132/2.0+(DEN(5,IR)+ODEN5)*Y133/2.0+
1      (DEN(9,IR)+ODEN9)*Y135/2.0+(DEN(11,IR)+ODEN11)*Y136/2.0

```

```

ZF1=(DEN(3,IR)+ODEN3)*Y132*.5/XYZT
ZF2=(DEN(5,IR)+ODEN5)*Y133*.5/XYZT
ZF3=(DEN(9,IR)+ODEN9)*Y135*.5/XYZT
ZF4=(DEN(11,IR)+ODEN11)*Y136*.5/XYZT
IF (JNN-JNUM) 124,120,120
120 WRITE OUTPUT TAPE NI,2,IR,ZF1,ZF2,ZF3,ZF4
124 CONTINUE
DO 125 K=1,3
123 KX=NY(K,IR)
125 YT(K)=YIELD1(KX)*ZF1+YIELD2(KX)*ZF2+YIELD3(KX)*ZF3+YIELD4(KX)*ZF4
DEN(13,IR)=ODEN13+YT(1)*DELSEC*XYZ
DEN(14,IR)=YT(2)*XYZ/(RPXE+2.1E-5+Y14)
DEN(15,IR)=YT(3)*XYZ/Y15
DEN100(IR)=YT(2)*XYZ/2.87E-5
IF(N0(IR))210,210,200
200 NK=16
NL=15+N0(IR)
DO 205 L=NK,NL
IL=NHOT(L,IR)
ILA=NHOT(L-1,IR)
Y16=0.0
Y16A=0.0
Z16=0.0
DO 116 IE=1,N26
Y16A=Y16A+RPHIAV(IE,IR)*ABSIG(IE,ILA)*SS(IL,L-1,IR)
116 Y16=Y16+RPHIAV(IE,IR)*ABSIG(IE,IL)*SS(IE,L,IR)
K=L-15
KFU=NX(K,IR)
YT(K)=YIELD1(KFU)*ZF1+YIELD2(KFU)*ZF2+YIELD3(KFU)*ZF3+YIELD4(KFU)*ZF4
ODEN(K)=DEN(L,IR)
SPLAT=(YT(K)*XYZ+.5*(DEN(L-1,IR)+ODEN(K-1))*Y16A*DIRAC(KFU))/Y16
205 DEN(L,IR)=SPLAT+(DEN(L,IR)-SPLAT)*EXPF(-Y16*DELSEC)
210 CONTINUE
IF(NLUM(IR)) 230,230,220
220 VK=16+N0(IR)
NL=15+N0(IR)+NLUM(IR)
CALL LUMP
DO 225 L=NK,NL
IL=NHOT(L,IR)
Y17=0.0
DO 117 IE=1,N26
117 Y17=Y17+RPHIAV(IE,IR)*ABSIG(IE,IL)*SS(IE,L,IR)
225 DEN(L,IR)=DEN(L,IR)*EXPF(-Y17*DELSEC)
230 CONTINUE
XXX=(.292794E-6*DEN(2,IR)+Z5*DEN(4,IR)+.344316E-5*DEN(8,IR)+Z11*
1 DEN(10,IR))*V0L(IR)
YYY=(DEN(3,IR)*Y3+DEN(5,IR)*Y5+DEN(7,IR)*Y9+DEN(11,IR)*Y11+
1 DEN(2,IR)*Y2*(.292794E-6/(.292794E-6+Y2))+DEN(8,IR)*Y8*
2 (.344316E-5/(.344316E-5+Y8)))*V0L(IR)
XXP=XXP+XXX
YYP=YYP+YYY
IF(XXX-1.0E+10) 250,240,240
240 XXX=0.0
GO TO 270
250 IF(YYY-1.0E-25) 260,260,270
260 YYY=0.0
XXX=0.0

```

```
210 CONTINUE
   CR(IR)=XXX/YYY
   900 IF (IR-N20) 30,1000,1000
  1000 IF (JNN-JNUM) 25,1001,1001
  1001 CONTINUE
  1200 CRT=XXP/YYP
      WRITE OUTPUT TAPE NT,3
      WRITE OUTPUT TAPE NT,4,(IR,CR(IR),VOL(IR),IR=1,N20)
      WRITE OUTPUT TAPE NT,5,CRT,VOLUME
      RETURN
      END
```

SUBROUTINE ABSPHI

```

C
C   COMPUTES ABSOLUTE FLUXES
C
C   .....
C   COMMON AND DIMENSION CARDS OMITTED. THEY SHOULD BE IDENTICAL TO
C   THOSE IN MAIN PROGRAM.
C   .....
C
      DO 300 IE=1,N26
      FISCO(IE)=0.0
      DO 290 I=1,N71
      IR=NBURN(I)
      FISMAL(IE,IR)=0.0
      DO 280 L=1,12
      IL=NHOT(L,IR)
      FISMAL(IE,IR)=FISMAL(IE,IR)+DEN(L,IR)*(FISIG(IE,IL)/XNU(IE,IL))*
X      SS(IE,L,IR)
280  CONTINUE
      FISCO(IE)=FISCO(IE)+FISMAL(IE,IR)*VFREG(IR)
290  CONTINUE
300  CONTINUE
350  CONTINUE
360  CONTINUE
      DENOM=0.0
      DO 400 IE=1,N26
400  DENOM=DENOM+RPHI(IE)*FISCO(IE)
      FUNC=FIWATT*POWER/(VOLUME*DENOM)*1.0E-24
450  DO 470 IE=1,N26
      RPHI(IE)=FUNC*RPHI(IE)
      DO 460 IR=1,N20
      RPHIAV(IE,IR)=FUNC*RPHIAV(IE,IR)
460  CONTINUE
470  CONTINUE
      RETURN
      END

```

SUBROUTINE CRPULL

```

C
C   CONTROL ROD POISON CONCENTRATION ADJUSTMENT
C
C   .....
C   COMMON AND DIMENSION CARDS OMITTED. THEY SHOULD BE IDENTICAL TO
C   THOSE IN MAIN PROGRAM.
C   .....
C
99  FORMAT (52H1 ALL CONTROL REGIONS SPECIFIED HAVE BEEN ADJUSTED )
361 FORMAT (46H1 SOUP UP CONTROL POISON OR TRY BOMB BUSINESS )
    SERK2=REACT(2)
    IF (NBUMP-3) 1000,7,1000
1000 IF (NBUMP-1) 10,1,2
    1 IF (DELK) 507,10,10
    2 IF (DELK) 10,10,7
    7 JS=0
    KSIM=JSIM+1
    JSIM=KSIM-1+LSIM
    GO TO 10
507 JS=0
    JSIM=KSIM-1
    KSIM=JSIM+1-LSIM
    IF (KSIM) 360,360,10
10  DO 200 IRR=KSIM,JSIM
    IR=NP0IS(IRR)
    XMIN=PINMIN(IRR)
    XMAX=PINMAX(IRR)
    IF (IR) 350,350,14
14  IF(JS) 20,20,15
15  ADJ=(ZKFIND-SERK2)/(SERK1-SERK2)
20  CONTINUE
    NK=16+N0(IR)+NLUM(IR)
    NL=15+N0(IR)+NLUM(IR)+NC(IR)
    DO 150 L=NK,NL
    K=L-N0(IR)-NLUM(IR)-15
28  IF(JS) 40,40,30
30  CONTINUE
    P0IS2(K,IR)=ADJ*(P0IS1(K,IR)-P0IS2(K,IR))+P0IS2(K,IR)
    P0IS1(K,IR)=DEN(L,IR)
    DEN(L,IR)=P0IS2(K,IR)
    GO TO 100
40  CONTINUE
    P0IS1(K,IR)=DEN(L,IR)
    P0IS2(K,IR)=P0IS1(K,IR)*(XMAX+XMIN)/2.0
    IF (P0IS2(K,IR)-P0IS1(K,IR)) 50,45,50
45  P0IS2(K,IR)=((XMAX-XMIN)*.75+XMIN)*P0IS1(K,IR)
50  CONTINUE
    DEN(L,IR)=P0IS2(K,IR)
100 CONTINUE
    IF (P0IS2(K,IR)-P0IS1(K,IR)*XMAX) 110,105,105
105 P0IS2(K,IR)=P0IS1(K,IR)*XMAX
    NBUMP=1
    GO TO 120
110 IF (P0IS1(K,IR)*XMIN-P0IS2(K,IR)) 130,115,115
115 P0IS2(K,IR)=P0IS1(K,IR)*XMIN
    NBUMP=2
120 CONTINUE

```

```
      GO TO 131
130 LBUMP=3
131 DEN(L,IR)=POIS2(K,IR)
150 CONTINUE
200 CONTINUE
      IF(LBUMP-3) 300,240,300
240 NBUMP=0
      LBUMP=0
300 JS=JS+1
      SERK1=SERK2
      JSS=JSS+1
400 RETURN
350 NSWIT=1
      WRITE OUTPUT TAPE NT,99
560 RETURN
360 NSWIT=1
      WRITE OUTPUT TAPE NT,361
      GO TO 560
      END
```

SUBROUTINE EXTRA

```

C
C   ADJUSTS XENON AND CONTROL POISON ATOMIC DENSITIES AND MAKES
C   APPROPRIATE EXITS TO COMPUTE MAXIMUM HOT K-EFF WITHOUT
C   CONTROL POISON, AND COLD SHUTDOWN K-EFF WITHOUT XENON AND
C   CONTROL POISON FULLY INSERTED
C   ALSO DOES XENON OVERRIDE CALCULATION
C
C   .....
C   COMMON AND DIMENSION CARDS OMITTED. THEY SHOULD BE IDENTICAL TO
C   THOSE IN MAIN PROGRAM.
C   .....
C
1  FORMAT (12H1 TIME STEP 14///)
2  FORMAT(36H HOT REACTOR WITHOUT CONTROL POISON 14X10H,K-EFF = 1PE
  X11.5//)
3  FORMAT (60H0 COLD REACTOR,NO XL AND ALL CONTROL RODS FULLY IN,K-EF
  XF = 1PE11.5 //)
4  FORMAT (31H0 (BETTER KEEP THIS THING WARM) //)
301 FORMAT (27H0XENON OVERRIDE CALCULATION //
  X      23H HOURS DOWN HOT MAX K //)
    IF (NSPEC) 5,5,7
    7 IF (NSHUFL-2) 215,6,215
    5 CONTINUE
    6 ZJN=JN
C
C   HOT MAXIMUM K-EFFECTIVE
C
    DO 30 IR=1,N20
      IF (NC(IR)) 30,30,10
10   VK=16+N0(IR)+NLUM(IR)
      NL=15+N0(IR)+NLUM(IR)+NC(IR)
      DO 20 L=NK,NL
        K=L-N0(IR)-NLUM(IR)-15
        POIS1(K,IR)=DEN(L,IR)
20   DEN(L,IR)=POISM(K,IR)
30   CONTINUE
      ICE=1
      CALL D0GWRK
      CALL DCALC
      WRITE OUTPUT TAPE NT,1,JN
      WRITE OUTPUT TAPE NT,2,REACT(2)
      SPEC=REACT(2)
299 IF (NSHUFL-2) 400,300,400
300 IF (JN-NDOW) 400,304,304
304 NDOW=NDOW+NXXX
      DTIME=0.0
      WRITE OUTPUT TAPE NT,301
      XJINT=JINT
      TDOWN=XDOWN*3.6E+3/XJINT
305 CALL DECAY
      CALL D0GWRK
      CALL DCALC
      DTIME=DTIME+TDOWN/3.6E+3
      WRITE OUTPUT TAPE NT,302,DTIME,REACT(2)
302 FORMAT (1P2E12.5)
      IF (DTIME-XDOWN) 305,400,400
400 CONTINUE

```



```

35 DO 60 IR=1,N20
   IF (NC(IR)) 60,60,40
40 VK=16+N0(IR)+NLUM(IR)
   NL=15+N0(IR)+NLUM(IR)+NC(IR)
   DO 50 L=NK,NL
   K=L-N0(IR)-NLUM(IR)-15
50 DEN(L,IR)=POISI(K,IR)
60 CONTINUE
   IF (NSPEC) 65,65,215
C
C   COLD SHUTDOWN K-EFFECTIVE
C
65 DO 90 IR=1,N20
   XENON(IR)=DEN(14,IR)
   DEN(14,IR)=0.0
   IF (NC(IR)) 90,90,70
70 VK=16+N0(IR)+NLUM(IR)
   NL=15+N0(IR)+NLUM(IR)+NC(IR)
   DO 80 L=NK,NL
   K=L-N0(IR)-NLUM(IR)-15
   POISI(K,IR)=DEN(L,IR)
80 DEN(L,IR)=POISI(K,IR)
90 CONTINUE
   ICE=2
   CALL D0GWRK
   DO 120 IR=1,N20
   DEN(14,IR)=XENON(IR)
   IF (NC(IR)) 120,120,100
100 VK=16+N0(IR)+NLUM(IR)
   NL=15+N0(IR)+NLUM(IR)+NC(IR)
   DO 110 L=NK,NL
   K=L-N0(IR)-NLUM(IR)-15
110 DEN(L,IR)=POISI(K,IR)
120 CONTINUE
   CALL DCALC
   WRITE OUTPUT TAPE NT,3,REACT(2)
   ICE=0
   IF (REACT(2)-1.0) 210,200,200
200 WRITE OUTPUT TAPE NT,4
210 CONTINUE
C
C   STORE FOR PLOT AT END OF RUN
C
   IF (JSPEC-50) 211,211,215
211 JSPLC=JSPEC+1
   IF (ZJN) 212,213,213
212 ZJN=0.0
213 CONTINUE
   TIME(JSPEC)=ZJN*DELDAY
   SPECK(JSPEC)=SPEC
   JSPEC=JSPEC+1
   TIME(JSPEC)=TIME(JSPEC-1)
   SPECK(JSPEC)=REACT(2)
215 CONTINUE
   RETURN
   END

```

SUBROUTINE SYNOPS

```

C
C   STORES SYNOPSIS OF CASE HISTORY AND PRINTS OUT AT END OF RUN
C
C   .....
C   COMMON AND DIMENSION CARDS OMITTED. THEY SHOULD BE IDENTICAL TO
C   THOSE IN MAIN PROGRAM.
C   .....
C
501 FORMAT (1H ////)
502 FORMAT (120H TIME          HOT MAX      SHUTDOWN      MAX/AVRG      MAX CONV
X     X      TH 232          U 233          U 235          PU 239          PU 241
X     /120H STEP      K-EFFECTIVE COLD K-EFF      POWER      PT.      RA
XTIO      (GRAMS)      (GRAMS)      (GRAMS)      (GRAMS)      (GRAMS)
X //)
503 FORMAT (15,1PE13.4,1P2E12.4,15,1P6E12.4)
504 FORMAT (46H1          TIME STEP REGION      INSERTION FRACTION //)
505 FORMAT (114,19,1PE19.4)
506 FORMAT (1H /)
      IF (NSYN) 10,10,500
10  CALL RESTAR
      IF (NXE) 15,15,16
15  JX=JN+2
      GO TO 19
16  JX=JN+1
19  CONTINUE
      ZJN=JN
      IF (ZJN) 17,17,18
17  ZJN=0.0
18  JXK=JN*2+3
      IF (NSPEC) 20,20,21
21  CONTINUE
      IF (NXE) 24,24,22
22  JXK=JXK-2
24  SPECK(JXK)=REACT(2)
      TIME(JXK)=ZJN*DELDAY
      JSPEC=JXK
20  DO 30 IR=1,N20
30  DIP(JX,IR)=CFRAC(1,IR)
      PMAX=0.0
      DO 35 IP=1,N28
      IF (PMAX-DENSM(IP)) 31,31,32
31  PMAX=DENSM(IP)
      IPS=IP
32  CONTINUE
35  CONTINUE
      IF (JX-25) 37,37,40
37  STORE(2,JX)=CKT
      STORE(3,JX)=GS(1)
      STORE(4,JX)=GS(3)
      STORE(5,JX)=GS(5)
      STORE(6,JX)=GS(9)
      STORE(7,JX)=GS(11)
      IF (NSYN) 40,36,36
36  CONTINUE
      STORE(1,JX)=PMAX*CORE/REACT(2)
      NSTO(JX)=IPS
40  RETURN

```

```

500 CONTINUE
    NQUIT=NQUIT+1
    IF (NQUIT-3) 511,511,650
511 CONTINUE
510 CALL HEAD(2)
    WRITE OUTPUT TAPE NT,502
    DO 600 J=1,JX
        JJ=2*J-2
        IF (NXE) 515,515,516
515 JTIME=J-2
        GO TO 520
516 JTIME=J-1
520 CONTINUE
    WRITE OUTPUT TAPE NT,503,JTIME,SPECK(JJ+1),SPECK(JJ+2),
X      STORE(L,J),NST0(J),(STORE(L,J),L=2,7)
600 CONTINUE
    IF (JSER) 610,610,500
610 WRITE OUTPUT TAPE NT,504
    IPAGE=0
    JY=JX-1
    DO 620 J=1,JY
        WRITE OUTPUT TAPE NT,506
        IPAGE=IPAGE+1
        IF (IPAGE-48) 606,605,605
605 IPAGE=0
        WRITE OUTPUT TAPE NT,504
606 CONTINUE
        IF (NXE) 608,608,607
607 JTIME=J-1
        GO TO 609
608 JTIME=J-2
609 CONTINUE
        DO 615 IR=1,N20
            IF (NC(IR)) 615,615,611
611 WRITE OUTPUT TAPE NT,505,JTIME,IR,DIP(J,IR)
            IPAGE=IPAGE+1
615 CONTINUE
620 CONTINUE
    GO TO 500
650 RETURN
    END

```

SUBROUTINE FINAL

```

C
C   PREPARES TO TERMINATE CASE
C
C   .....
C   COMMON AND DIMENSION CARDS OMITTED. THEY SHOULD BE IDENTICAL TO
C   THOSE IN MAIN PROGRAM.
C   .....
C
C   DIMENSION YDEN(20)
90  FORMAT(1H0 15X 49H K-EFFECTIVE VS TIME (MAX HOT AND COLD SHUTDOWN)
X )
91  FORMAT (17H1 CASE COMPLETED /1H1)
92  FORMAT(1H0 15X 4H U23 11,40H CONCENTRATION VS POSITION AT TIME STE
XP 13)
    IF (JSER-1) 2,4,100
2   IF (JS-JSMAX) 1,3,3
1   IF (JSS-JSSMAX) 4,3,3
3   CALL DENOUT
    CALL DPRIN
    CALL AVRAGE
4   CONTINUE

C
C   CALL EXTRA
    NSYN=-1
    CALL SYNOPS
    IF (NPL0T) 50,50,95
50  CONTINUE
60  CALL HEAD(2)
    WRITE OUTPUT TAPE NT,90
    CALL PLOT (TIME,SPECK,JSPEC,100,40,NT)
    DO 80 L=3,5,2
    DO 70 IR=1,N20
70  YDEN(IR)=DEN(L,IR)
    CALL HEAD(2)
    WRITE OUTPUT TAPE NT,92,L,JN
    CALL PLOT (RADR,YDEN,N20,100,40,NT)
80  CONTINUE
95  CONTINUE
    NSYN=1
    CALL SYNOPS
    IF (NSHUFL-1) 100,217,100
217 CALL SHUFL
    GO TO 5
100 CONTINUE
    WRITE OUTPUT TAPE NT,91
200 CONTINUE
250 CONTINUE
5   RETURN
    END

```

SUBROUTINE RESTAR

```

C
C   PUNCHES OUT ATOM DENSITIES FOR USE IN CONTINUATION CASE
C
C   .....
C   COMMON AND DIMENSION CARDS OMITTED. THEY SHOULD BE IDENTICAL TO
C   THOSE IN MAIN PROGRAM.
C   .....
C
1  FORMAT (1H )
2  FORMAT (3I4,1P5E12.5,12,2I3)
   IF (NRSTRT) 25,25,5
5  IF (JN-NRSTRT) 25,6,6
6  DO 20 IR=1,N20
   MATERS=NMAT(IR)
   DO 10 L=1,MATERS
10  PUNCH 2,L,NHOT(L,IR),NCOL(L,IR),DEN(L,IR),(SS(IE,L,IR),IE=1,4),
     X      JN,IR,L
   PUNCH 1
20  CONTINUE
25  RETURN
   END

```

SUBROUTINE DECAY

```

C
C   DEPLETION AND BUILDUP BY RADIOACTIVE DECAY
C
C   .....
C   COMMON AND DIMENSION CARDS OMITTED. THEY SHOULD BE IDENTICAL TO
C   THOSE IN MAIN PROGRAM.
C   .....
C
24 DO 100 IR=1,N20
  DEN(14,IR)=(DEN(14,IR)-3.72727*DENI0D(IR)          *(EXP(-.77E-5*
X      TD0WN)-1.0))*EXP(-2.1E-5*TD0WN)
  DENI0D(IR)=DENI0D(IR)*EXP(-2.87E-5*TD0WN)
  DEN(3,IR)=DEN(3,IR)+DEN(2,IR)*(1.0-EXP(-TD0WN*.292794E-6))
  DEN(9,IR)=DEN(9,IR)+DEN(8,IR)*(1.0-EXP(-TD0WN*.344316E-5))
  DEN(2,IR)=DEN(2,IR)*EXP(-TD0WN*.292794E-6)
  DEN(8,IR)=DEN(8,IR)*EXP(-TD0WN*.344316E-5)
100 CONTINUE
  RETURN
  END

```

SUBROUTINE SHUFL

```

C
C   READS DATA FOR SHUTDOWN-STARTUP OPERATION AND ACCOUNTS FOR
C   RADIOACTIVE DECAY OF CERTAIN ISOTOPES DURING SHUTDOWN TIME
C
C   .....
C   COMMON AND DIMENSION CARDS OMITTED. THEY SHOULD BE IDENTICAL TO
C   THOSE IN MAIN PROGRAM.
C   .....
C
1  FORMAT (36H1  SHUTDOWN-STARTUP OPERATION OCCURS //)
2  FORMAT (3E12.4,2I4)
3  FORMAT (19H NEW OPERATING DATA //
X      25H DOWN TIME(HOURS)----- =1PE12.5/
X      25H NEW POWER(WATTS)----- =E12.5/
X      25H BURNUP TIME STEP(DAYS) =E12.5/
X      25H FINAL TIME STEP NUMBER =I6)
      IF (NSHUFL-1) 100,10,100
10 NSH=NSHUFL
      CALL INIT
      WRITE OUTPUT TAPE NT,1
      READ INPUT TAPE NS,2,XDOWN,POWER,DELDAY,JNSTOP,NSHUFL
      WRITE OUTPUT TAPE NT,3,XDOWN,POWER,DELDAY,JNSTOP
      TDOWN=XDOWN*3.6E+3
      CALL DECAY
100 RETURN
      END

```

SUBROUTINE BAL

```

C
C      NEUTRON BALANCE CALCULATION AND PRINT
C
C      AB(IE)          INTERNAL VARIABLE REFERING TO VOLUME AND FLUX
C                      AVERAGED MACROSCOPIC ABSORPTION OF GROUP (IE)
C      AM(IE)          INTERNAL VARIABLE REFERING TO VOLUME AND FLUX
C                      AVERAGED MACROSCOPIC ABSORPTION OF GROUP (IE)
C                      AND EACH MATERIAL
C      BUK(IE)         NORMAL BUCKLING COMPUTED FROM NEUTRON BALANCE
C      DEE(IE)         AVERAGE DIFFUSION COEFF
C      ZLEAK1(IE)      INTERNAL VARIABLE REFERING TO AVERAGE TRANSVERSE
C                      LEAKAGE
C      ZLEAK2(IE)      INTERNAL VARIABLE REFERING TO AVERAGE NORMAL
C                      LEAKAGE
C      PK(IE)          INTERNAL VARIABLE REFERING TO AVERAGE NEUTRON
C                      PRODUCTION GROUP (IE)
C      SIGL2(IE)       NORMAL LEAKAGE CROSS SECTION COMPUTED FROM
C                      NEUTRON BALANCE
C      PM(IE)          INTERNAL VARIABLE REFERING TO AVERAGE NEUTRON
C                      PRODUCTION GROUP (IE) FOR EACH MATERIAL
C      SIN(IE)         SOURCE IN EACH GROUP PER INITIAL SOURCE NEUTRON
C      SOUT(IE)        OUT SCATTERING PER SOURCE NEUTRON FOR EACH GROUP
C      PKT             TOTAL NEUTRON PRODUCTION (NU*SIGMAFISSION)
C      SUMA            TOTAL NEUTRON ABSORPTION
C      SUMAB           TOTAL NEUTRON ABSORPTION PER SOURCE NEUTRON
C      SUML1           TOTAL TRANSVERSE LEAKAGE PER SOURCE NEUTRON
C      SUML2           TOTAL NORMAL LEAKAGE PER SOURCE NEUTRON
C      PT             TOTAL NEUTRON PRODUCTION /K (NU*SIGMAFISSION/K)
C
C      .....
C      COMMON AND DIMENSION CARDS OMITTED. THEY SHOULD BE IDENTICAL TO
C      THOSE IN MAIN PROGRAM.
C      .....
C
C      DIMENSION
C      1AB(4),AM(4),BUK(4),DEE(4),ZLEAK1(4),ZLEAK2(4),PK(4),PM(4),SIGL2(4)
C      2,SIN(5),SOUT(4)
C 10 FORMAT (10H0TIME STEP 13,45X,13H K-EFFECTIVE= 1PE12.5/////
C      X          14X 34HNEUTRON BALANCE PER SOURCE NEUTRON 36X 14HNORMAL
C      1 LEAKAGE/// 64H GROUP ABSORPTION TRANSVERSE SCATTERING SOURCE
C      2E          NORMAL 19X 18HCROSS BUCKLING/ 22X 16HLEAKAGE OUT
C      319X 7HLEAKAGE 18X 7HSECTION// 4(I4,1PE14.4,1P4E12.4,1PE24.
C      44,1PE12.4//)
C 11 FORMAT(23X 23H FRACTIONAL ABSORPTIONS 36X 23H FRACTIONAL PRODUCTION
C      1NS//118HOMATERIAL GROUP 1 GROUP 2 GROUP 3 GROUP 4 A
C      2LL GROUPS GROUP 1 GROUP 2 GROUP 3 GROUP 4 //)
C 12 FORMAT(I4,2X,1P5E12.4,4X,4E12.4)
C 13 FORMAT ( 6H TOTAL 1P2E12.4,1PE36.4/////////)
C      PKT=0.0
C      SUMA=0.0
C      SUMAB=0.0
C      SUML1=0.0
C      SUML2=0.0
C      DO 2 IE=1,N26
C      AB(IE)=0.0
C      PK(IE)=0.0
C      SOUT(IE)=0.0

```



```

ZLEAK1(IE)=0.0
DEE(IE)=0.0
DO 1 I=1,N71
  IR=NBURN(I)
  AB(IE)=AB(IE)+SIGA(IE,IR)*RPHIAV(IE,IR)*VOL(IR)
  PK(IE)=PK(IE)+TRIC(IE,IR)*RPHIAV(IE,IR)*VOL(IR)
  SOUT(IE)=SOUT(IE)+SIGS(IE,IR)*RPHIAV(IE,IR)*VOL(IR)
  ZLEAK1(IE)=ZLEAK1(IE)+DIFL(IE,IR)*TRANS(IE,IR)*RPHIAV(IE,IR)*
  IVOL(IR)
  DEE(IE)=DEE(IE)+DIFL(IE,IR)*RPHIAV(IE,IR)*VOL(IR)
1 CONTINUE
  PKT=PKT+PK(IE)
  SUMA=SUMA+AB(IE)
  DEE(IE)=DEE(IE)/(RPHI(IE)*VOLUME)
2 CONTINUE
  PT=PKT/REACT(2)
  SIN(1)=1.0
  DO 3 IE=1,N26
    AB(IE)=AB(IE)/PT
    SOUT(IE)=SOUT(IE)/PT
    ZLEAK1(IE)=ZLEAK1(IE)/PT
    ZLEAK2(IE)=SIN(IE)-AB(IE)-SOUT(IE)-ZLEAK1(IE)
    SUMAB=SUMAB+AB(IE)
    SUML1=SUML1+ZLEAK1(IE)
    SUML2=SUML2+ZLEAK2(IE)
    SIGL2(IE)=ZLEAK2(IE)*PT/(RPHI(IE)*VOLUME)
    BUK(IE)=SIGL2(IE)/DEE(IE)
    SIN(IE+1)=SOUT(IE)
3 CONTINUE
  CALL HEAD(2)
  WRITE OUTPUT TAPE NT,10,JN,REACT(2),
X      (IE,AB(IE),ZLEAK1(IE),SOUT(IE),SIN(IE),
1ZLEAK2(IE),SIGL2(IE),BUK(IE),IE=1,N26)
  WRITE OUTPUT TAPE NT,13,          SUMAB,SUML1,SUML2
  WRITE OUTPUT TAPE NT,11
  DO 7 L=1,25
    DO 6 IE=1,N26
      AM(IE)=0.0
      PM(IE)=0.0
    DO 5 I =1,N71
      IR=NBURN(I)
      MATERS=NMAT(IR)
      IF(L-MATERS)4,4,5
4 CONTINUE
      IL=NHOT(L,IR)
      DENKZ=DEN(L,IR)*SS(IE,L,IR)*RPHIAV(IE,IR)*VOL(IR)
      AM(IE)=AM(IE)+DENKZ*ABSIG(IE,IL)
      PM(IE)=PM(IE)+DENKZ*FISIG(IE,IL)
5 CONTINUE
      AM(IE)=AM(IE)/SUMA
      PM(IE)=PM(IE)/PKT
6 CONTINUE
      AMT=AM(1)+AM(2)+AM(3)+AM(4)
      WRITE OUTPUT TAPE NT,12,L,(AM(IE), IE=1,4),AMT,(PM(IE), IE=1,4)
7 CONTINUE
  RETURN
END

```

```

SUBROUTINE PLOT(X,Y,N,N1,N2,NOUT)
DIMENSION X(1),Y(1),IP(150),B(6),A(18),NB(6),NA(18)
EQUIVALENCE (A,NA),(B,NB),(C,NC),(D,ND)
C   X=ABSCISSA VALUES TO BE PLOTTED
C   Y=ORDINATE VALUES TO BE PLOTTED
C   N=NUMBER OF POINTS TO BE PLOTTED (150 OR LESS)
C   N1=NUMBER OF PRINT WHEELS TO BE USED (108 OR LESS)
C   N2=NUMBER OF LINES TO BE USED (RECOMMEND 50)
C   NOUT=TAPE NO. OF OUTPUT TAPE
C   RESTORATION AND HEADING OF PAGE IS LEFT TO USER
B   B(1)=040000000000
B   B(2)=000400000000
B   B(3)=000004000000
B   B(4)=000000040000
B   B(5)=000000000400
B   B(6)=000000000004
B   C=606060606060
B   D=404040404040
C   INITIALIZES FORMAT
DO 9 L=1,18
9   A(L)=C
C   SEARCHES X POINTS FOR HIGHEST AND LOWEST VALUES
XMIN=1.E+35
XMAX=-1.E-35
YMIN=1.E+35
YMAX=-1.E-35
DO 10 I=1,N
YMAX=MAX1F(YMAX,Y(I))
YMIN=MIN1F(YMIN,Y(I))
XMAX=MAX1F(XMAX,X(I))
10  XMIN=MIN1F(XMIN,X(I))
DELTAX=(XMAX-XMIN)/(FLOAT(N1-1))
DELTAY=(YMAX-YMIN)/(FLOAT(N2-1))
DELT=YMAX
C   REORDERS Y INTO DESCENDING VALUES
DO 25 I=1,N
IP(I)=0
21  DO 24 IL=1,N
IF(YMAX-Y(IL))22,22,24
22  DO 23 IK=1,I
IF(IL-IP(IK))23,24,23
23  CONTINUE
IP(I)=IL
GO TO 25
24  CONTINUE
YMAX=YMAX-DELTAY
GO TO 21
25  CONTINUE
C   PLOTTING SECTION
DO 41 K=1,N
I=IP(K)
J=IP(K+1)
IF(K-1)33,33,30
30  IF(L)31,31,33
31  DELT=DELT-DELTAY
IF(Y(I)-DELT)32,33,33
C   PRINTS BLANK LINES
32  L=-1

```

```

      GO TO 37
C     PRINT WHEEL POSITION (0,1,2,3....N1-1)
33  NPWP=(X(I)-XMIN)/DELTAX
C     SECTOR(1,2,3,4,5....N1/6+1)
      NSECT=(NPWP/6)+1
C     POSITION IN SECTOR(1,2,3,4,5,6)
      NF=XMODF(NPWP,6)+1
C     PLACES * IN FORMAT
      NA(NSECT)=NA(NSECT)+NB(NF)
      IF(K-N)34,36,36
C     REPEATS IF Y(I) AND Y(J) ARE CLOSER THAN DELTAY
34  IF(Y(J)-DELT)36,35,35
35  L=1
      GO TO 41
36  L=0
C     PRINTING ROUTINE
37  CONTINUE
      WRITE OUTPUT TAPE NOUT,38,DELT,(A(IL),IL=1,18)
38  FORMAT(1PE11.4,1H1,18A6)
      IF(L)31,39,39
C     RESTORES FORMAT
39  DO 40 IL=1,18
40  A(IL)=C
41  CONTINUE
C     DRAWS BOTTOM AXIS
      DO 42 I=1,18
42  A(I)=D
      WRITE OUTPUT TAPE NOUT,43,(A(I),I=1,18)
43  FORMAT(12X,18A6)
C     RESTORES A ARRAY TO BLANKS
      DO 44 I=1,18
44  A(I)=C
C     SETS UP * EVERY 10 PLACES FOR LOWER AXIS
      DO 45 I=2,12,5
        NA(I)=NA(I)+NB(4)
        NA(I+2)=NA(I+2)+NB(2)
45  NA(I+3)=NA(I+3)+NB(6)
        NA(17)=NA(17)+NB(4)
        NA(1)=NA(1)+NB(1)
      WRITE OUTPUT TAPE NOUT,43,(A(I),I=1,18)
      DELTAX=((XMAX-XMIN)/FLOATF(N1))*10.
      DO 46 I=1,11
46  A(I)=XMIN+FLOATF(I-1)*DELTAX
      WRITE OUTPUT TAPE NOUT,47,(A(I),I=2,11)
47  FORMAT(16X,1P10E10.4)
      RETURN
      END

```

Appendix C

INPUT DATA

The input data forms which follow are as complete as possible. However, since a large amount of information is involved, some additional remarks concerning input are necessary.

C. 1. FORTRAN INPUT SYSTEM

FORTRAN reads blanks in fixed and floating formats as zeros. Therefore, all data must be pushed to the extreme right of each data field unless the blank spaces interpreted as zeros would result in the correct value being interpreted by the machine.

Fixed-point Numbers (Indicated on Input Forms by "No Decimal")

Fixed-point data must always be entered at the extreme right of the field except for zeros.

EXAMPLES

<table border="1"><tr><td></td><td></td><td>2</td><td>1</td></tr></table>			2	1	= 21	<table border="1"><tr><td></td><td></td><td></td><td></td></tr></table>					= -0
		2	1								
<table border="1"><tr><td></td><td>2</td><td>1</td><td></td></tr></table>		2	1		= 210	<table border="1"><tr><td></td><td>0</td><td></td><td></td></tr></table>		0			= 0
	2	1									
	0										
<table border="1"><tr><td>2</td><td></td><td></td><td>1</td></tr></table>	2			1	= 2001	<table border="1"><tr><td></td><td></td><td></td><td></td></tr></table>					
2			1								

Floating-point Numbers (Indicated on Input Forms by "Decimal")

There are many variations possible, but it is suggested that decimal points always be entered explicitly and that exponents be omitted whenever possible.

If floating-point numbers are entered with a decimal point and no exponent is used, they may be placed anywhere in the field.

EXAMPLES

	3	.	1	4	1	5	9				
--	---	---	---	---	---	---	---	--	--	--	--

 $= \pi$

					3	.	1	4	1	5	9
--	--	--	--	--	---	---	---	---	---	---	---

 $= \pi$

	.	0	0	0	0	1	2	3			
--	---	---	---	---	---	---	---	---	--	--	--

 $= 1.23 \times 10^{-5}$

Floating-point numbers entered with exponents must have the exponent part pushed to the extreme right of the field.

EXAMPLES

	+	3	1	4	.	1	5	9	-	0	2
--	---	---	---	---	---	---	---	---	---	---	---

 $= \pi$

	.	3	1	4	1	5	9		+	1
--	---	---	---	---	---	---	---	--	---	---

 $= \pi$

+	3	1	.	4	1	5	9		-	0	1
---	---	---	---	---	---	---	---	--	---	---	---

 $= \pi$

Signed numbers (both fixed- and floating-point) may have the sign entered any place in the field to the left of the numerals.

Any method of entering data on cards is permissible if it is known to be acceptable to a FORTRAN program. The examples above are given to aid those who are unfamiliar with the FORTRAN input, and they do not represent all possible variations.

C. 2. NOTES ON INPUT DATA

Input data for FEVER are divided into two types:

1. The cross section and miscellaneous data library.
2. Case input.

The cross-section library is a compilation of few-group cross sections (and a small amount of additional miscellaneous data), which is read in immediately after the program deck. This data ordinarily will not change from case to case and, therefore, may remain in the computer memory without modification until execution of all problems has terminated. It is also possible to read-in new library data before each succeeding case. However, it is advisable to make up a library which is as complete as possible, containing data for all materials that may be used in a series of cases. The library can then remain fixed and semipermanently attached to the program deck for a number of computer runs.

A series of cases may be run by stacking the data for a number of problems behind the cross-section library.

FEVER Cross-section and Miscellaneous Data Library

<u>Card</u>	<u>Word</u>	<u>Comments</u>
A1	2	A cross-section "block" consists of one card A4 and as many A5's as there are groups. Block numbers are assigned in the order that the cross sections are read into the machine.
A1	3	A special data "set" consists of the data on card A6. At least three of these cards must be included, one for nonsaturating fission products, one for Xe^{135} , and one for Sm^{149} . These materials are not referred to as "special" materials, but obviously require fission-yield data.
A1	4, 5, 6	Special data "sets" are numbered in the order in which these cards appear. The "set" numbers to be supplied here will apply uniformly throughout all regions, unless superseded by region data. These materials are not classed as "special" materials, but require fission-yield data, since they are fission products.
A2	1-4	Group diffusion coefficients are multiplied by this factor (usually 1.0).

<u>Card</u>	<u>Word</u>	<u>Comments</u>
A3	3	Control-poison search is satisfied when $K_{\text{eff}} - K_{\text{crit}} \leq \text{SERCON}$. Usually $K_{\text{crit}} = 1.0$ and is specified in the case input data (card 14, word 4).
A4, A5	All	A maximum of 120 cross-section blocks is permitted. See card A1, word 2.
A6	All	A maximum of 15 "special data" cards is permitted. See card A1, word 3.
A6	1	This word must always be zero when the data are associated with materials 13-16 because they can never be produced by the immediately preceding nuclide. The value must be 1.0 only when neutron captures in the immediately preceding nuclide (L-1) contribute to the production of a daughter product, material L. Parent-daughter product chains may be extended to include several materials, if desired.

FEVER Case-input Data

<u>Card</u>	<u>Word</u>	<u>Comments</u>
2	3	If lumped poisons are to be specified for the "single diffusion calculation" option, some adjustment of data on card 11 is required to obtain the correct volume of poison element relative to the region volume. To avoid this, use the "straight burnup" option and set termination time step number equal to -1. Be sure to supply cards 14 and 15 if this is done.
6	All	<u>All</u> regions containing materials having fission cross sections (even if very small) <u>must</u> be mentioned in the list. Absolute neutron-flux amplitude is normalized over the sum of the volumes of the regions given here.
7	2	Note that materials 13, 14, and 15 (nonsaturating fission products, Xe^{135} and Sm^{149}) are <u>not</u> counted as special materials.
7	5, 6	Cross-section block numbers, atomic densities, and self-shielding factors may be given by cards 8 and 9. At the beginning of each case, all atom densities are set to 0.0 and self-shielding is 1.0. A card 8 is required to supply cross-section block numbers for materials which are not present initially (i. e., have 0.0 atom densities initially). Card 9 is used for materials with nonzero atom densities

<u>Card</u>	<u>Word</u>	<u>Comments</u>
		<p>or if self-shielding is $\neq 1.0$. For the first region, the sum of cards 8 plus cards 9 must equal the <u>total number</u> of materials in the region. For the second and succeeding regions (if cross sections, atomic densities, and self-shielding factors are similar to a prior region), it is only necessary to read as many cards 8 and 9 as would be required to make minor changes in this data from a preceding region. For example, suppose that region 3 contains the same materials and concentrations as region 2, except for a single nuclide. In this case, the best way to supply the input data would be to punch a 2 in word 7 and supply one card 9 containing a different atomic density. An alternative method would be to leave word 7 blank and supply cards 8 or 9 for each nuclide to be considered in region 3.</p>
7	7, 11	<p>Proper use of this card will make it possible to reduce, by a significant amount, the number of input data cards required. Words 7 through 11 will <u>always</u> be zero for the <u>first region</u>. For the second and succeeding regions, they may contain punches indicating the region number of a previously specified region. In that case, the program uses the data from the region indicated, and it is not necessary to supply it on cards. If any of words 7 through 11 contain zeros or are blank, the program will expect to read data cards for that type of data, if the data are needed for the calculation.</p>
7	12, 13, 14	<p>These data have been specified in the FEVER data library and hold for all regions. Ordinarily, they are not spatially dependent and need not be respecified.</p>
8, 9	All	<p>Each material must be assigned a material number conforming with the following list of materials. It is not necessary to supply cards 8 and 9 in any special order according to material number, but all cards 8 for a given region must precede all cards 9 for that region. Cold cross-section block numbers may be omitted if no cold calculations are to be performed.</p> <p>Note that materials numbered 1-15 are <u>always required</u>. Materials numbered 16 and greater must be given the next larger available material number.</p>

Examples:

1. The second special material would be assigned material number 17.
2. If there are no special materials, material number 16 would be assigned to the first lumped poison.
3. If there are two special materials, one lumped material, one control poison, and 2 nonburnable materials, the second nonburnable material would be assigned material number 21.

<u>Material Number</u>	<u>Material</u>	<u>Number Required in Each Region of the Case</u>
1	Th ²³²	1
2	Pa ²³³	1
3	U ²³³	1
4	U ²³⁴	1
5	U ²³⁵	1
6	U ²³⁶	1
7	U ²³⁸	1
8	Np ²³⁹	1
9	Pu ²³⁹	1
10	Pu ²⁴⁰	1
11	Pu ²⁴¹	1
12	Pu ²⁴²	1
13	Nonsaturating fission- product aggregate	1
14	Xe ¹³⁵	1
15	Sm ¹⁴⁹	1
16 ...	Special materials	0-10
. . . .	Lumped poisons	0-4
. . . .	Control poisons	0-4
. . . .	Nonburnable	1-10

Note: A maximum of 25 materials may be used in any single region.

<u>Card</u>	<u>Word</u>	<u>Comments</u>
10	All	One card 10 must be supplied for a region containing materials defined as "special" materials if data are not the same as a preceding region.
11	All	Geometry of a poison lump is assumed to be a cylinder, extending in the axial direction of a cylindrical reactor. For other lump geometries, it is only necessary to supply dimensions which will give an equivalent volume. One of these cards must be supplied for each material defined as lumped poison. It is not necessary to supply atomic densities for lumped poisons because these are computed from the value of word 6 (g/cm^3). Therefore, use card 8 for lumped poisons. Noninteger numbers of lumped poison rods may be used. These cards may be omitted if data are the same as in a previous region.
12	All	A set of cards 12 (one for each group) follows immediately after each card 11 in order from highest to lowest energy group. If cold multiplication is to be calculated, two additional cards are required for the cold self-shielding coefficients of the lowest two groups.
13	All	One card 13 must be supplied for each material defined as control poison in a region. The program uses these minimum and maximum atom densities to compute hot maximum and cold shutdown multiplication. These cards may be omitted if data are the same as in a previous region.
14	3	Core height for radial case; Core radius for axial case.
14	4	Control point multiplication for control search case (usually 1.0); shutdown multiplication for straight burnup case (usually 1.0).
14	6	A constant to allow for the physical leakage of xenon gas from the core.
15	1, 2	A large time step is the time interval specified on card 13, word 1. Burnup is actually calculated in a series of smaller steps to improve the accuracy of the finite difference equations.
16	1, 2	Program execution is terminated if these values are exceeded.
16	3	This value may be as small as 1 or as large as the total number of regions containing control poisons.
16	4	A list of control-region numbers is to be given immediately following. This number indicates the length of the list.

<u>Card</u>	<u>Word</u>	<u>Comments</u>
		Any region may be mentioned in the list as often as desired and is counted each time it is mentioned.
16	5	A maximum of 50 entries can be made; continue list on succeeding cards, if necessary.
17, 18	All	<p>One minimum and one maximum control-rod insertion fraction must be supplied for <u>each</u> entry in the list of regions given in card 16. (Minimum and maximum must never be identical.) In most cases, the <u>first</u> time a region is mentioned its maximum insertion fraction will be <u>1.0</u>. Also, the <u>last</u> time a region is mentioned its minimum insertion fraction will usually be <u>zero</u>. The other limits may be set in accordance with the user's requirements to obtain the desired control-rod program. FEVER works down the control region adjustment list when reactivity is decreasing, and upwards in the list when reactivity is increasing. Adjustments are made in a region (or set of regions simultaneously) until it is not possible to obtain criticality within the limits given. It is at this point that the code goes to the next step in the list. (This may be upward or downward, depending on reactivity requirements.) If narrow limits are placed on the permissible insertion fractions, computing time will be increased because of the increased number of control-region switches which will occur. Care should be taken to specify a suitable control-region order and appropriate limits on insertion fractions. Since FEVER is a 1-D program, certain inherent limitations should be evident. Control-rod insertion falls into this category. Actually, the control-rod insertion fraction referred to here is a control-poison dilution factor. In the case of simultaneous adjustments in two or more regions, the minimum and maximum insertion fractions associated with every region of a simultaneous set must be identical; however, minimum and maximum control-poison atom densities (card 13) may be different for each region.</p>
19, 20	All	<p>It is possible to use only one of the following two options for a single case:</p> <p><u>Option A</u> --Shutdown--start-up; use card 19</p> <p>If a xenon override problem exists at any start-up attempt (for a control search case) the problem will be thrown off the computer and it is probable that succeeding cases will not run. Therefore, it is suggested that the use of this option be restricted to the last case if a series of cases are run.</p>

Option B--Xenon override; use card 20

If a xenon override problem exists at the end of the time interval given for the override calculation, execution of the problem is terminated at that point. Therefore, it is well to be sure that the override time interval specified is long enough to decay the xenon back to its original equilibrium value or less.

C.3. LOCATING INPUT DATA ERRORS

No matter how carefully input data are checked, the human element makes it probable that errors will occur occasionally. It should be of some help in locating these errors if it is known that certain data are printed immediately after being read into the machine. These cards then serve as check points. Examination of the printout of a case which "hangs up" on input will reveal data which were received incorrectly. Use of the following input data check points and a small amount of detective work should resolve most problems promptly:

		<u>Probable Location of Trouble</u>	
<u>Card</u>	<u>Data</u>	<u>If Data Are Printed Correctly</u>	<u>If Data are <u>Not</u> Printed Correctly</u>
A4 and A5	Cross-section data	a. After this card b. Number of cross-section blocks specified incorrectly	This card or up to 4 cards back
1	Case identification	Card 2, 3, 4, 5, or 6	Special data cards in data library
7	Material summary	Some cards in this region (cards 7-12)	This card or some card in previous region

C.4. FEVER INPUT DATA FORMS

FEVER input data forms are given on the following pages.

FEVER LIBRARY DATA

Word	1	2	3	4	5	6
Column	4	6-8	11-12	15-16	19-20	23-24
Format	No Decimal	No Decimal	No Decimal	No Decimal	No Decimal	No Decimal
Card A1	Number of groups $2 \leq N26 \leq 4$	Number of cross-section blocks (sets) in library $NLB \leq 120$	Number of special material data sets in library $NLT \leq 15$	Special data set number to be used for nonsaturating fission product (Material 13)	Special data set number to be used for Xe^{135} (Material 14)	Special data set number to be used for Sm^{149} (Material 15)
Symbol	N26	NLB	NLT	M1	M2	M3

One card per library

Word	1	2	3	4		
Column	1-12	13-24	25-36	37-48		
Format	Decimal	Decimal	Decimal	Decimal		
Card A2	Diffusion coefficient adjustment factor for Group 1	Diffusion coefficient adjustment factor for Group 2	Diffusion coefficient adjustment factor for Group 3	Diffusion coefficient adjustment factor for Group 4		
Symbol	BUG (1)	BUG (2)	BUG (3)	BUG (4)		

One card per library
Supply as many diffusion coefficient factors as groups (N26).

Word	1	2	3			
Column	1-12	13-24	25-36			
Format	Decimal	Decimal	Decimal			
Card A3	Eigenvalue convergence criterion	Point convergence criterion	Control search convergence criterion			
Symbol	CONK	CONEIG	SERCON			

One card per library

Word						
Column		2-40		61-72		
Format		Hollerith		Decimal		
Card A4		Cross-section block identification (Alpha-numeric)		Density factor (dilution due to physical expansion)		
Symbol				X BUG		

One card for each cross-section set (NLB) followed by as many card A5's as there are groups (N26).

Word	1	2	3	4	5	
Column	1-12	13-24	25-36	37-48	49-60	
Format	Decimal	Decimal	Decimal	Decimal	Decimal	
Card A5	$\nu\sigma_f$	σ_T	σ_A	$\sigma_{g, g+1}$	ν	
Symbol	FISIG(1E, 1L)	TOSIG(1E, 1L)	ABSIG(1E, 1L)	OUSIG(1E, 1L)	XNU(1E, 1L)	

One card for each group (N26).

Word	1	2	3	4	5	
Column	1-12	13-24	25-36	37-48	49-60	
Format	Decimal	Decimal	Decimal	Decimal	Decimal	
Card A6	A capture product of preceding nuclide? 0 0 - NO 1 0 - YES	Fission yield from U ²³³	Fission yield from U ²³⁵	Fission yield from Pu ²³⁹	Fission yield from Pu ²⁴¹	
Symbol	DIRAC(K)	YIELD 1(K)	YIELD 2(K)	YIELD 3(K)	YIELD 4(K)	

One card for each special data set (NLT).

FEVER CASE INPUT DATA

Word	
Column	2-72
Format	Hollerith
Card 1	Case Identification (Alpha-numeric)
Symbol	

One card per case

Word	1	2	3	4	5	6
Column	3-4	8	12	16	20	24
Format	No Decimal	No Decimal	No Decimal	No Decimal	No Decimal	No Decimal
Card 2	Number of regions ≤ 20	Geometry 1-slab 2-cylinder	0-Control poison search, burnup 1-Straight burnup 2-Single diffusion calculation	0-Calculation hot max and cold shutdown K_{eff} 1-Omit above calculation	0-Plot power and summary data 1-Omit plot	0-Calculation xenon build-up before proceed- ing 1-All initial atom densities given as input
Symbol	N20	N27	JSER	NSPEC	NPLOT	NXE

One card per case

Word	7	8	9	10		
Column	28	32	36	61-72		
Format	No Decimal	No Decimal	No Decimal	Decimal		
Card 2 (cont'd)	0-No punched cards-- non-0, punch atom density cards, start with time step number indicated	Cross-section library for next case 0-Same 1-Read new libr- ary (if any)	0-No effect 1-Shutdown-- start-up 2-Xenon override calculation	Position of mesh point zero		
Symbol	NRSTRT	KSER		RAD		

Word	1	2	3	4		
Column	1-12	13-24	25-36	37-48		
Format	Decimal	Decimal	Decimal	Decimal		
Card 3	Left albedo Group 1	Left albedo Group 2	Left albedo Group 3, if necessary	Left albedo Group 4, if necessary		
Symbol	ALI(1)	ALI(2)	ALI(3)	ALI(4)		

One card per case,
supply as many al-
bedo values as
groups

Word	1	2	3	4		
Column	1-12	13-24	25-36	37-48		
Format	Decimal	Decimal	Decimal	Decimal		
Card 4	Right albedo Group 1	Right albedo Group 2	Right albedo Group 3, if necessary	Right albedo Group 4, if necessary		
Symbol	AL2(1)	AL2(2)	AL2(3)	AL2(4)		

One card per case.

Word	1	2	3	4	5	6
Column	10-12	13-24	25-36	37-48	49-60	61-72
Format	No Decimal	Decimal	Decimal	Decimal	Decimal	Decimal
Card 5	Number of intervals in this region	Region outer radius	Transverse buckling Group 1	Transverse buckling Group 2	Transverse buckling Group 3, if necessary	Transverse buckling Group 4, if necessary
Symbol	NVALS(IR)	RADR(IR)	TRANS(1, IR)	TRANS(2, IR)	TRANS(3, IR)	TRANS(4, IR)

One card for each
region.

Word	1	2	3	4	5	6
Column	3-4	7-8	11-12	15-16	19-20	23-24
Format	No Decimal	No Decimal	No Decimal	No Decimal	No Decimal	No Decimal
Card 6	Number of power-generating regions	Region number of 1st power- generating region	Region number of 2nd power- generating region	Region number of 3rd power- generating region	Region number of 4th power- generating region	Region number of 5th power- generating region
Symbol	N71	NBURN(1)	NBURN(2)	NBURN(3)	NBURN(4)	NBURN(5)

One or two cards
per case depending
on number of regions

REGION DATA: Supply Cards 7, 8, 9, 10, 11, 12, and 13 in Sets for Each Region

Word	1	2	3	4	5	6
Column	3-4	8	12	16	19-20	23-24
Format	No Decimal	No Decimal	No Decimal	No Decimal	No Decimal	No Decimal
Card 7	Total number of materials in this region	Number of special materials for this region	Number of lumped poisons for this region	Number of control poisons for this region	Number of card 8's for this region	Number of card 9's for this region
Symbol	NMAT(IR)	NO(IR)	NLUM(IR)	NC(IR)	NREAD 1	NREAD

One card for each region

Word	7	8	9	10	11	12
Column	27-28	31-32	35-36	39-40	43-44	47-48
Format	No Decimal	No Decimal	No Decimal	No Decimal	No Decimal	No Decimal
Card 7 (cont d)	Number of previous specified region having same atomic densities, self-shielding and cross-section blocks	Number of a previous specified region having the same special material data (Card 10)	Number of a previous specified region having same lump poison geom data (Card 11)	Number of a previously specified region having same self-shielding coefficient (Card 12)	Number of a prior region having same control poison data (Card 13)	Fission product aggregate yield data identification number M1
Symbol	NCH1	NCH2	NCH3	NCH4	NCH5	M1

If number of cards 8 and cards 9 $\leq$ number of materials, specify #0 value for word 7
M1, M2, M3 omitted if correctly specified in library data (that is, region invariant)

Word	13	14				
Column	51-52	55-56				
Format	No Decimal	No Decimal				
Card 7 (cont a)	Xe ¹³⁵ yield data identification number	Sm ¹⁴⁰ yield data identification number				
Symbol	M2	M3				

Word	1	2	3			
Column	3-4	7-8	11-12			
Format	No Decimal	No Decimal	No Decimal			
Card 8	Material number	Hot cross-section block associated with this material	Cold cross-section block associated with this material			
Symbol	L	NHOT(L, IR)	NCOL(L, IR)			

Supply this card for each material whose initial atom densities are zero or to change block numbers if not the same as a preceding region

Word	1	2	3	4	5	6
Column	3-4	6-8	10-12	13-24	25-36	37-48
Format	No Decimal	No Decimal	No Decimal	Decimal	Decimal	Decimal
Card 9	Material number	Hot cross-section block associated with this material	Cold cross-section block associated with this material	Atomic density (atoms per barn-cm)	Self-shielding factor for Group 1	Self-shielding factor for Group 2
Symbol	L	NHOT(L, IR)	NCOL(L, IR)	DEN(L, IR)	SS(1, L, IR)	SS(2, L, IR)

Supply one card for each material whose atom density $\neq 0$, or self shielding $\neq 1$ or to change atomic density, and as self-shielding if not same as a preceding region

Word	7	8				
Column	49-60	61-72				
Format	Decimal	Decimal				
Card 9 (cont'd)	Self-shielding factor for Group 3	Self-shielding factor for Group 4				
Symbol	SS(3, L, IR)	SS(4, L, IR)				

SPECIAL MATERIAL DATA

Word	1	2	3	4	5	6
Column	3-4	7-8	11-12	15-16	19-20	23-24
Format						
Card 10	Special data identification number for 1st special material	Special data identification number for 2nd special material	Special data identification number for 3rd special material	Special data identification number for 4th special material	Continue for as many materials as necessary	
Symbol	NX(1, IR)	NX(2, IR)	NX(3, IR)	NX(4, IR)		

One card per region only if necessary. Supply one number for each special material. Omit card if same as a preceding region (i.e., if card 7, word 8 ≠ 0).

LUMPED POISON DATA: Cards 11 and 12 to be Supplied in Sets for Each Lumped Poison

Word	1	2	3	4	5	6
Column	1-12	13-24	25-36	37-48	49-60	61-72
Format	Decimal	Decimal	Decimal	Decimal	Decimal	Decimal
Card 11	Number of lumped poison rods in this region	Inner diameter of lumped poison rod (cm)	Outer diameter of lumped poison rod (cm)	Height of lumped poison rod (cm)	Atomic weight of lumped poison	Density of lumped poison in the lump (g/cm ³)
Symbol	RODS(K, IR)	DILP(K, IR)	DOLP(K, IR)	HLP(K, IR)	AW(K, IR)	RHO(K, IR)

Supply one card for each lumped-poison material. Omit this data if the same as in a preceding region (i.e., if card 7, word 9 ≠ 0).

Word	1	2	3	4	5	6
Column	1-12	13-24	25-36	37-48	49-60	61-72
Format	Decimal	Decimal	Decimal	Decimal	Decimal	Decimal
Card 12	L. P. coefficient A ₀	L. P. coefficient A ₁	L. P. coefficient A ₂	L. P. coefficient A ₃	L. P. coefficient A ₄	L. P. coefficient A ₅
Symbol	A0(IE, K, IR)	A1(IE, K, IR)	A2(IE, K, IR)	A3(IE, K, IR)	A4(IE, K, IR)	A5(IE, K, IR)

Supply one card for each group (hot poison). If cold shutdown K_{eff} is computed, supply two extra cards for lowest two groups (cold poison). Omit data if the same as in a preceding region (i.e., if card 7, word 10 ≠ 0).

CONTROL POISON DATA

Word	1	2				
Column	1-12	13-24				
Format	Decimal	Decimal				
Card 13	Minimum control poison atom density (atoms per barn-cm)	Maximum control poison atom density (atoms per barn-cm)				
Symbol	POISM(K, IR)	POISL(K, IR)				

Supply one card for each control poison material. Omit this data if the same as in a preceding region (i.e., if card 7, word 11 ≠ 0).

BURNUP DATA: Supply Cards 14 and 15 only for Burnup Cases

Word	1	2	3	4	5	6
Column	1-12	13-24	25-36	37-48	49-60	61-72
Format	Decimal	Decimal	Decimal	Decimal	Decimal	Decimal
Card 14	Large burnup time step (days)	Thermal power of the reactor (watts)	Core height (cm)	Control point or shutdown K_{eff}	Fissions per watt-sec	Xenon removal constant (1/sec)
Symbol	DELDAY	POWER	HCORE	ZKFIND	FIWATT	RPXE

One card per case.

Word	1	2				
Column	1-4	5-8				
Format	No Decimal	No Decimal				
Card 15	Termination time step number ≤ 24	Number of small time steps per large time step				
Symbol	JNSTOP	JNUM				

One card per case.

CONTROL SEARCH DATA: Supply Cards 16, 17 and 18 only for Control Search Cases

Word	1	2	3	4	5	6
Column	1-4	5-8	11-12	14-16	19-20	23-24
Format	No Decimal	No Decimal	No Decimal	No Decimal	No Decimal	No Decimal
Card 16	Maximum control poison adjustments for a single region during one search	Maximum total control poison adjustments	Number of control regions adjusted simultaneously	Total number of control regions in following list	Control region number (to be adjusted 1st)	Control region number (to be adjusted 2nd)
Symbol	JS MAX	JSS MAX	LSIM	KSS	NPOIS(IRR)	NPOIS(IRR)

Use additional cards if necessary.

Word	7					
Column	27-28					
Format	No Decimal					
Card 16 (cont'd)	Control region number (to be adjusted 3rd)	Supply as many control region numbers as required to complete the list				
Symbol	NPOIS(IRR)					

Use additional cards if necessary.

Word	1	2	3	4	5	6
Column	1-12	13-24	25-36	37-48	49-60	61-72
Format	Decimal	Decimal	Decimal	Decimal	Decimal	Decimal
Card 17	Minimum poison insertion fraction (corr. to 1st region in above list)	Minimum poison insertion fraction (corr. to 2nd region in above list)	Minimum poison insertion fraction (corr. to 3rd region in above list)	Minimum poison insertion fraction (corr. to 4th region in above list)	Minimum poison insertion fraction (corr. to 5th region in above list)	Minimum poison insertion fraction (corr. to 6th region in above list)
Symbol	PINMIN(IRR)	PINMIN(IRR)	PINMIN(IRR)	PINMIN(IRR)	PINMIN(IRR)	PINMIN(KSS)

Use additional cards if necessary.

Word	1	2	3	4	5	6
Column	1-12	13-24	25-36	37-48	49-60	61-72
Format	Decimal	Decimal	Decimal	Decimal	Decimal	Decimal
Card 18	Maximum poison insertion fraction (corr. to 1st region in above list)	Maximum poison insertion fraction (corr. to 2nd region in above list)	Maximum poison insertion fraction (corr. to 3rd region in above list)	Maximum poison insertion fraction (corr. to 4th region in above list)	Maximum poison insertion fraction (corr. to 5th region in above list)	Maximum poison insertion fraction (corr. to 6th region in above list)
Symbol	PINMAX(IRR)	PINMAX(IRR)	PINMAX(IRR)	PINMAX(IRR)	PINMAX(IRR)	PINMAX(KSS)

Use additional cards if necessary.

SHUTDOWN-START-UP CARD: This card may be repeated as often as desired

Word	1	2	3	4	5	
Column	1-12	13-24	25-36	39-40	44	
Format	Decimal	Decimal	Decimal	No Decimal	No Decimal	
Card 19	Shutdown time (hours)	New operating power (watts)	Large burnup time step (days)	Maximum number of large time steps	0-Last card for this case 1-Another card 19 for succeeding shutdown-start-up follows	
Symbol	X DOWN	POWER	DELDAY	JNSTOP	NSHUFL	

Supply this card only for shutdown-start-up case:
NSHUFL = 1 (card 2, word 9).

XENON OVERRIDE CARD

Word	1	2	3	4		
Column	1-12	15-16	19-20	23-24		
Format	Decimal	No Decimal	No Decimal	No Decimal		
Card 20	Time interval of override calculation (hours)	Number of times for K_{eff} calculation during override time interval	First time step for Xe override calculation	Frequency of override calculation (number of large burnup time steps)		
Symbol	X DOWN	JINT	NDOW	NXXX		

Supply this card only for xenon override case.
NSHUFL = 2 (card 2, word 9).

Appendix D

SAMPLE PROBLEM

SAMPLE INPUT--LIBRARY DATA

4	50	10	1	2	3				
1.0			1.0			1.0		1.0	
.00001			.001			.001			
TH 232						HUT			1.0
9.31724-02			6.26868+00			1.78843-01		1.42295+00	2.72225+00
0.			2.05636+01			6.11667+00		1.11311-02	0.
0.			1.27135+01			4.75764-01		5.82343-02	0.
0.0			14.916			2.452		0.0	0.0
PA 233						HUT			1.0
1.13527+00			6.59121+00			7.31876-01		1.27431+00	2.83283+00
0.			3.35319+01			2.18307+01		2.55950-01	0.
0.			1.88164+02			1.76059+02		5.76907-02	0.
0.0			32.75			22.75		0.0	0.0
U 233						HUT			1.0
5.50061+00			6.48020+00			2.13840+00		6.41994-01	2.64303+00
4.40909+01			3.19359+01			1.98304+01		8.71165-03	2.31000+00
2.56288+02			1.35914+02			1.23446+02		5.89310-02	2.51000+00
554.9			254.49			242.13		0.0	2.50
U 234						HUT			1.0
1.93828+00			6.64390+00			8.73759-01		8.63747-01	2.61416+00
7.45457-04			2.31605+01			6.38747+00		9.08234-03	2.34000+00
0.			3.61512+02			3.09544+02		3.75503-02	0.
0.0			39.269			26.65		0.0	0.0
U 235						HUT			1.0
3.52808+00			6.43577+00			1.40177+00		1.34531+00	2.57799+00
3.77292+01			3.50349+01			2.43695+01		7.61265-03	2.41000+00
9.31419+01			8.44397+01			7.27309+01		5.65565-02	2.41000+00
386.13			206.27			190.1		0.0	2.43
U 236						HUT			1.0
7.93985-01			6.45854+00			4.26058-01		1.12141+00	2.70289+00
0.			2.75388+01			7.23609+00		8.92460-03	0.
0.			1.15984+02			9.96357+01		4.38489-02	0.
0.0			11.012			1.970		0.0	0.0
U 238						HUT			1.0
3.68699-01			6.12173+00			2.65231-01		1.27826+00	2.77369+00
0.			3.66711+01			1.21385+01		7.24335-03	0.
0.			8.49637+01			7.20582+01		3.73900-02	0.
0.0			9.1578			0.8810		0.0	0.0
VP 239						HUT			1.0
7.95394-01			6.57478+00			5.57799-01		1.27488+00	2.70769+00
0.			3.75439+01			2.33648+01		1.39205-02	0.
0.			1.47690+02			1.30028+02		8.20207-02	0.
0.0			27.805			17.86		0.0	0.0
PU 239						HUT			1.0
5.42437+00			6.80526+00			1.98384+00		7.68053-01	3.02561+00
3.40481+01			3.32412+01			2.16139+01		1.15519-02	2.91010+00
1.18105+02			8.68264+01			7.60274+01		4.41178-02	2.91000+00
2159.2			1216.0			1206.0		0.0	2.91
PU 240						HUT			1.0
2.56679+00			6.57282+00			9.08638-01		6.36629-01	3.30630+00
0.			3.78944+01			1.48305+01		1.38409-02	0.
0.			3.98354+01			2.77022+01		6.04162-02	0.
0.0			1924.6			1890.		0.0	0.0
PU 241						HUT			1.0
5.65515+00			6.80370+00			1.98384+00		7.70005-01	3.15433+00
5.32713+01			4.73633+01			3.54280+01		1.61727-02	3.02440+00
4.81049+02			2.83426+02			2.66359+02		4.55843-02	3.04805+00
1624.9			765.97			756.0		0.0	3.00

PU 242	H0T				1.0
2.56679+00	6.56516+00	9.08638-01	6.36479-01	3.30630+00	
0.	2.35874+01	5.69706+00	8.88935-03	0.	
0.	5.72652+02	5.28726+02	1.18039+00	0.	
0.0	18.235	8.661	0.0	0.0	
NON-SAT FISS PR00	H0T				1.0
0.	4.04766-02	4.04766-02	0.	0.	
0.	1.91482+00	1.91482+00	0.	0.	
0.	5.88098-01	5.88098-01	0.	0.	
0.0	9.658	1.658	0.0	0.0	
XE 135	H0T				1.0
0.	5.80014+00	0.	8.11007-01	0.	
0.	2.44377+01	1.44605-01	5.62948-01	0.	
0.	1.64098+02	7.09793+01	1.07992+00	0.	
0.0	611504.	611500.	0.0	0.0	
SM 149	H0T				1.0
0.	5.41444+00	4.64240-02	6.29518-01	0.	
0.	9.32582+01	4.66509+01	3.48159-02	0.	
0.	2.42463+02	2.21484+02	7.35986-02	0.	
0.0	20108.	20100.	0.0	0.0	
SAT FISS PR00	H0T				1.0
	.12952	.12952			
	10.618	10.618			
	95.984	95.984			
	10.671	10.671			
RH 103	H0T				1.0
0.	1.50418-01	1.50418-01	0.	0.	
0.	2.61037+00	2.61037+00	0.	0.	
0.	2.31692+00	2.31692+00	0.	0.	
0.0	243.27	238.2	0.0	0.0	
XE 131	H0T				1.0
0.	9.57390-02	9.57390-02	0.	0.	
0.	6.33199+01	6.33199+01	0.	0.	
0.	8.17908+00	8.17908+00	0.	0.	
0.0	43.558	39.28	0.0	0.0	
ND 143	H0T				1.0
0.	2.81293-02	2.81293-02	0.	0.	
0.	5.68292+00	5.68292+00	0.	0.	
0.	6.78060+00	6.78060+00	0.	0.	
0.0	106.12	98.15	0.0	0.0	
PM 147	H0T				1.0
0.	5.67455-01	5.67455-01	0.	0.	
0.	3.65606+01	3.65606+01	0.	0.	
0.	1.06122+03	1.06122+03	0.	0.	
0.0	63.814	55.85	0.0	0.0	
SM 151	H0T				1.0
0.	6.77019-01	6.77019-01	0.	0.	
0.	4.93214+01	4.93214+01	0.	0.	
0.	3.03074+02	3.03074+02	0.	0.	
0.0	1498.8	1491.	0.0	0.0	
SM 152	H0T				1.0
	6.76310-2	6.76310-2			
	1.98030+1	1.98030+1			
	1.22910+3	1.22910+3			
	7.05900+1	7.05900+1			
.B 10	H0T				1.0
	12.669	1.0958	0.6948		
	42.48	23.86	0.2838		

0.0	256.4	236.85	1.918		
NATURAL BORON	1245.8	1227.0	0.0	0.0	
	2.5337	0.21915	0.139		1.0
	8.496	4.7717	0.05676		
	51.28	47.37	0.3836		
0.0	249.15	245.4	0.0	0.0	
CARBON		HOT			1.0
0.	2.81256+00	0.	1.60133-01	0.	
0.	4.43164+00	0.	6.05384-02	0.	
0.	4.46265+00	0.	4.09452-01	0.	
0.0	4.8169	.001213	0.0	0.0	
TH 232		COLD			1.0
9.31726-02	6.26948+00	1.79643-01	1.42295+00	2.92225+00	
0.	1.96282+01	5.16373+00	1.14207-02	0.	
0.	1.27135+01	4.75769-01	5.82360-02	0.	
0.0	15.592	3.127	0.0	0.0	
PA 233		COLD			1.0
1.13528+00	6.59121+00	7.31875-01	1.27431+00	2.83283+00	
0.	3.37781+01	2.20751+01	2.55059-01	0.	
0.	1.88165+02	1.76061+02	5.16924-02	0.	
0.0	38.99	28.98	0.0	0.0	
U 233		COLD			1.0
5.50061+00	6.48020+00	2.13840+00	6.41995-01	2.64303+00	
4.46090+01	3.21674+01	2.00601+01	9.01721-03	2.51000+00	
2.56287+02	1.35914+02	1.23446+02	5.89327-02	2.51000+00	
675.75	317.10	295.2	0.0	2.50	
U 234		COLD			1.0
1.93828+00	6.64389+00	8.73760-01	8.68747-01	2.61416+00	
7.41872-04	2.31950+01	6.42608+00	9.31524-03	2.34000+00	
0.	3.61523+02	3.09553+02	3.75514-02	0.	
0.0	49.288	36.85	0.0	0.0	
U 235		COLD			1.0
3.52808+00	6.43576+00	1.40177+00	1.34531+00	2.57799+00	
3.80959+01	3.53027+01	2.46306+01	7.86870-03	2.43000+00	
9.31386+01	8.44372+01	7.27284+01	5.65582-02	2.43000+00	
507.63	264.26	248.2	0.0	2.43	
U 236		COLD			1.0
7.93986-01	6.45853+00	4.26058-01	1.12141+00	2.70289+00	
0.	2.76059+01	7.28335+00	9.15599-03	0.	
0.	1.15987+02	9.96388+01	4.38502-02	0.	
0.0	11.723	2.510	0.0	0.0	
U 238		COLD			1.0
3.68700-01	6.12173+00	2.65232-01	1.27826+00	2.77369+00	
0.	3.68614+01	1.22011+01	7.41517-03	0.	
0.	8.35482+01	7.06425+01	3.73912-02	0.	
0.0	9.4007	1.124	0.0	0.0	
NP 239		COLD			1.0
7.95395-01	6.57477+00	5.57799-01	1.27488+00	2.70769+00	
0.	3.78421+01	2.36488+01	1.43262-02	0.	
0.	1.47690+02	1.30027+02	8.20232-02	0.	
0.0	32.692	22.72	0.0	0.0	
PU 239		COLD			1.0
5.42437+00	6.80525+00	1.98384+00	7.68054-01	3.02561+00	
3.44855+01	3.35536+01	2.19134+01	1.19570-02	2.91010+00	
1.18103+02	8.68243+01	7.60254+01	4.41191-02	2.91000+00	
1734.9	951.17	941.2	0.0	2.91	
PU 240		COLD			1.0

2.56680+00	6.57282+00	9.08639-01	6.36629-01	3.30630+00	
0.	3.81681+01	1.50434+01	1.40976-02	0.	
0.	3.98357+01	2.77025+01	6.04180-02	0.	
0.0	1994.7	1951.	0.0	0.0	
PU 241		COLD			1.0
5.65515+00	6.80370+00	1.98384+00	7.70006-01	3.15433+00	
5.42052+01	4.80391+01	3.60771+01	1.67400-02	3.02489+00	
4.81051+02	2.83426+02	2.66359+02	4.55857-02	3.04805+00	
1658.5	785.97	776.0	0.0	3.06	
PU 242		COLD			1.0
2.56680+00	6.56515+00	9.08639-01	6.36479-01	3.30630+00	
0.	2.36581+01	5.72969+00	9.11405-03	0.	
0.	5.72669+02	5.28742+02	1.18042+00	0.	
0.0	19.704	10.13	0.0	0.0	
NON-SAT FISS		COLD			1.0
0.	4.04765-02	4.04765-02	0.	0.	
0.	1.92650+00	1.92650+00	0.	0.	
0.	5.88099-01	5.88099-01	0.	0.	
0.0	10.114	2.114	0.0	0.0	
XE 135		COLD			1.0
0.	5.80014+00	0.	8.11008-01	0.	
0.	2.48118+01	1.49510-01	5.82693-01	0.	
0.	1.64095+02	7.09812+01	1.07995+00	0.	
0.0	1128004.	1128000.	0.0	0.0	
SM 149		COLD			1.0
0.	5.41443+00	4.64237-02	6.29518-01	0.	
0.	9.41288+01	4.72137+01	3.60370-02	0.	
0.	2.42459+02	2.21481+02	7.36008-02	0.	
0.0	33208.	33200.	0.0	0.0	
SAT FISS PRD		COLD			1.0
	.12952	.12952			
	10.618	10.618			
	95.984	95.984			
	13.597	13.597			
RH 103		COLD			1.0
0.	1.50418-01	1.50418-01	0.	0.	
0.	2.60535+00	2.60535+00	0.	0.	
0.	2.31699+00	2.31699+00	0.	0.	
0.0	264.96	260.0	0.0	0.0	
XE 131		COLD			1.0
0.	9.57388-02	9.57388-02	0.	0.	
0.	6.53683+01	6.53683+01	0.	0.	
0.	8.17915+00	8.17915+00	0.	0.	
0.0	54.20	50.20	0.0	0.0	
ND 143		COLD			1.0
0.	2.81293-02	2.81293-02	0.	0.	
0.	5.70258+00	5.70258+00	0.	0.	
0.	6.78075+00	6.78075+00	0.	0.	
0.0	136.8	128.9	0.0	0.0	
PM 147		COLD			1.0
0.	5.67455-01	5.67455-01	0.	0.	
0.	3.68493+01	3.68493+01	0.	0.	
0.	1.06125+03	1.06125+03	0.	0.	
0.0	79.6	71.8	0.0	0.0	
SM 151		COLD			1.0
0.	6.77019-01	6.77019-01	0.	0.	
0.	4.99103+01	4.99103+01	0.	0.	
0.	3.03075+02	3.03075+02	0.	0.	

0.0	3118.	3110.	0.0	0.0	
SM 152		CJLD			1.0
	6.76310-2	6.76310-2			
	1.98030+1	1.98030+1			
	1.22910+3	1.22910+3			
	8.89900+1	8.89900+1			
B 10		CJLD			1.0
	12.669	1.0958	0.6948		
	42.48	23.86	0.2838		
	256.4	236.85	1.918		
0.0	1582.3	1563.5	0.0	0.0	
NATURAL BORON		CJLD			1.0
	2.5337	0.21915	0.139		
	8.496	4.7717	0.05676		
	51.28	47.37	0.3836		
0.0	316.45	312.7	0.0	0.0	
CARBON		CJLD			1.0
0.	2.81255+00	0.	1.60131-01	0.	
0.	4.43100+00	0.	6.26640-02	0.	
0.	4.46264+00	0.	4.09465-01	0.	
0.0	4.7950	.001541	0.0	0.0	
	1.2557	1.00	1.3203	1.3203	
	.067	.0641	.055	.055	
	.006575	.011778	.02040	.02040	
	.20245	.23412	.21957	.21957	
	.016	.030	.057	.057	
	.037	.0293	.032	.032	
	.052	.0598	.061	.061	
	.017	.0238	.026	.026	
	.0026	.0045	.010	.010	
1.0		1.7-3	2.85-3	7.5-3	7.5-3

SAMPLE INPUT--CASE DATA

SAMPLE CASE											
8	2	0	0	0	0	0	0	0	0	0.0	1
1.0			1.0			1.0		1.0			2
0.0			0.0			0.0		0.0			3
		4	31.7			3.25-4		1.62-4		7.46-6	4
		4	40.8			3.25-4		1.62-4		7.46-6	1 5
		4	68.0			3.25-4		1.62-4		7.46-6	2 5
		4	77.1			3.25-4		1.62-4		7.46-6	3 5
		4	93.5			3.25-4		1.62-4		7.46-6	4 5
		4	102.6			3.25-4		1.62-4		7.46-6	5 5
		8	140.0			3.25-4		1.62-4		7.46-6	6 5
		8	210.0			8.03-5		8.03-5		8.03-5	7 5
7	1	2	3	4	5	6	7				8 5
23	7	0	0	19	4						6
2	2	27									1 7
3	3	28									1 8
4	4	29									1 8
6	6	31									1 8
8	8	33									1 8
9	9	34									1 8
10	10	35									1 8
11	11	36									1 8
12	12	37									1 8
13	13	38									1 8
14	14	39									1 8
15	15	40									1 8
16	16	41									1 8
17	17	42									1 8
18	18	43									1 8
19	19	44									1 8
20	20	45									1 8
21	21	46									1 8
22	22	47									1 8
1	1	26		1.95-4		1.0		1.0		1.0	1 9
5	5	30		2.90-5		1.0		1.0		1.0	1 9
7	7	32		2.78-6		1.0		1.0		1.0	1 9
23	25	50		7.50-2		1.0		1.0		1.0	1 9
4	5	6		7	8	9	10				1 10
24	7	0		1	0	2		1	1	0	2 7
23	24	49		1.627-3		.886		.656		.143	2 9
24	25	50		7.50-2		1.0		1.0		1.0	2 9
0.0				1.627-3							2 13
24	7	1		0	1	1		1	1	0	3 7
23	23	48									3 8
24	25	50		7.50-2		1.0		1.0		1.0	3 9
11.712				0.0		2.2225		228.6		10.016	3 11
9.7681-1				-3.8982-2		-2.1705+1		7.7086+2		0.0	3 12
9.9986-1				-2.1934+0		-4.7158+2		5.3225+4		-1.7335+6	3 12
1.0034+0				-2.8348+1		3.7779+2		2.6625+4		-1.2054+6	3 12
1.0145+0				-1.8766+2		2.5806+4		-1.9211+6		5.2524+7	3 12
1.0034+0				-2.8229+1		3.1805+2		3.3796+4		-1.4472+6	3 12
1.0196+0				-2.3181+2		3.6657+4		-2.9215+6		8.2496+7	3 12
25	7	1		1	0	2		3	1	0	4 7
24	24	49		8.134-4		.820		.588		.121	4 9
25	25	50		7.50-2		1.0		1.0		1.0	4 9
5.1404				0.0		2.2225		228.6		10.016	4 11
0.0				8.134-4							4 13
24	7	1		0	0	0		3	1	0	5 7

10.928	0.0	2.2225	228.6	10.016	6.9825-3	5 11
25 7 1	1 0 1	4 1 0	3 0			6 7
24 24 49	1.204-3	.862	.630	.134	.0211	6 9
6.9468	0.0	2.2225	228.6	10.016	6.9825-3	6 11
0.0	1.204-3					6 13
24 7 1	0 0 0	3 1 0	3 0			7 7
35.4116	0.0	2.2225	228.6	10.016	6.9825-3	7 11
16 0 0	0 0 4	1 0 0	0 0			8 7
1 1 26	0.0	1.0	1.0	1.0	1.0	8 9
5 5 30	0.0	1.0	1.0	1.0	1.0	8 9
7 7 32	0.0	1.0	1.0	1.0	1.0	8 9
16 25 50	8.525-2	1.0	1.0	1.0	1.0	8 9
100.0	1.150+8	228.6	1.0	3.38+10	0.0	14
5 10						15
20 200 1	4 2 6	4 2				16
.50	0.0	0.0	0.0			17
1.0	1.0	1.0	.50			18

SAMPLE PRINTOUT

FEVER LIBRARY CONTAINS THE FOLLOWING DATA

NU*FISSION TRANSPORT ABSORPTION SCATTER OUT NEUTS/FISSION DILUTION

BLOCK NO. 1					
TH 232	HGT				1.0000+00
9.3172-02	6.2687+00	1.7884-01	1.4229+00	2.9222+00	
0.	2.0564+01	6.1167+00	1.1131-02	0.	
0.	1.2713+01	4.7576-01	5.8234-02	0.	
0.	1.4916+01	2.4520+00	0.	0.	
BLOCK NO. 2					
PA 233	HGT				1.0000+00
1.1353+00	6.5912+00	7.3188-01	1.2743+00	2.8329+00	
0.	3.3532+01	2.1831+01	2.5595-01	0.	
0.	1.8816+02	1.7606+02	5.7691-02	0.	
0.	3.2750+01	2.2750+01	0.	0.	
BLOCK NO. 3					
U 233	HGT				1.0000+00
5.5006+00	6.4802+00	2.1344+00	6.4199-01	2.6430+00	
4.4091+01	3.1936+01	1.9830+01	8.7116-03	2.5100+00	
2.5629+02	1.3591+02	1.2345+02	5.8931-02	2.5100+00	
5.5490+02	2.5449+02	2.4213+02	0.	2.5000+00	
BLOCK NO. 4					
U 234	HGT				1.0000+00
1.9383+00	6.6439+00	8.7376-01	8.6875-01	2.6142+00	
7.4546-04	2.3160+01	6.3875+00	9.0823-03	2.3400+00	
0.	3.6151+02	3.0954+02	3.7550-02	0.	
0.	3.9269+01	2.6650+01	0.	0.	
BLOCK NO. 5					
U 235	HGT				1.0000+00
3.5281+00	6.4359+00	1.4018+00	1.3453+00	2.5780+00	
3.7729+01	3.5035+01	2.4369+01	7.6126-03	2.4300+00	
9.3142+01	8.4440+01	7.2731+01	5.6556-02	2.4300+00	
3.8613+02	2.0627+02	1.9010+02	0.	2.4300+00	
BLOCK NO. 6					
U 236	HGT				1.0000+00
7.9398-01	6.4585+00	4.2606-01	1.1214+00	2.7029+00	
0.	2.7539+01	7.2361+00	8.9246-03	0.	
0.	1.1598+02	9.9636+01	4.3849-02	0.	
0.	1.1012+01	1.9700+00	0.	0.	

FEVER LIBRARY CONTAINS THE FOLLOWING DATA

NU*FISSION TRANSPORT ABSORPTION SCATTER OUT NEUTS/FISSION DILUTION

BLOCK NO. 7

U 238		HJT			1.0000+00
5.6870-01	6.1217+00	2.6523-01	1.2783+00	2.7737+00	
0.	3.6671+01	1.2138+01	7.2433-03	0.	
0.	8.4904+01	7.2058+01	3.7390-02	0.	
0.	9.1578+00	8.8100-01	0.	0.	

BLOCK NO. 8

UP 239		HJT			1.0000+00
7.9539-01	6.5748+00	5.5780-01	1.2749+00	2.7077+00	
0.	3.7544+01	2.3365+01	1.3920-02	0.	
0.	1.4769+02	1.3003+02	8.2071-02	0.	
0.	2.7805+01	1.7860+01	0.	0.	

BLOCK NO. 9

PU 239		HJT			1.0000+00
5.4244+00	6.8053+00	1.9830+00	7.5805-01	3.0256+00	
3.4048+01	3.3241+01	2.1614+01	1.1552-02	2.9101+00	
1.1810+02	8.6826+01	7.6027+01	4.4118-02	2.9100+00	
2.1592+03	1.2160+03	1.2060+03	0.	2.9100+00	

BLOCK NO. 10

PU 240		HJT			1.0000+00
2.5668+00	6.5729+00	9.0864-01	6.3663-01	3.3063+00	
0.	3.7894+01	1.4830+01	1.3841-02	0.	
0.	3.9835+01	2.7702+01	6.0416-02	0.	
0.	1.9246+03	1.3900+03	0.	0.	

BLOCK NO. 11

PU 241		HJT			1.0000+00
5.6551+00	6.8037+00	1.9838+00	7.7000-01	3.1543+00	
5.3271+01	4.7363+01	3.5420+01	1.6173-02	3.0244+00	
4.8105+02	2.8343+02	2.6636+02	4.5584-02	3.0490+00	
1.6249+03	7.6577+02	7.5600+02	0.	3.0600+00	

BLOCK NO. 12

PU 242		HJT			1.0000+00
2.5668+00	6.5652+00	9.0864-01	6.3648-01	3.3063+00	
0.	2.3587+01	3.6971+00	8.8893-03	0.	
0.	5.7265+02	5.2873+02	1.1804+00	0.	
0.	1.8235+01	3.6610+00	0.	0.	

BLOCK NO. 13

NON-SAT FISSION PROD		HJT			1.0000+00
0.	4.0477-02	4.0477-02	0.	0.	
0.	1.9148+00	1.9148+00	0.	0.	
0.	5.8810-01	5.8810-01	0.	0.	
0.	9.6580+00	1.6580+00	0.	0.	

FEVER LIBRARY CONTAINS THE FOLLOWING DATA

NU*FISSION TRANSPORT ABSORPTION SCATTER JUT NEUTS/FISSION DILUTION

BLOCK NO. 14					
XE 135		HGT			1.0000+00
0.	5.8001+00	0.	8.1101-01	0.	
0.	2.4438+01	1.4460-01	5.6295-01	0.	
0.	1.6410+02	7.0979+01	1.0799+00	0.	
0.	6.1150+05	6.1150+05	0.	0.	
BLOCK NO. 15					
SM 149		HGT			1.0000+00
0.	5.4144+00	4.6424-02	6.2952-01	0.	
0.	9.3258+01	4.6651+01	3.4816-02	0.	
0.	2.4246+02	2.2148+02	7.3599-02	0.	
0.	2.0108+04	2.0100+04	0.	0.	
BLOCK NO. 16					
SAT FISSION PROD		HGT			1.0000+00
-0.	1.2952-01	1.2952-01	-0.	-0.	
-0.	1.0618+01	1.0618+01	-0.	-0.	
-0.	9.5934+01	7.5964+01	-0.	-0.	
-0.	1.0671+01	1.0671+01	-0.	-0.	
BLOCK NO. 17					
PH 103		HGT			1.0000+00
0.	1.5042-01	1.5042-01	0.	0.	
0.	2.6134+00	2.6104+00	0.	0.	
0.	2.3167+00	2.3109+00	0.	0.	
0.	2.4327+02	2.3820+02	0.	0.	
BLOCK NO. 18					
XE 131		HGT			1.0000+00
0.	9.5739-02	1.5739-02	0.	0.	
0.	6.3320+01	6.3320+01	0.	0.	
0.	8.1791+00	8.1791+00	0.	0.	
0.	4.3558+01	3.9250+01	0.	0.	
BLOCK NO. 19					
ID 143		HGT			1.0000+00
0.	2.8129-02	2.8129-02	0.	0.	
0.	5.6829+00	5.6829+00	0.	0.	
0.	6.7806+00	6.7806+00	0.	0.	
0.	1.0612+02	9.8150+01	0.	0.	
BLOCK NO. 20					
PM 147		HGT			1.0000+00
0.	5.6745-01	5.6745-01	0.	0.	
0.	3.6561+01	3.6561+01	0.	0.	
0.	1.0612+03	1.0612+03	0.	0.	
0.	6.3814+01	5.5850+01	0.	0.	

FEVER LIBRARY CONTAINS THE FOLLOWING DATA

NU*FISSION TRANSPORT ABSORPTION SCATTER CUT NEUTS/FISSION DILUTION

BLOCK NO. 21					
SM 151		HJT			1.0000+00
0.	6.7702-01	6.7702-01	0.	0.	
0.	4.9321+01	4.9321+01	0.	0.	
0.	3.0307+02	3.0307+02	0.	0.	
0.	1.4988+03	1.4910+03	0.	0.	
BLOCK NO. 22					
SM 152		HJT			1.0000+00
-0.	6.7631-02	6.7631-02	-0.	-0.	
-0.	1.9803+01	1.9803+01	-0.	-0.	
-0.	1.2291+03	1.2291+03	-0.	-0.	
-0.	7.0590+01	7.0590+01	-0.	-0.	
BLOCK NO. 23					
H 10		HJT			1.0000+00
-0.	1.2669+01	1.0958+00	6.9480-01	-0.	
-0.	4.2480+01	2.3860+01	2.8380-01	-0.	
-0.	2.5640+02	2.3685+02	1.9180+00	-0.	
0.	1.2458+03	1.2270+03	0.	0.	
BLOCK NO. 24					
NATURAL BORO		HJT			1.0000+00
-0.	2.5337+00	2.1915-01	1.3900-01	-0.	
-0.	8.4960+00	4.7717+00	5.6760-02	-0.	
-0.	5.1280+01	4.7370+01	3.8360-01	-0.	
0.	2.4915+02	2.4540+02	0.	0.	
BLOCK NO. 25					
CARBON		HJT			1.0000+00
0.	2.3126+00	0.	1.6013-01	0.	
0.	4.4316+00	0.	6.0538-02	0.	
0.	4.4626+00	0.	4.0945-01	0.	
0.	4.8169+00	1.2130-03	0.	0.	
BLOCK NO. 26					
TH 232		COLD			1.0000+00
9.3173-02	6.2695+00	1.7764-01	1.4229+00	2.9227+00	
0.	1.9628+01	5.1637+00	1.1421-02	0.	
0.	1.2713+01	4.7577-01	5.8236-02	0.	
0.	1.5592+01	5.1270+00	0.	0.	
BLOCK NO. 27					
PA 233		COLD			1.0000+00
1.1353+00	6.5912+00	7.3167-01	1.2743+00	2.8328+00	
0.	3.3778+01	2.2075+01	2.5506-01	0.	
0.	1.8816+02	1.7606+02	5.7692-02	0.	
0.	3.8990+01	2.8980+01	0.	0.	

FEVER LIBRARY CONTAINS THE FOLLOWING DATA

NU*FISSION TRANSPORT ABSORPTION SCATTER BUT NEUTS/FISSION DILUTION

BLOCK NO. 28

U 233		CGLD			1.0000+00
5.5006+00	6.4802+00	2.1384+00	6.4199-01	2.6430+00	
4.4609+01	3.2167+01	2.0060+01	9.0172-03	2.5100+00	
2.5629+02	1.3591+02	1.2345+02	5.8933-02	2.5100+00	
6.7575+02	3.1710+02	2.9520+02	0.	2.5000+00	

BLOCK NO. 29

U 234		CGLD			1.0000+00
1.9383+00	6.6439+00	8.7376-01	8.6875-01	2.6142+00	
7.4187-04	2.3195+01	6.4261+00	9.3152-03	2.3400+00	
0.	3.6152+02	3.0955+02	3.7551-02	0.	
0.	4.9288+01	3.6850+01	0.	0.	

BLOCK NO. 30

U 235		CGLD			1.0000+00
3.5281+00	6.4358+00	1.4018+00	1.3453+00	2.5780+00	
3.8096+01	3.5303+01	2.4631+01	7.2687-03	2.4300+00	
9.3139+01	8.4437+01	7.2728+01	5.6558-02	2.4300+00	
5.0763+02	2.6426+02	2.4820+02	0.	2.4300+00	

BLOCK NO. 31

U 236		CGLD			1.0000+00
7.9399-01	6.4585+00	4.2606-01	1.1214+00	2.7029+00	
0.	2.7606+01	7.2833+00	9.1560-03	0.	
0.	1.1599+02	7.9639+01	4.3850-02	0.	
0.	1.1723+01	2.5100+00	0.	0.	

BLOCK NO. 32

U 238		CGLD			1.0000+00
3.6870-01	6.1217+00	2.6523-01	1.2783+00	2.7737+00	
0.	3.6861+01	1.2201+01	7.4152-03	0.	
0.	8.3549+01	7.0642+01	3.7391-02	0.	
0.	9.4007+00	1.1240+00	0.	0.	

BLOCK NO. 33

NP 239		CGLD			1.0000+00
7.9539-01	6.5748+00	5.5780-01	1.2749+00	2.7077+00	
0.	3.7842+01	2.3649+01	1.4326-02	0.	
0.	1.4769+02	1.3003+02	3.2023-02	0.	
0.	3.2692+01	2.2720+01	0.	0.	

BLOCK NO. 34

PU 239		CGLD			1.0000+00
5.4244+00	6.8052+00	1.9838+00	7.6805-01	3.0256+00	
3.4485+01	3.3554+01	2.1913+01	1.1957-02	2.9101+00	
1.1810+02	8.6824+01	7.6025+01	4.4119-02	2.9100+00	
1.7349+03	9.5117+02	9.4120+02	0.	2.9100+00	

FEVER LIBRARY CONTAINS THE FOLLOWING DATA

NU*FISSION TRANSPJRT ABSORPTION SCATTER OUT NEUTS/FISSION DILUTION

BLOCK NO. 35						
PU 240		COLD				1.0000+00
2.5668+00	6.5728+00	9.0864-01	6.3663-01	3.3063+00		
0.	3.8168+01	1.5043+01	1.4098-02	0.		
0.	3.9836+01	2.7702+01	6.0418-02	0.		
0.	1.9947+03	1.9510+03	0.	0.		
BLOCK NO. 36						
PU 241		COLD				1.0000+00
5.6551+00	6.8037+00	1.9838+00	7.7001-01	3.1543+00		
5.4205+01	4.8039+01	3.6077+01	1.6740-02	3.0249+00		
4.8105+02	2.8343+02	2.6636+02	4.3586-02	3.0480+00		
1.6585+03	7.8597+02	7.7600+02	0.	3.0600+00		
BLOCK NO. 37						
PU 242		COLD				1.0000+00
2.5668+00	6.5651+00	9.0864-01	6.3648-01	3.3063+00		
0.	2.3658+01	5.7297+00	9.1140-03	0.		
0.	5.7267+02	5.2874+02	1.1804+00	0.		
0.	1.9704+01	1.0130+01	0.	0.		
BLOCK NO. 33						
NON-SAT FISS PRSD		COLD				1.0000+00
0.	4.0476-02	4.0476-02	0.	0.		
0.	1.9265+00	1.9265+00	0.	0.		
0.	5.8810-01	5.8810-01	0.	0.		
0.	1.0114+01	2.1140+00	0.	0.		
BLOCK NO. 39						
XE 135		COLD				1.0000+00
0.	5.8001+00	0.	8.1101-01	0.		
0.	2.4812+01	1.4951-01	5.8269-01	0.		
0.	1.6409+02	7.0981+01	1.0799+00	0.		
0.	1.1280+06	1.1280+06	0.	0.		
BLOCK NO. 40						
SM 149		COLD				1.0000+00
0.	5.4144+00	4.6424-02	6.2952-01	0.		
0.	9.4129+01	4.7214+01	3.6037-02	0.		
0.	2.4246+02	2.2148+02	7.3601-02	0.		
0.	3.3208+04	3.3200+04	0.	0.		
BLOCK NO. 41						
SAT FISS PRSD		COLD				1.0000+00
-0.	1.2952-01	1.2952-01	-0.	-0.		
-0.	1.0618+01	1.0618+01	-0.	-0.		
-0.	9.5984+01	9.5984+01	-0.	-0.		
-0.	1.3597+01	1.3597+01	-0.	-0.		

FEVER LIBRARY CONTAINS THE FOLLOWING DATA

NU*FISSION TRANSPORT ABSORPTION SCATTER OUT NEUTS/FISSION DILUTION

BLOCK NO. 42					
RH 103		COLD			1.0000+00
0.	1.5042-01	1.5042-01	0.	0.	
0.	2.6053+00	2.6053+00	0.	0.	
0.	2.3170+00	2.3170+00	0.	0.	
0.	2.6496+02	2.6000+02	0.	0.	
BLOCK NO. 43					
XE 131		COLD			1.0000+00
0.	9.5739-02	9.5739-02	0.	0.	
0.	6.5368+01	6.5368+01	0.	0.	
0.	8.1791+00	8.1791+00	0.	0.	
0.	5.4200+01	5.0200+01	0.	0.	
BLOCK NO. 44					
ND 143		COLD			1.0000+00
0.	2.8129-02	2.8129-02	0.	0.	
0.	5.7026+00	5.7026+00	0.	0.	
0.	6.7807+00	6.7807+00	0.	0.	
0.	1.3680+02	1.2890+02	0.	0.	
BLOCK NO. 45					
PM 147		COLD			1.0000+00
0.	5.6745-01	5.6745-01	0.	0.	
0.	3.6849+01	3.6849+01	0.	0.	
0.	1.0612+03	1.0612+03	0.	0.	
0.	7.9600+01	7.1800+01	0.	0.	
BLOCK NO. 46					
SM 151		COLD			1.0000+00
0.	6.7702-01	6.7702-01	0.	0.	
0.	4.9910+01	4.9910+01	0.	0.	
0.	3.0307+02	3.0307+02	0.	0.	
0.	3.1180+03	3.1100+03	0.	0.	
BLOCK NO. 47					
SM 152		COLD			1.0000+00
-0.	6.7631-02	6.7631-02	-0.	-0.	
-0.	1.9803+01	1.9803+01	-0.	-0.	
-0.	1.2291+03	1.2291+03	-0.	-0.	
-0.	8.8990+01	8.8990+01	-0.	-0.	
BLOCK NO. 48					
B 10		COLD			1.0000+00
-0.	1.2669+01	1.0958+00	6.9480-01	-0.	
-0.	4.2480+01	2.3860+01	2.8380-01	-0.	
-0.	2.5640+02	2.3685+02	1.9180+00	-0.	
0.	1.5823+03	1.5635+03	0.	0.	

FEVER LIBRARY CONTAINS THE FOLLOWING DATA

NU*FISSION TRANSPORT ABSORPTION SCATTER OUT NEUTS/FISSION DILUTION

BLOCK NO. 49

NATURAL BORON

COLD

1.0000+00

-0.	2.5337+00	2.1915-01	1.3900-01	-0.
-0.	8.4960+00	4.7717+00	5.6760-02	-0.
-0.	5.1280+01	4.7370+01	3.8360-01	-0.
0.	3.1645+02	3.1270+02	0.	0.

BLOCK NO. 50

CARBON

COLD

1.0000+00

0.	2.8125+00	0.	1.6013-01	0.
0.	4.4310+00	0.	6.2664-02	0.
0.	4.4626+00	0.	4.0946-01	0.
0.	4.7950+00	1.5410-03	0.	0.

FEVER LIBRARY CONTAINS THE FOLLOWING DATA

SPECIAL DATA	CAPTURE	-----FISSION YIELDS-----			
SET IDENT.NO	FACTOR	FROM U233	FROM U235	FROM PU239	FROM PU241
1	-0.	1.2557+00	1.0000+00	1.3203+00	1.3203+00
2	-0.	6.7000-02	6.4100-02	5.5000-02	5.5000-02
3	-0.	6.5750-03	1.1778-02	2.0400-02	2.0400-02
4	-0.	2.0245-01	2.3412-01	2.1957-01	2.1957-01
5	-0.	1.6000-02	3.0000-02	5.7000-02	5.7000-02
6	-0.	3.7000-02	2.9300-02	3.2000-02	3.2000-02
7	-0.	5.2000-02	5.9800-02	6.1000-02	6.1000-02
8	-0.	1.7000-02	2.3800-02	2.6000-02	2.6000-02
9	-0.	2.6000-03	4.5000-03	10.0000-03	10.0000-03
10	1.0000+00	1.7000-03	2.8500-03	7.5000-03	7.5000-03

CRITERION FOR- CONVERGENCE CRITERION

EIGENVALUE-----	10.0000-06
PCINT-----	10.0000-04
CONTROL SEARCH----	10.0000-04

FEVER

SAMPLE CASE

PROBLEM TYPE---

CONTROL SEARCH BURNUP

NUMBER OF REGIONS--- 8

GEOMETRY-----

CYLINDER

NUMBER OF GROUPS---- 4

MATERIAL SUMMARY

REGION	TOTAL	SPECIAL	LUMPED POIS	CONTROL POIS
1	23	7	0	0
2	24	7	0	1
3	24	7	1	0
4	25	7	1	1
5	24	7	1	0
6	25	7	1	1
7	24	7	1	0
8	16	0	0	0

CORE HEIGHT	POWER(WATTS)	FISS/WATT-SEC	XE REMOVAL FRACT
2.28600+02	1.15000+08	3.38000+10	0.

MIN OR SEARCH KEFF	TIME STEP(DAYS)	MAX TIME STEPS	SMALL/LARGE STEPS
1.00000+00	1.00000+02	5	10

GROUP	LEFT ALBEDO	RIGHT ALBEDO
1	1.00000+00	0.
2	1.00000+00	0.
3	1.00000+00	0.
4	1.00000+00	0.

REGION	1		2		3		4	
MATERIAL NO.	HOT BLOCK NO.	COLD BLOCK NO.	HOT BLOCK NO.	COLD BLOCK NO.	HOT BLOCK NO.	COLD BLOCK NO.	HOT BLOCK NO.	COLD BLOCK NO.
1	1	26	1	26	1	26	1	26
2	2	27	2	27	2	27	2	27
3	3	28	3	28	3	28	3	28
4	4	29	4	29	4	29	4	29
5	5	30	5	30	5	30	5	30
6	6	31	6	31	6	31	6	31
7	7	32	7	32	7	32	7	32
8	8	33	8	33	8	33	8	33
9	9	34	9	34	9	34	9	34
10	10	35	10	35	10	35	10	35
11	11	36	11	36	11	36	11	36
12	12	37	12	37	12	37	12	37
13	13	38	13	38	13	38	13	38
14	14	39	14	39	14	39	14	39
15	15	40	15	40	15	40	15	40
16	16	41	16	41	16	41	16	41
17	17	42	17	42	17	42	17	42
18	18	43	18	43	18	43	18	43
19	19	44	19	44	19	44	19	44
20	20	45	20	45	20	45	20	45
21	21	46	21	46	21	46	21	46
22	22	47	22	47	22	47	22	47
23	25	50	24	49	23	48	23	48
24	0	0	25	50	25	50	24	49
25	0	0	0	0	0	0	25	50

REGION	5		6		7		8	
MATERIAL NO.	HOT BLOCK NO.	COLD BLOCK NO.	HOT BLOCK NO.	COLD BLOCK NO.	HOT BLOCK NO.	COLD BLOCK NO.	HOT BLOCK NO.	COLD BLOCK NO.
1	1	26	1	26	1	26	1	26
2	2	27	2	27	2	27	2	27
3	3	28	3	28	3	28	3	28
4	4	29	4	29	4	29	4	29
5	5	30	5	30	5	30	5	30
6	6	31	6	31	6	31	6	31
7	7	32	7	32	7	32	7	32
8	8	33	8	33	8	33	8	33
9	9	34	9	34	9	34	9	34
10	10	35	10	35	10	35	10	35
11	11	36	11	36	11	36	11	36
12	12	37	12	37	12	37	12	37
13	13	38	13	38	13	38	13	38
14	14	39	14	39	14	39	14	39
15	15	40	15	40	15	40	15	40
16	16	41	16	41	16	41	25	50
17	17	42	17	42	17	42	0	0
18	18	43	18	43	18	43	0	0
19	19	44	19	44	19	44	0	0
20	20	45	20	45	20	45	0	0
21	21	46	21	46	21	46	0	0
22	22	47	22	47	22	47	0	0
23	23	48	23	48	23	49	0	0
24	25	50	24	49	25	50	0	0
25	0	0	25	50	0	0	0	0

SPECIAL MATERIAL DATA

REGION	MATERIAL	CAPTURE PRODUCT	FISSION YIELDS			
			FROM U233	FROM U235	FROM PU239	FROM PU241
1	13	NO	1.25570+00	1.00000+00	1.32030+00	1.32030+00
1	14	NO	6.70000-02	6.41000-02	5.50000-02	5.50000-02
1	15	NO	6.57500-03	1.17780-02	2.04000-02	2.04000-02
1	16	NO	2.02450-01	2.34120-01	2.19570-01	2.19570-01
1	17	NO	1.60000-02	3.00000-02	5.70000-02	5.70000-02
1	18	NO	3.70000-02	2.93000-02	3.20000-02	3.20000-02
1	19	NO	5.20000-02	5.98000-02	6.10000-02	6.10000-02
1	20	NO	1.70000-02	2.38000-02	2.60000-02	2.60000-02
1	21	NO	2.60000-03	4.50000-03	10.00000-03	10.00000-03
1	22	YES	1.70000-03	2.85000-03	7.50000-03	7.50000-03
2	13	NO	1.25570+00	1.00000+00	1.32030+00	1.32030+00
2	14	NO	6.70000-02	6.41000-02	5.50000-02	5.50000-02
2	15	NO	6.57500-03	1.17780-02	2.04000-02	2.04000-02
2	16	NO	2.02450-01	2.34120-01	2.19570-01	2.19570-01
2	17	NO	1.60000-02	3.00000-02	5.70000-02	5.70000-02
2	18	NO	3.70000-02	2.93000-02	3.20000-02	3.20000-02
2	19	NO	5.20000-02	5.98000-02	6.10000-02	6.10000-02
2	20	NO	1.70000-02	2.38000-02	2.60000-02	2.60000-02
2	21	NO	2.60000-03	4.50000-03	10.00000-03	10.00000-03
2	22	YES	1.70000-03	2.85000-03	7.50000-03	7.50000-03
3	13	NO	1.25570+00	1.00000+00	1.32030+00	1.32030+00
3	14	NO	6.70000-02	6.41000-02	5.50000-02	5.50000-02
3	15	NO	6.57500-03	1.17780-02	2.04000-02	2.04000-02
3	16	NO	2.02450-01	2.34120-01	2.19570-01	2.19570-01
3	17	NO	1.60000-02	3.00000-02	5.70000-02	5.70000-02
3	18	NO	3.70000-02	2.93000-02	3.20000-02	3.20000-02
3	19	NO	5.20000-02	5.98000-02	6.10000-02	6.10000-02
3	20	NO	1.70000-02	2.38000-02	2.60000-02	2.60000-02
3	21	NO	2.60000-03	4.50000-03	10.00000-03	10.00000-03
3	22	YES	1.70000-03	2.85000-03	7.50000-03	7.50000-03
4	13	NO	1.25570+00	1.00000+00	1.32030+00	1.32030+00
4	14	NO	6.70000-02	6.41000-02	5.50000-02	5.50000-02
4	15	NO	6.57500-03	1.17780-02	2.04000-02	2.04000-02
4	16	NO	2.02450-01	2.34120-01	2.19570-01	2.19570-01
4	17	NO	1.60000-02	3.00000-02	5.70000-02	5.70000-02
4	18	NO	3.70000-02	2.93000-02	3.20000-02	3.20000-02
4	19	NO	5.20000-02	5.98000-02	6.10000-02	6.10000-02
4	20	NO	1.70000-02	2.38000-02	2.60000-02	2.60000-02
4	21	NO	2.60000-03	4.50000-03	10.00000-03	10.00000-03
4	22	YES	1.70000-03	2.85000-03	7.50000-03	7.50000-03
5	13	NO	1.25570+00	1.00000+00	1.32030+00	1.32030+00
5	14	NO	6.70000-02	6.41000-02	5.50000-02	5.50000-02
5	15	NO	6.57500-03	1.17780-02	2.04000-02	2.04000-02

SPECIAL MATERIAL DATA

REGION MATERIAL		CAPTURE PRODUCT	FISSION YIELDS			
			FROM U233	FROM U235	FROM PU239	FROM PU241
5	16	NO	2.02450-01	2.34120-01	2.19570-01	2.19570-01
5	17	NO	1.60000-02	3.00000-02	5.70000-02	5.70000-02
5	18	NO	3.70000-02	2.93000-02	3.20000-02	3.20000-02
5	19	NO	5.20000-02	5.98000-02	6.10000-02	6.10000-02
5	20	NO	1.70000-02	2.38000-02	2.60000-02	2.60000-02
5	21	NO	2.60000-03	4.50000-03	10.00000-03	10.00000-03
5	22	YES	1.70000-03	2.85000-03	7.50000-03	7.50000-03
6	13	NO	1.25570+00	1.00000+00	1.32030+00	1.32030+00
6	14	NO	6.70000-02	6.41000-02	5.50000-02	5.50000-02
6	15	NO	6.57500-03	1.17780-02	2.04000-02	2.04000-02
6	16	NO	2.02450-01	2.34120-01	2.19570-01	2.19570-01
6	17	NO	1.60000-02	3.00000-02	5.70000-02	5.70000-02
6	18	NO	3.70000-02	2.93000-02	3.20000-02	3.20000-02
6	19	NO	5.20000-02	5.98000-02	6.10000-02	6.10000-02
6	20	NO	1.70000-02	2.38000-02	2.60000-02	2.60000-02
6	21	NO	2.60000-03	4.50000-03	10.00000-03	10.00000-03
6	22	YES	1.70000-03	2.85000-03	7.50000-03	7.50000-03
7	13	NO	1.25570+00	1.00000+00	1.32030+00	1.32030+00
7	14	NO	6.70000-02	6.41000-02	5.50000-02	5.50000-02
7	15	NO	6.57500-03	1.17780-02	2.04000-02	2.04000-02
7	16	NO	2.02450-01	2.34120-01	2.19570-01	2.19570-01
7	17	NO	1.60000-02	3.00000-02	5.70000-02	5.70000-02
7	18	NO	3.70000-02	2.93000-02	3.20000-02	3.20000-02
7	19	NO	5.20000-02	5.98000-02	6.10000-02	6.10000-02
7	20	NO	1.70000-02	2.38000-02	2.60000-02	2.60000-02
7	21	NO	2.60000-03	4.50000-03	10.00000-03	10.00000-03
7	22	YES	1.70000-03	2.85000-03	7.50000-03	7.50000-03
8	13	NO	1.25570+00	1.00000+00	1.32030+00	1.32030+00
8	14	NO	6.70000-02	6.41000-02	5.50000-02	5.50000-02
8	15	NO	6.57500-03	1.17780-02	2.04000-02	2.04000-02

LUMPED POISSON DATA

REG	MAT	RDDS	I.D.	O.D.	LENGTH	ATOMIC WT	DENSITY
3	23	1.1712+01	0.	2.2225+00	2.2860+02	1.0016+01	6.9825-03
4	23	5.1404+00	0.	2.2225+00	2.2860+02	1.0016+01	6.9825-03
5	23	1.0928+01	0.	2.2225+00	2.2860+02	1.0016+01	6.9825-03
6	23	6.9468+00	0.	2.2225+00	2.2860+02	1.0016+01	6.9825-03
7	23	3.5412+01	0.	2.2225+00	2.2860+02	1.0016+01	6.9825-03

REG	MAT	COEFF 0	COEFF 1	COEFF 2	COEFF 3	COEFF 4	COEFF 5
3	23	9.7681-01	-3.8982-02	-2.1705+01	7.7086+02	0.	-0.
3	23	9.9986-01	-2.1934+00	-4.7158+02	5.3225+04	-1.7335+06	-0.
3	23	1.0034+00	-2.8343+01	3.7779+02	2.6625+04	-1.2054+06	-0.
3	23	1.0145+00	-1.8765+02	2.5806+04	-1.9211+06	5.2524+07	-0.
3	23	1.0034+00	-2.8229+01	3.1805+02	3.3796+04	-1.4472+06	-0.
3	23	1.0196+00	-2.3181+02	3.6657+04	-2.9215+06	8.2496+07	-0.
4	23	9.7681-01	-3.8982-02	-2.1705+01	7.7086+02	0.	-0.
4	23	9.9986-01	-2.1934+00	-4.7158+02	5.3225+04	-1.7335+06	-0.
4	23	1.0034+00	-2.8343+01	3.7779+02	2.6625+04	-1.2054+06	-0.
4	23	1.0145+00	-1.8766+02	2.5806+04	-1.9211+06	5.2524+07	-0.
4	23	1.0034+00	-2.8229+01	3.1805+02	3.3796+04	-1.4472+06	-0.
4	23	1.0196+00	-2.3181+02	3.6657+04	-2.9215+06	8.2496+07	-0.
5	23	9.7681-01	-3.8982-02	-2.1705+01	7.7086+02	0.	-0.
5	23	9.9986-01	-2.1934+00	-4.7158+02	5.3225+04	-1.7335+06	-0.
5	23	1.0034+00	-2.8343+01	3.7779+02	2.6625+04	-1.2054+06	-0.
5	23	1.0145+00	-1.8766+02	2.5806+04	-1.9211+06	5.2524+07	-0.
5	23	1.0034+00	-2.8229+01	3.1805+02	3.3796+04	-1.4472+06	-0.
5	23	1.0196+00	-2.3181+02	3.6657+04	-2.9215+06	8.2496+07	-0.
6	23	9.7681-01	-3.8982-02	-2.1705+01	7.7086+02	0.	-0.
6	23	9.9986-01	-2.1934+00	-4.7158+02	5.3225+04	-1.7335+06	-0.
6	23	1.0034+00	-2.8343+01	3.7779+02	2.6625+04	-1.2054+06	-0.
6	23	1.0145+00	-1.8765+02	2.5806+04	-1.9211+06	5.2524+07	-0.
6	23	1.0034+00	-2.8229+01	3.1805+02	3.3796+04	-1.4472+06	-0.
6	23	1.0196+00	-2.3181+02	3.6657+04	-2.9215+06	8.2496+07	-0.
7	23	9.7681-01	-3.8982-02	-2.1705+01	7.7086+02	0.	-0.
7	23	9.9986-01	-2.1934+00	-4.7158+02	5.3225+04	-1.7335+06	-0.
7	23	1.0034+00	-2.8343+01	3.7779+02	2.6625+04	-1.2054+06	-0.
7	23	1.0145+00	-1.8765+02	2.5806+04	-1.9211+06	5.2524+07	-0.
7	23	1.0034+00	-2.8229+01	3.1805+02	3.3796+04	-1.4472+06	-0.
7	23	1.0196+00	-2.3181+02	3.6657+04	-2.9215+06	8.2496+07	-0.

CONTROL POISON DATA

REGION	MATERIAL	MAX ATOM DENSITY	MIN ATOM DENSITY
2	23	1.62700-03	0.
4	24	3.13400-04	0.
6	24	1.20400-03	0.

MAX TOTAL ADJ.	MAX ADJ (OVE REG)	13.REG.ADJ.SIMULTANEOUSLY
200	20	1

ORDER OF USE	CONTROL REG	MAX INSERT.FRACT	MIN INSERT.FRACT
1	2	1.00000+00	5.00000-01
2	6	1.00000+00	0.
3	4	1.00000+00	0.
4	2	5.00000-01	0.

TIME STEP -1

REGION 1

MATERIAL	ATOM DENSITY	GROUP SELF SHIELDING FACTORS			
1	1.95000-04	1.00000+00	1.00000+00	1.00000+00	1.00000+00
2	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
3	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
4	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
5	2.90000-05	1.00000+00	1.00000+00	1.00000+00	1.00000+00
6	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
7	2.78000-06	1.00000+00	1.00000+00	1.00000+00	1.00000+00
8	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
9	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
10	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
11	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
12	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
13	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
14	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
15	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
16	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
17	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
18	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
19	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
20	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
21	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
22	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
23	7.50000-02	1.00000+00	1.00000+00	1.00000+00	1.00000+00

TIME STEP -1

REGION 2

MATERIAL	ATOM DENSITY	GROUP SELF SHIELDING FACTORS			
1	1.95000-04	1.00000+00	1.00000+00	1.00000+00	1.00000+00
2	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
3	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
4	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
5	2.90000-05	1.00000+00	1.00000+00	1.00000+00	1.00000+00
6	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
7	2.78000-05	1.00000+00	1.00000+00	1.00000+00	1.00000+00
8	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
9	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
10	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
11	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
12	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
13	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
14	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
15	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
16	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
17	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
18	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
19	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
20	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
21	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
22	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
23	1.62700-03	8.86000-01	6.56000-01	1.43000-01	2.35000-02
24	7.50000-02	1.00000+00	1.00000+00	1.00000+00	1.00000+00

TIME STEP -1

REGION 3

MATERIAL	ATOM DENSITY	GROUP SELF SHIELDING FACTORS			
1	1.95000-04	1.00000+00	1.00000+00	1.00000+00	1.00000+00
2	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
3	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
4	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
5	2.90000-05	1.00000+00	1.00000+00	1.00000+00	1.00000+00
6	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
7	2.78000-06	1.00000+00	1.00000+00	1.00000+00	1.00000+00
8	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
9	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
10	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
11	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
12	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
13	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
14	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
15	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
16	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
17	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
18	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
19	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
20	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
21	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
22	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
23	2.05262-06	9.75742-01	9.75551-01	8.30078-01	4.33190-01
24	7.50000-02	1.00000+00	1.00000+00	1.00000+00	1.00000+00

TIME STEP -1

REGION 4

MATERIAL	ATOM DENSITY	GROUP SELF SHIELDING FACTORS				
1	1.95000-04	1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00
2	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00
3	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00
4	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00
5	2.90000-05	1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00
6	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00
7	2.78000-06	1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00
8	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00
9	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00
10	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00
11	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00
12	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00
13	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00
14	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00
15	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00
16	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00
17	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00
18	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00
19	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00
20	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00
21	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00
22	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00
23	2.01913-06	9.75742-01	9.75551-01	8.40078-01	4.33190-01	4.33190-01
24	8.13400-04	8.20000-01	5.80000-01	1.21000-01	1.85000-02	1.85000-02
25	7.50000-02	1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00

TIME STEP -1

REGION 5

MATERIAL	ATOM DENSITY	GROUP SELF SHIELDING FACTORS			
1	1.95000-04	1.00000+00	1.00000+00	1.00000+00	1.00000+00
2	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
3	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
4	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
5	2.90000-05	1.00000+00	1.00000+00	1.00000+00	1.00000+00
6	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
7	2.78000-06	1.00000+00	1.00000+00	1.00000+00	1.00000+00
8	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
9	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
10	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
11	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
12	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
13	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
14	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
15	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
16	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
17	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
18	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
19	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
20	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
21	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
22	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
23	2.02579-06	9.75742-01	9.75551-01	8.30078-01	4.33190-01
24	7.50000-02	1.00000+00	1.00000+00	1.00000+00	1.00000+00

TIME STEP -1

REGION 6

MATERIAL	ATOM DENSITY	GROUP SELF SHIELDING FACTORS			
1	1.95000-04	1.00000+00	1.00000+00	1.00000+00	1.00000+00
2	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
3	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
4	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
5	2.90000-05	1.00000+00	1.00000+00	1.00000+00	1.00000+00
6	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
7	2.78000-06	1.00000+00	1.00000+00	1.00000+00	1.00000+00
8	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
9	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
10	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
11	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
12	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
13	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
14	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
15	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
16	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
17	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
18	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
19	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
20	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
21	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
22	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
23	2.01902-06	9.75742-01	9.75551-01	8.30078-01	4.33190-01
24	1.20400-03	8.62000-01	6.30000-01	1.34000-01	2.11000-02
25	7.50000-02	1.00000+00	1.00000+00	1.00000+00	1.00000+00

TIME STEP -1

REGION 7

MATERIAL	ATOM DENSITY	GROUP SELF SHIELDING FACTORS				
1	1.95000-04	1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00
2	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00
3	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00
4	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00
5	2.90000-05	1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00
6	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00
7	2.78000-06	1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00
8	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00
9	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00
10	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00
11	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00
12	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00
13	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00
14	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00
15	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00
16	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00
17	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00
18	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00
19	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00
20	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00
21	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00
22	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00
23	2.02422-06	9.75742-01	9.75551-01	8.30078-01	4.33190-01	4.33190-01
24	7.50000-02	1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00

TIME STEP -1

REGION 8

MATERIAL	ATOM DENSITY	GROUP SELF SHIELDING FACTORS			
1	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
2	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
3	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
4	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
5	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
6	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
7	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
8	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
9	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
10	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
11	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
12	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
13	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
14	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
15	0.	1.00000+00	1.00000+00	1.00000+00	1.00000+00
16	8.52500-02	1.00000+00	1.00000+00	1.00000+00	1.00000+00

TIME STEP -1

WEIGHTS OF MATERIALS (GRAMS)

REGION	TH-232	PA-233	U-233	U-234	U-235	U-236
1	5.42175+04	0.	0.	0.	2.16753+03	0.
2	3.55959+04	0.	0.	0.	5.36231+03	0.
3	1.59668+05	0.	0.	0.	2.40530+04	0.
4	7.12409+04	0.	0.	0.	1.07320+04	0.
5	1.50954+05	0.	0.	0.	2.27402+04	0.
6	9.62806+04	0.	0.	0.	1.45041+04	0.
7	4.89534+05	0.	0.	0.	7.37454+04	0.
8	0.	0.	0.	0.	0.	0.
TOTAL	1.05749+06	0.	0.	0.	1.59305+05	0.
REGION	U-238	NP-239	PU-239	PU-240	PU-241	PU-242
1	7.92773+02	0.	0.	0.	0.	0.
2	5.20618+02	0.	0.	0.	0.	0.
3	2.33527+03	0.	0.	0.	0.	0.
4	1.04195+03	0.	0.	0.	0.	0.
5	2.20782+03	0.	0.	0.	0.	0.
6	1.40618+03	0.	0.	0.	0.	0.
7	7.15983+03	0.	0.	0.	0.	0.
8	0.	0.	0.	0.	0.	0.
TOTAL	1.54666+04	0.	0.	0.	0.	0.

TIME STEP -1

LUMPED POISON DATA - DENSITY AND HOT,COLD SELF SHIELDING (SS)

REGION	MATERIAL	GRAMS/CC	HOT SS GRP1	HOT SS GRP2	HOT SS GRP3	HOT SS GRP4	COLD SS GRP3	COLD SS GRP4
3	23	6.98250-03	9.75742-01	9.75551-01	8.30078-01	4.33190-01	8.29863-01	3.89732-01
4	23	6.98250-03	9.75742-01	9.75551-01	8.30078-01	4.33190-01	8.29863-01	3.89732-01
5	23	6.98250-03	9.75742-01	9.75551-01	8.30078-01	4.33190-01	8.29863-01	3.89732-01
6	23	6.98250-03	9.75742-01	9.75551-01	8.30078-01	4.33190-01	8.29863-01	3.89732-01
7	23	6.98250-03	9.75742-01	9.75551-01	8.30078-01	4.33190-01	8.29863-01	3.89732-01

STATUS OF CONTROL POISONS -- TIME STEP -1

REGION	MATERIAL	ATOM DENSITY	INSERTION FRACT
2	23	1.62700-03	1.00000+00
4	24	8.13400-04	1.00000+00
6	24	1.20400-03	1.00000+00

SAMPLE CASE

DIFFUSION CALCULATION

TIME STEP -1

REGIONAL DATA

REGION	INTERVALS	POSITION
1	4	3.17000+01
2	4	4.08000+01
3	4	6.80000+01
4	4	7.71000+01
5	4	9.35000+01
6	4	1.02600+02
7	8	1.40000+02
8	8	2.10000+02

GROUP CONSTANTS

REGION	GROUP	BUCKLING	DIFFUSION	ABSORPTION	FISSION	SCATTER OUT
1	1	3.25000-04	1.56960+00	7.62631-05	1.21508-04	1.23300-02
1	2	1.62000-04	9.87652-01	1.93321-03	1.09415-03	4.54279-03
1	3	7.46000-06	9.80788-01	2.40229-03	2.70112-03	3.07220-02
1	4	7.46000-06	9.00455-01	6.08446-03	1.11978-02	0.
2	1	3.25000-04	1.54306+00	3.92173-04	1.21508-04	1.25304-02
2	2	1.62000-04	9.51810-01	7.02610-03	1.09415-03	4.60337-03
2	3	7.46000-06	9.47525-01	1.34234-02	2.70112-03	3.09112-02
2	4	7.46000-06	8.77864-01	1.54672-02	1.11978-02	0.
3	1	3.25000-04	1.56941+00	7.84578-05	1.21508-04	1.23314-02
3	2	1.62000-04	9.87403-01	1.98099-03	1.09415-03	4.54336-03
3	3	7.46000-06	9.79529-01	2.80585-03	2.70112-03	3.07253-02
3	4	7.46000-06	8.97768-01	7.17548-03	1.11978-02	0.
4	1	3.25000-04	1.55703+00	2.24592-04	1.21508-04	1.24241-02
4	2	1.62000-04	9.75663-01	4.26241-03	1.09415-03	4.57050-03
4	3	7.46000-06	9.65233-01	7.46148-03	2.70112-03	3.07630-02
4	4	7.46000-06	8.88836-01	1.08504-02	1.11978-02	0.
5	1	3.25000-04	1.56942+00	7.84291-05	1.21508-04	1.23314-02
5	2	1.62000-04	9.87406-01	1.98036-03	1.09415-03	4.54335-03
5	3	7.46000-06	9.79545-01	2.80057-03	2.70112-03	3.07252-02
5	4	7.46000-06	8.97803-01	7.16122-03	1.11978-02	0.
6	1	3.25000-04	1.55022+00	3.35866-04	1.21508-04	1.24756-02
6	2	1.62000-04	7.68911-01	5.59964-03	1.09415-03	4.58640-03
6	3	7.46000-06	9.56299-01	1.04417-02	2.70112-03	3.07871-02
6	4	7.46000-06	8.82762-01	1.33919-02	1.11978-02	0.

REGION	GROUP	BUCKLING	DIFFUSION	ABSORPTION	FISSION	SCATTER	GUT
7	1	3.25000-04	1.56942+00	7.84274-05	1.21508-04	1.23314-02	
7	2	1.62000-04	9.87406-01	1.98033-03	1.09415-03	4.54335-03	
7	3	7.46000-06	9.79546-01	2.80026-03	2.70112-03	3.07252-02	
7	4	7.46000-06	8.97805-01	7.16039-03	1.11978-02	0.	
8	1	8.03000-05	1.39022+00	0.	0.	1.36513-02	
8	2	8.03000-05	8.82307-01	0.	0.	5.16090-03	
8	3	8.03000-05	8.76176-01	0.	0.	3.49058-02	
8	4	8.03000-05	8.11740-01	1.03408-04	0.	0.	
			K-EFFECTIVE				
		94	8.99145-01				

POINT	POSITION	POWER DIST.	FLUX 1	FLUX 2	FLUX 3	FLUX 4
1	7.92500+00	8.8002-01	9.0696-01	1.4965+00	1.9978-01	8.3853-01
2	1.58500+01	8.3330-01	8.7298-01	1.4433+00	1.9209-01	7.9060-01
3	2.37750+01	7.4681-01	8.1983-01	1.3510+00	1.7756-01	7.0121-01
4	3.17000+01	6.1713-01	7.6700-01	1.2227+00	1.5318-01	5.6654-01
5	3.39750+01	5.8521-01	7.5977-01	1.1924+00	1.4618-01	5.3343-01
6	3.62500+01	5.7645-01	7.5808-01	1.1877+00	1.4481-01	5.2386-01
7	3.85250+01	5.8879-01	7.6192-01	1.2067+00	1.4850-01	5.3570-01
8	4.08000+01	6.2153-01	7.7055-01	1.2490+00	1.5735-01	5.6813-01
9	4.76000+01	7.1660-01	8.0984-01	1.3673+00	1.7932-01	6.6350-01
10	5.44000+01	7.6392-01	8.4078-01	1.4328+00	1.8961-01	7.1035-01
11	6.12000+01	7.7168-01	8.5668-01	1.4557+00	1.9198-01	7.1657-01
12	6.80000+01	7.4291-01	8.6196-01	1.4392+00	1.8626-01	6.8542-01
13	7.02750+01	7.3224-01	8.6506-01	1.4324+00	1.8371-01	6.7402-01
14	7.25500+01	7.3141-01	8.6993-01	1.4369+00	1.8375-01	6.7253-01
15	7.49250+01	7.4000-01	8.7677-01	1.4523+00	1.8620-01	6.8054-01
16	7.71000+01	7.5784-01	8.8542-01	1.4785+00	1.9112-01	6.9783-01
17	8.12000+01	7.8874-01	9.0294-01	1.5249+00	1.9937-01	7.2774-01
18	8.53000+01	8.0198-01	9.1987-01	1.5534+00	2.0314-01	7.3956-01
19	8.94000+01	7.9795-01	9.3652-01	1.5645+00	2.0263-01	7.3363-01
20	9.35000+01	7.7661-01	9.5582-01	1.5569+00	1.9687-01	7.1026-01
21	9.57750+01	7.6990-01	9.7095-01	1.5576+00	1.9413-01	7.0276-01
22	9.80500+01	7.8290-01	9.9080-01	1.5793+00	1.9607-01	7.1535-01
23	1.00325+02	8.1564-01	1.0155+00	1.6214+00	2.0246-01	7.4822-01
24	1.02600+02	8.6903-01	1.0445+00	1.6843+00	2.1359-01	8.0233-01
25	1.07275+02	7.8558-01	1.1094+00	1.8118+00	2.3539-01	9.2203-01
26	1.11750+02	1.0803+00	1.1686+00	1.8999+00	2.4836-01	1.0217+00
27	1.16625+02	1.1602+00	1.2140+00	1.9472+00	2.5551-01	1.1097+00
28	1.21300+02	1.2341+00	1.2379+00	1.9503+00	2.5580-01	1.1966+00
29	1.25975+02	1.3141+00	1.2306+00	1.9048+00	2.4989-01	1.2974+00
30	1.30650+02	1.4179+00	1.1759+00	1.8079+00	2.3818-01	1.4333+00
31	1.35325+02	1.5715+00	1.0447+00	1.6618+00	2.2192-01	1.6350+00
32	1.40000+02	1.8141+00	7.8521-01	1.4820+00	2.0394-01	1.9471+00
32	1.40000+02	0.	7.8521-01	1.4820+00	2.0384-01	1.9471+00
33	1.48750+02	0.	3.2736-01	9.9955-01	1.4741-01	2.4274+00
34	1.57500+02	0.	1.3670-01	6.0877-01	9.3973-02	2.4463+00
35	1.66250+02	0.	5.7167-02	3.5047-01	5.5765-02	2.2010+00
36	1.75000+02	0.	2.3930-02	1.9445-01	3.1587-02	1.8236+00
37	1.83750+02	0.	1.0009-02	1.0452-01	1.7224-02	1.3913+00
38	1.92500+02	0.	4.1453-03	5.3537-02	8.9086-03	9.4544-01
39	2.01250+02	0.	1.6146-03	2.3783-02	3.9789-03	5.0538-01
40	2.10000+02	0.	3.8934-04	3.9914-03	6.6389-04	7.9093-02

	AVERAGE CORE FLUXES			
REGION	FLUX 1	FLUX 2	FLUX 3	FLUX 4
ALL POWER PRODUCERS	5.0606-11	8.2298-11	1.0717-11	4.8790-11

	AVERAGE REGION FLUXES			
REGION	FLUX 1	FLUX 2	FLUX 3	FLUX 4
1	4.2043-11	6.8834-11	9.0015-12	3.5781-11
2	3.8573-11	6.1046-11	7.5297-12	2.7334-11
3	4.2266-11	7.1288-11	9.3358-12	3.4646-11
4	4.4110-11	7.3153-11	9.3947-12	3.4403-11
5	4.6620-11	7.8010-11	1.0116-11	3.6763-11
6	5.0359-11	8.0758-11	1.0102-11	3.7016-11
7	5.7372-11	9.1882-11	1.2088-11	6.4523-11
8	5.1287-12	1.7181-11	2.5861-12	7.6464-11

SAMPLE CASE

POWER DISTRIBUTION AT TIME STEP -1

1.8141+00I
1.7676+00I
1.7210+00I
1.6745+00I
1.6280+00I
1.5815+00I
1.5350+00I
1.4885+00I
1.4420+00I
1.3954+00I
1.3489+00I
1.3024+00I
1.2559+00I
1.2094+00I
1.1629+00I
1.1164+00I
1.0698+00I
1.0233+00I
9.7681-01I
9.3029-01I
8.8378-01I
3.3726-01I*
7.9075-01I
7.4424-01I
6.9772-01I
6.5121-01I
6.0469-01I
5.5813-01I
5.1165-01I
4.6515-01I
4.1863-01I
3.7212-01I
3.2560-01I
2.7909-01I
2.3257-01I
1.8606-01I
1.3954-01I
9.3029-02I
4.6515-02I
-2.1234-07I

STATUS OF CONTROL POISONS -- TIME STEP -1

REGION	MATERIAL	ATOM DENSITY	INSERTION FRACT
2	23	8.13500-04	5.00000-01
4	24	8.13400-04	1.00000+00
6	24	1.48508-04	1.23346-01

SAMPLE CASE

DIFFUSION CALCULATION

TIME STEP -1

REGIONAL DATA

REGION	INTERVALS	POSITION
1	4	3.17000+01
2	4	4.08000+01
3	4	6.80000+01
4	4	7.71000+01
5	4	9.35000+01
6	4	1.02600+02
7	8	1.40000+02
8	8	2.10000+02

GROUP CONSTANTS

REGION	GROUP	BUCKLING	DIFFUSION	ABSORPTION	FISSION	SCATTER CUT
1	1	3.25000-04	1.56960+00	7.62631-05	1.21508-04	1.23300-02
1	2	1.62000-04	9.87652-01	1.93321-03	1.09415-03	4.54279-03
1	3	7.46000-06	9.63870-01	2.40229-03	2.70112-03	3.07220-02
1	4	7.46000-06	9.00455-01	6.08446-03	1.11978-02	0.
2	1	3.25000-04	1.55622+00	2.34218-04	1.21508-04	1.24302-02
2	2	1.62000-04	9.74560-01	4.47766-03	1.09415-03	4.57308-03
2	3	7.46000-06	9.63870-01	7.91287-03	2.70112-03	3.07666-02
2	4	7.46000-06	8.89016-01	1.07758-02	1.11978-02	0.
3	1	3.25000-04	1.56941+00	7.84578-05	1.21508-04	1.23314-02
3	2	1.62000-04	9.87403-01	1.98099-03	1.09415-03	4.54336-03
3	3	7.46000-06	9.79529-01	2.80585-03	2.70112-03	3.07253-02
3	4	7.46000-06	8.97768-01	7.17548-03	1.11978-02	0.
4	1	3.25000-04	1.55703+00	2.24592-04	1.21508-04	1.24241-02
4	2	1.62000-04	9.75663-01	4.26241-03	1.09415-03	4.57050-03
4	3	7.46000-06	9.65233-01	7.46148-03	2.70112-03	3.07630-02
4	4	7.46000-06	8.88836-01	1.08504-02	1.11978-02	0.
5	1	3.25000-04	1.56942+00	7.84291-05	1.21508-04	1.23314-02
5	2	1.62000-04	9.87406-01	1.98036-03	1.09415-03	4.54335-03
5	3	7.46000-06	9.79545-01	2.80057-03	2.70112-03	3.07252-02
5	4	7.46000-06	8.97803-01	7.16122-03	1.11978-02	0.
6	1	3.25000-04	1.56702+00	1.06476-04	1.21508-04	1.23492-02
6	2	1.62000-04	9.85088-01	2.42665-03	1.09415-03	4.54866-03
6	3	7.46000-06	9.76621-01	3.74191-03	2.70112-03	3.07328-02
6	4	7.46000-06	8.95928-01	7.92659-03	1.11978-02	0.

REGION	GROUP	BUCKLING	DIFFUSION	ABSORPTION	FISSION	SCATTER OUT
7	1	3.25000-04	1.56942+00	7.84274-05	1.21508-04	1.23314-02
7	2	1.62000-04	9.37406-01	1.98033-03	1.09415-03	4.54335-03
7	3	7.46000-06	9.79546-01	2.80026-03	2.70112-03	3.07252-02
7	4	7.46000-06	8.77805-01	7.16039-03	1.11978-02	0.
8	1	3.03000-05	1.39022+00	0.	0.	1.35513-02
8	2	6.03000-05	3.82307-01	0.	0.	5.16050-03
8	3	8.03000-05	3.76176-01	0.	0.	3.49055-02
8	4	5.03000-05	8.11740-01	1.03408-04	0.	0.

K-EFFECTIVE

14 9.99867-01

POINT	POSITION	POWER DIST.	FLUX 1	FLUX 2	FLUX 3	FLUX 4
1	7.92500+00	1.0557+00	1.0887+00	1.8530+00	2.4932-01	1.1043+00
2	1.58500+01	1.0168+00	1.0582+00	1.8052+00	2.4253-01	1.0609+00
3	2.37750+01	9.4451-01	1.0087+00	1.7223+00	2.2992-01	9.7969-01
4	3.17000+01	8.3548-01	9.5370-01	1.6082+00	2.0949-01	8.5617-01
5	3.39750+01	8.0615-01	9.4234-01	1.5790+00	2.0346-01	8.2290-01
6	3.62500+01	7.9193-01	9.3429-01	1.5662+00	2.0120-01	8.0650-01
7	3.95250+01	7.9132-01	9.2963-01	1.5687+00	2.0230-01	8.0525-01
8	4.08000+01	8.0335-01	9.2798-01	1.5860+00	2.0673-01	8.1797-01
9	4.76000+01	8.4021-01	9.3268-01	1.6333+00	2.1717-01	8.5818-01
10	5.44000+01	8.5005-01	9.3540-01	1.6488+00	2.2014-01	8.6857-01
11	6.12000+01	8.3627-01	9.3349-01	1.6400+00	2.1794-01	8.5227-01
12	6.80000+01	7.9909-01	9.3230-01	1.6077+00	2.0963-01	8.0964-01
13	7.02750+01	7.8880-01	9.3569-01	1.5995+00	2.0671-01	7.9787-01
14	7.25500+01	7.9081-01	9.4209-01	1.6060+00	2.0702-01	7.9968-01
15	7.48250+01	8.0476-01	9.5158-01	1.6266+00	2.1036-01	8.1470-01
16	7.71000+01	8.3062-01	9.6383-01	1.6612+00	2.1681-01	8.4288-01
17	8.12000+01	8.8068-01	9.8954-01	1.7270+00	2.2859-01	8.9768-01
18	8.53000+01	9.1852-01	1.0151+00	1.7787+00	2.3678-01	9.3903-01
19	8.94000+01	9.4560-01	1.0382+00	1.8175+00	2.4221-01	9.6850-01
20	9.35000+01	9.6308-01	1.0583+00	1.8437+00	2.4513-01	9.8749-01
21	9.57750+01	9.7103-01	1.0682+00	1.8547+00	2.4615-01	9.9629-01
22	9.80500+01	9.8036-01	1.0775+00	1.8656+00	2.4743-01	1.0068+00
23	1.00325+02	9.9123-01	1.0861+00	1.8763+00	2.4891-01	1.0193+00
24	1.02600+02	1.0036+00	1.0939+00	1.8866+00	2.5062-01	1.0340+00
25	1.07275+02	1.0272+00	1.1063+00	1.8971+00	2.5246-01	1.0624+00
26	1.11950+02	1.0447+00	1.1113+00	1.8863+00	2.5088-01	1.0863+00
27	1.16625+02	1.0603+00	1.1068+00	1.8521+00	2.4592-01	1.1109+00
28	1.21300+02	1.0300+00	1.0892+00	1.7917+00	2.3749-01	1.1444+00
29	1.25975+02	1.1124+00	1.0522+00	1.7019+00	2.2551-01	1.1981+00
30	1.30650+02	1.1708+00	9.3332-01	1.5807+00	2.1023-01	1.2895+00
31	1.35325+02	1.2754+00	8.6006-01	1.4297+00	1.9260-01	1.4443+00
32	1.40000+02	1.4562+00	6.4169-01	1.2610+00	1.7474-01	1.6999+00
32	1.40000+02	0.	6.4169-01	1.2610+00	1.7474-01	1.6999+00
33	1.48750+02	0.	2.6752-01	8.4187-01	1.2470-01	2.0935+00
34	1.57500+02	0.	1.1172-01	5.1006-01	7.8957-02	2.0982+00
35	1.66250+02	0.	4.6718-02	2.9272-01	4.6664-02	1.8821+00
36	1.75000+02	0.	1.9556-02	1.6208-01	2.6363-02	1.5565+00
37	1.83750+02	0.	8.1794-03	8.6997-02	1.4350-02	1.1863+00
38	1.92500+02	0.	3.3876-03	4.4518-02	7.4135-03	8.0562-01
39	2.01250+02	0.	1.3195-03	1.9765-02	3.3087-03	4.3050-01
40	2.10000+02	0.	3.1818-04	3.3170-03	5.5207-04	6.7374-02

	AVERAGE CORE FLUXES			
REGION	FLUX 1	FLUX 2	FLUX 3	FLUX 4
ALL POWER PRODUCERS	4.6637-11	7.9551-11	1.0554-11	4.9138-11

	AVERAGE REGION FLUXES			
REGION	FLUX 1	FLUX 2	FLUX 3	FLUX 4
1	4.7446-11	8.0721-11	1.0745-11	4.5923-11
2	4.3660-11	7.3558-11	9.5003-12	3.8105-11
3	4.3516-11	7.6048-11	1.0072-11	3.9537-11
4	4.4059-11	7.5425-11	9.7664-12	3.7777-11
5	4.7346-11	8.2651-11	1.0966-11	4.3498-11
6	5.0242-11	8.7016-11	1.1549-11	4.7042-11
7	4.7229-11	7.9177-11	1.0558-11	5.7232-11
8	3.8626-12	1.3316-11	2.0113-12	6.0393-11

SAMPLE CASE

TIME STEP -1

K-EFFECTIVE= 9.99867-01

NEUTRON BALANCE PER SOURCE NEUTRON

NORMAL LEAKAGE

GROUP	ABSORPTION	TRANSVERSE LEAKAGE	SCATTERING OUT	SOURCE	NORMAL LEAKAGE	CROSS SECTION	BUCKLING
1	6.6172-03	3.5391-02	8.5714-01	1.0000+00	1.0085-01	1.4522-03	9.2616-04
2	2.6606-01	1.8923-02	5.3859-01	8.5714-01	3.3565-02	2.8334-04	2.8735-04
3	5.2171-02	1.1466-04	4.8294-01	5.3859-01	3.3611-03	2.1387-04	2.1869-04
4	5.4609-01	4.8968-04	0.	4.8294-01	-6.3636-02	-8.6968-04	-9.6946-04
TOTAL	8.7094-01	5.4918-02			7.4144-02		

FRACTIONAL ABSORPTIONS

FRACTIONAL PRODUCTIONS

MATERIAL	GROUP 1	GROUP 2	GROUP 3	GROUP 4	ALL GROUPS	GROUP 1	GROUP 2	GROUP 3	GROUP 4
1	2.7809-03	1.6223-01	1.6741-03	4.0171-02	2.0686-01	1.2619-03	0.	0.	0.
2	0.	0.	0.	0.	0.	0.	0.	0.	0.
3	0.	0.	0.	0.	0.	0.	0.	0.	0.
4	0.	0.	0.	0.	0.	0.	0.	0.	0.
5	3.2415-03	9.6125-02	3.8060-02	4.6317-01	6.0059-01	7.1065-03	1.2963-01	4.2456-02	8.1947-01
6	0.	0.	0.	0.	0.	0.	0.	0.	0.
7	5.8796-05	4.5899-03	3.6148-03	2.0577-04	8.4692-03	7.1193-05	0.	0.	0.
8	0.	0.	0.	0.	0.	0.	0.	0.	0.
9	0.	0.	0.	0.	0.	0.	0.	0.	0.
10	0.	0.	0.	0.	0.	0.	0.	0.	0.
11	0.	0.	0.	0.	0.	0.	0.	0.	0.
12	0.	0.	0.	0.	0.	0.	0.	0.	0.
13	0.	0.	0.	0.	0.	0.	0.	0.	0.
14	0.	0.	0.	0.	0.	0.	0.	0.	0.
15	0.	0.	0.	0.	0.	0.	0.	0.	0.
16	0.	0.	0.	0.	0.	-0.	-0.	-0.	-0.
17	0.	0.	0.	0.	0.	0.	0.	0.	0.
18	0.	0.	0.	0.	0.	0.	0.	0.	0.
19	0.	0.	0.	0.	0.	0.	0.	0.	0.
20	0.	0.	0.	0.	0.	0.	0.	0.	0.
21	0.	0.	0.	0.	0.	0.	0.	0.	0.
22	0.	0.	0.	0.	0.	-0.	-0.	-0.	-0.
23	5.5534-04	1.6667-02	9.6142-03	9.4489-02	1.2133-01	-0.	-0.	-0.	0.
24	9.6123-04	2.5875-02	6.9395-03	2.7915-02	6.1690-02	0.	0.	0.	0.
25	0.	0.	0.	1.0621-03	1.0621-03	0.	0.	0.	0.

SAMPLE CASE

POWER DISTRIBUTION AT TIME STEP -1

1.4562+00I
1.4188+00I
1.3815+00I
1.3442+00I
1.3068+00I
1.2695+00I
1.2321+00I
1.1948+00I
1.1575+00I
1.1201+00I
1.0828+00I
1.0455+00I*
1.0081+00I
9.7078-01I
9.3344-01I
8.9610-01I
8.5877-01I
8.2143-01I
7.8409-01I
7.4675-01I
7.0942-01I
6.7208-01I
6.3474-01I
5.9740-01I
5.6007-01I
5.2273-01I
4.8539-01I
4.4805-01I
4.1071-01I
3.7338-01I
3.3604-01I
2.9870-01I
2.6136-01I
2.2403-01I
1.8669-01I
1.4935-01I
1.1201-01I
7.4675-02I
3.7338-02I
-7.5437-08I

TIME STEP -1

HOT REACTOR WITHOUT CONTROL POISON ,K-EFF = 1.12366+00

COLD REACTOR, NO XE AND ALL CONTROL RODS FULLY IN, K-EFF = 9.54758-01

TIME STEP -0

REGION	-----FRACTION OF FISSIONS FROM-----			
	U-233	U-235	PU-239	PU-241
1	0.	1.00000+00	0.	0.
2	0.	1.00000+00	0.	0.
3	0.	1.00000+00	0.	0.
4	0.	1.00000+00	0.	0.
5	0.	1.00000+00	0.	0.
6	0.	1.00000+00	0.	0.
7	0.	1.00000+00	0.	0.
8	0.	0.	0.	0.

REGION	CONVERSION RATIO	REG VOLUME	
1	-0.	7.21679+05	
2	-0.	4.73811+05	
3	-0.	2.12532+06	
4	-0.	9.48275+05	
5	-0.	2.00932+06	
6	-0.	1.26158+06	
7	-0.	6.51611+06	
8	0.	1.75951+07	
AVERAGE	0.	POWER GENERATING VOL=	1.40761+07

TIME STEP -0

ATOMIC DENSITIES

REGION	1	2	3	4	5	6	7	8
MATERIAL								
1	1.95000-04	1.95000-04	1.95000-04	1.95000-04	1.95000-04	1.95000-04	1.95000-04	0.
2	-0.	-0.	-0.	-0.	-0.	-0.	-0.	-0.
3	0.	0.	0.	0.	0.	0.	0.	0.
4	0.	0.	0.	0.	0.	0.	0.	0.
5	2.90000-05	2.90000-05	2.90000-05	2.90000-05	2.90000-05	2.90000-05	2.90000-05	0.
6	0.	0.	0.	0.	0.	0.	0.	0.
7	2.78000-06	2.78000-06	2.78000-06	2.78000-06	2.78000-06	2.78000-06	2.78000-06	0.
8	-0.	-0.	-0.	-0.	-0.	-0.	-0.	-0.
9	0.	0.	0.	0.	0.	0.	0.	0.
10	0.	0.	0.	0.	0.	0.	0.	0.
11	0.	0.	0.	0.	0.	0.	0.	0.
12	0.	0.	0.	0.	0.	0.	0.	0.
13	0.	0.	0.	0.	0.	0.	0.	0.
14	3.42297-10	3.20189-10	3.25629-10	3.21127-10	3.39409-10	3.49202-10	3.58634-10	0.
15	3.32229-09	3.37858-09	3.37892-09	3.40157-09	3.37105-09	3.35306-09	3.19104-09	0.
16	-0.	-0.	-0.	-0.	-0.	-0.	-0.	8.52500-02
17	-0.	-0.	-0.	-0.	-0.	-0.	-0.	0.
18	-0.	-0.	-0.	-0.	-0.	-0.	-0.	0.
19	-0.	-0.	-0.	-0.	-0.	-0.	-0.	0.
20	-0.	-0.	-0.	-0.	-0.	-0.	-0.	0.
21	-0.	-0.	-0.	-0.	-0.	-0.	-0.	0.
22	-0.	-0.	-0.	-0.	-0.	-0.	-0.	0.
23	7.50000-02	8.13500-04	2.05262-06	2.01913-06	2.02579-06	2.01902-06	2.02422-06	0.
24	0.	7.50000-02	7.50000-02	8.13400-04	7.50000-02	1.48508-04	7.50000-02	0.
25	0.	0.	0.	7.50000-02	0.	7.50000-02	0.	0.

TIME STEP -0

WEIGHTS OF MATERIALS (GRAMS)

REGION	TH-232	PA-233	U-233	U-234	U-235	U-236
1	5.42175+04	-0.	0.	0.	8.16753+03	0.
2	3.55959+04	-0.	0.	0.	5.36231+03	0.
3	1.59668+05	-0.	0.	0.	2.40530+04	0.
4	7.12409+04	-0.	0.	0.	1.07320+04	0.
5	1.50954+05	-0.	0.	0.	2.27402+04	0.
6	9.62808+04	-0.	0.	0.	1.45041+04	0.
7	4.89534+05	-0.	0.	0.	7.37454+04	0.
8	0.	-0.	0.	0.	0.	0.
TOTAL	1.05749+06	0.	0.	0.	1.59305+05	0.

REGION	U-238	NP-239	PU-239	PU-240	PU-241	PU-242
1	7.92973+02	-0.	0.	0.	0.	0.
-2	5.20618+02	-0.	0.	0.	0.	0.
3	2.33527+03	-0.	0.	0.	0.	0.
4	1.04195+03	-0.	0.	0.	0.	0.
5	2.20782+03	-0.	0.	0.	0.	0.
6	1.40813+03	-0.	0.	0.	0.	0.
7	7.15983+03	-0.	0.	0.	0.	0.
8	0.	-0.	0.	0.	0.	0.
TOTAL	1.54666+04	0.	0.	0.	0.	0.

TIME STEP -0

LUMPED POISON DATA - DENSITY AND HOT,COLD SELF SHIELDING (SS)

REGION	MATERIAL	GRAMS/CC	HOT SS GRP1	HOT SS GRP2	HOT SS GRP3	HOT SS GRP4	COLD SS GRP3	COLD SS GRP4
3	23	6.98250-03	9.75742-01	9.75551-01	8.30078-01	4.33190-01	8.29863-01	3.89732-01
4	23	6.98250-03	9.75742-01	9.75551-01	8.30078-01	4.33190-01	8.29863-01	3.89732-01
5	23	6.98250-03	9.75742-01	9.75551-01	8.30078-01	4.33190-01	8.29863-01	3.89732-01
6	23	6.98250-03	9.75742-01	9.75551-01	8.30078-01	4.33190-01	8.29863-01	3.89732-01
7	23	6.98250-03	9.75742-01	9.75551-01	8.30078-01	4.33190-01	8.29863-01	3.89732-01

STATUS OF CONTROL POISONS -- TIME STEP -0

REGION	MATERIAL	ATOM DENSITY	INSERTION FRACT
2	23	8.13500-04	5.00000-01
4	24	6.13400-04	1.00000+00
6	24	1.48500-04	1.23346-01

SAMPLE CASE

DIFFUSION CALCULATION

TIME STEP -0

REGIONAL DATA

REGION	INTERVALS	POSITION
1	4	3.17000+01
2	4	4.08000+01
3	4	6.80000+01
4	4	7.71000+01
5	4	9.35000+01
6	4	1.02600+02
7	8	1.40000+02
8	8	2.10000+02

GROUP CONSTANTS

REGION	GROUP	BUCKLING	DIFFUSION	ABSORPTION	FISSION	SCATTER OUT
1	1	3.25000-04	1.56960+00	7.62632-05	1.21508-04	1.23300-02
1	2	1.62000-04	9.87651-01	1.93337-03	1.09415-03	4.54279-03
1	3	7.46000-06	9.80785-01	2.40305-03	2.70112-03	3.07220-02
1	4	7.46000-06	8.99783-01	6.36056-03	1.11978-02	0.
2	1	3.25000-04	1.55622+00	2.34218-04	1.21508-04	1.24302-02
2	2	1.62000-04	9.74559-01	4.47982-03	1.09415-03	4.57308-03
2	3	7.46000-06	9.63867-01	7.91364-03	2.70112-03	3.07666-02
2	4	7.46000-06	8.88391-01	1.10395-02	1.11978-02	0.
3	1	3.25000-04	1.56941+00	7.84579-05	1.21508-04	1.23314-02
3	2	1.62000-04	9.87402-01	1.98115-03	1.09415-03	4.54336-03
3	3	7.46000-06	9.79526-01	2.80662-03	2.70112-03	3.07253-02
3	4	7.46000-06	8.97123-01	7.44264-03	1.11978-02	0.
4	1	3.25000-04	1.55703+00	2.24593-04	1.21508-04	1.24241-02
4	2	1.62000-04	9.75662-01	4.26257-03	1.09415-03	4.57050-03
4	3	7.46000-06	9.65231-01	7.46226-03	2.70112-03	3.07630-02
4	4	7.46000-06	8.88209-01	1.11152-02	1.11978-02	0.
5	1	3.25000-04	1.56942+00	7.84292-05	1.21508-04	1.23314-02
5	2	1.62000-04	9.87405-01	1.98052-03	1.09415-03	4.54335-03
5	3	7.46000-06	9.79543-01	2.80134-03	2.70112-03	3.07252-02
5	4	7.46000-06	8.97138-01	7.43652-03	1.11978-02	0.
6	1	3.25000-04	1.56702+00	1.06476-04	1.21508-04	1.23492-02
6	2	1.62000-04	9.85087-01	2.42681-03	1.09415-03	4.54866-03
6	3	7.46000-06	9.76618-01	3.74268-03	2.70112-03	3.07328-02
6	4	7.46000-06	8.95252-01	8.20754-03	1.11978-02	0.

REGION	GROUP	BUCKLING	DIFFUSION	ABSORPTION	FISSION	SCATTER OUT
7	1	3.25000-04	1.56942+00	7.84275-05	1.21508-04	1.23314-02
7	2	1.62000-04	7.87406-01	1.98048-03	1.09415-03	4.54335-03
7	3	7.46000-06	9.79544-01	2.80099-03	2.70112-03	3.07252-02
7	4	7.46000-06	8.97120-01	7.44383-03	1.11978-02	0.
8	1	8.03000-05	1.39022+00	0.	0.	1.36513-02
8	2	8.03000-05	8.82367-01	0.	0.	5.16090-03
8	3	8.03000-05	8.76176-01	0.	0.	3.49058-02
8	4	8.03000-05	9.11740-01	1.03408-04	0.	0.

K-EFFECTIVE

62	9.71405-01
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POINT	POSITION	POWER DIST.	FLUX 1	FLUX 2	FLUX 3	FLUX 4
1	7.92500+00	1.0510+00	1.0849+00	1.8484+00	2.4859-01	1.0607+00
2	1.58500+01	1.0130+00	1.0552+00	1.8015+00	2.4192-01	1.0197+00
3	2.37750+01	9.4228-01	1.0069+00	1.7200+00	2.2949-01	9.4285-01
4	3.17000+01	8.3513-01	9.5316-01	1.6074+00	2.0929-01	8.2544-01
5	3.39750+01	8.0631-01	9.4216-01	1.5786+00	2.0332-01	7.9381-01
6	3.62500+01	7.9251-01	9.3446-01	1.5663+00	2.0111-01	7.7840-01
7	3.85250+01	7.9225-01	9.3011-01	1.5692+00	2.0226-01	7.7756-01
8	4.08000+01	8.0458-01	9.2875-01	1.5868+00	2.0674-01	7.9016-01
9	4.76000+01	8.4208-01	9.3413-01	1.6350+00	2.1730-01	8.2969-01
10	5.44000+01	8.5234-01	9.3730-01	1.6512+00	2.2036-01	8.4017-01
11	6.12000+01	8.3380-01	9.3562-01	1.6426+00	2.1821-01	8.2464-01
12	6.80000+01	8.0163-01	9.3441-01	1.6102+00	2.0989-01	7.5333-01
13	7.02750+01	7.9126-01	9.3773-01	1.6019+00	2.0677-01	7.7190-01
14	7.25500+01	7.9316-01	9.4404-01	1.6082+00	2.0727-01	7.7351-01
15	7.48250+01	8.0696-01	9.5341-01	1.6287+00	2.1059-01	7.8785-01
16	7.71000+01	8.3263-01	9.6552-01	1.6631+00	2.1702-01	8.1488-01
17	8.12000+01	8.8227-01	9.9091-01	1.7286+00	2.2878-01	8.6739-01
18	8.53000+01	9.1965-01	1.0161+00	1.7799+00	2.3692-01	9.0684-01
19	8.94000+01	9.4623-01	1.0388+00	1.8182+00	2.4230-01	9.3476-01
20	9.35000+01	9.6316-01	1.0584+00	1.8439+00	2.4516-01	9.5250-01
21	9.57750+01	9.7079-01	1.0681+00	1.8545+00	2.4615-01	9.6064-01
22	9.80500+01	9.7980-01	1.0772+00	1.8652+00	2.4740-01	9.7046-01
23	1.00325+02	9.9033-01	1.0355+00	1.8756+00	2.4886-01	9.8215-01
24	1.02600+02	1.0026+00	1.0931+00	1.8857+00	2.5054-01	9.9597-01
25	1.07275+02	1.0252+00	1.1050+00	1.8958+00	2.5233-01	1.0227+00
26	1.11950+02	1.0421+00	1.1097+00	1.8847+00	2.5072-01	1.0452+00
27	1.16625+02	1.0572+00	1.1051+00	1.8505+00	2.4576-01	1.0687+00
28	1.21300+02	1.0767+00	1.0870+00	1.7903+00	2.3735-01	1.1011+00
29	1.25975+02	1.1094+00	1.0510+00	1.7009+00	2.2541-01	1.1540+00
30	1.30650+02	1.1693+00	9.8288-01	1.5801+00	2.1019-01	1.2450+00
31	1.35325+02	1.2773+00	8.6047-01	1.4297+00	1.9260-01	1.4002+00
32	1.40000+02	1.4653+00	6.4256-01	1.2614+00	1.7479-01	1.6582+00
32	1.40000+02	0.	6.4256-01	1.2614+00	1.7479-01	1.6582+00
33	1.48750+02	0.	2.6789-01	8.4234-01	1.2478-01	2.0599+00
34	1.57500+02	0.	1.1197-01	5.1042-01	7.9018-02	2.0713+00
35	1.66250+02	0.	4.6782-02	2.9295-01	4.6705-02	1.8610+00
36	1.75000+02	0.	1.7582-02	1.6222-01	2.6389-02	1.5404+00
37	1.83750+02	0.	8.1905-03	8.7074-02	1.4365-02	1.1746+00
38	1.92500+02	0.	3.3922-03	4.4559-02	7.4212-03	7.9791-01
39	2.01250+02	0.	1.3213-03	1.9783-02	3.3122-03	4.2644-01
40	2.10000+02	0.	3.1661-04	3.3201-03	5.5266-04	6.6739-02

	AVERAGE CORE FLUXES			
REGION	FLUX 1	FLUX 2	FLUX 3	FLUX 4
ALL POWER PRODUCERS	4.7998-11	8.1873-11	1.0861-11	4.8823-11

	AVERAGE REGION FLUXES			
REGION	FLUX 1	FLUX 2	FLUX 3	FLUX 4
1	4.8731-11	9.2952-11	1.1036-11	4.5475-11
2	4.4943-11	7.5708-11	9.7732-12	3.7850-11
3	4.4872-11	7.8370-11	1.0376-11	3.9356-11
4	4.5437-11	7.7732-11	1.0063-11	3.7605-11
5	4.8772-11	8.5114-11	1.1292-11	4.3228-11
6	5.1690-11	8.9535-11	1.1885-11	4.6666-11
7	4.8566-11	8.1441-11	1.0862-11	5.6862-11
8	3.9807-12	1.3713-11	2.0713-12	6.1366-11

SAMPLE CASE

POWER DISTRIBUTION AT TIME STEP -0

1.4653+00I
1.4277+00I
1.3902+00I
1.3526+00I
1.3150+00I
1.2774+00I
1.2399+00I
1.2023+00I
1.1647+00I
1.1272+00I
1.0896+00I
1.0520+00I
1.0144+00I*
9.7687-01I
9.3930-01I
9.0172-01I
8.6415-01I
8.2658-01I
7.8901-01I
7.5144-01I
7.1386-01I
6.7629-01I
6.3872-01I
6.0115-01I
5.6358-01I
5.2601-01I
4.8843-01I
4.5086-01I
4.1329-01I
3.7572-01I
3.3815-01I
3.0057-01I
2.6300-01I
2.2543-01I
1.8786-01I
1.5029-01I
1.1272-01I
7.5143-02I
3.7572-02I
-2.2538-07I

STATUS OF CONTROL POISONS -- TIME STEP -0

REGION	MATERIAL	ATOM DENSITY	INSERTION FRACT
2	23	8.13500-04	5.00000-01
4	24	5.74442-04	7.06223-01
6	24	0.	0.

SAMPLE CASE

DIFFUSION CALCULATION

TIME STEP -0

REGIONAL DATA

REGION	INTERVALS	POSITION
1	4	3.17000+01
2	4	4.08000+01
3	4	6.80000+01
4	4	7.71000+01
5	4	9.35000+01
6	4	1.02600+02
7	8	1.40000+02
8	8	2.10000+02

GROUP CONSTANTS

REGION	GROUP	BUCKLING	DIFFUSION	ABSORPTION	FISSION	SCATTER CUT
1	1	3.25000-04	1.56960+00	7.62632-05	1.21508-04	1.23300-02
1	2	1.62000-04	9.87651-01	1.93337-03	1.09415-03	4.54279-03
1	3	7.46000-06	9.80785-01	2.40305-03	2.70112-03	3.07220-02
1	4	7.46000-06	8.99783-01	6.36056-03	1.11978-02	0.
2	1	3.25000-04	1.55622+00	2.34218-04	1.21508-04	1.24302-02
2	2	1.62000-04	9.74559-01	4.47982-03	1.09415-03	4.57308-03
2	3	7.46000-06	9.63867-01	7.91364-03	2.70112-03	3.07666-02
2	4	7.46000-06	8.88391-01	1.10395-02	1.11978-02	0.
3	1	3.25000-04	1.56941+00	7.84579-05	1.21508-04	1.23314-02
3	2	1.62000-04	9.87402-01	1.98115-03	1.09415-03	4.54336-03
3	3	7.46000-06	9.79526-01	2.80662-03	2.70112-03	3.07253-02
3	4	7.46000-06	8.97123-01	7.44264-03	1.11978-02	0.
4	1	3.25000-04	1.56065+00	1.81651-04	1.21508-04	1.23969-02
4	2	1.62000-04	9.79083-01	3.59212-03	1.09415-03	4.56252-03
4	3	7.46000-06	9.69393-01	6.09261-03	2.70112-03	3.07519-02
4	4	7.46000-06	8.90824-01	1.00303-02	1.11978-02	0.
5	1	3.25000-04	1.56942+00	7.84292-05	1.21508-04	1.23314-02
5	2	1.62000-04	9.87405-01	1.98052-03	1.09415-03	4.54335-03
5	3	7.46000-06	9.79543-01	2.80134-03	2.70112-03	3.07252-02
5	4	7.46000-06	8.97138-01	7.43652-03	1.11978-02	0.
6	1	3.25000-04	1.56942+00	7.84220-05	1.21508-04	1.23314-02
6	2	1.62000-04	9.87406-01	1.98036-03	1.09415-03	4.54335-03
6	3	7.46000-06	9.79547-01	2.80001-03	2.70112-03	3.07252-02
6	4	7.46000-06	8.97133-01	7.43857-03	1.11978-02	0.

REGION	GROUP	BUCKLING	DIFFUSION	ABSORPTION	FISSION	SCATTER OUT
7	1	3.25000-04	1.56942+00	7.84275-05	1.21508-04	1.23314-02
7	2	1.62000-04	9.87406-01	1.98048-03	1.09415-03	4.54335-03
7	3	7.46000-06	9.79544-01	2.80099-03	2.70112-03	3.07252-02
7	4	7.46000-06	8.97120-01	7.44383-03	1.11978-02	0.
8	1	8.03000-05	1.39022+00	0.	0.	1.36513-02
8	2	8.03000-05	8.82307-01	0.	0.	5.16090-03
8	3	8.03000-05	8.76176-01	0.	0.	3.49058-02
8	4	8.03000-05	8.11740-01	1.03408-04	0.	0.
K-EFFECTIVE						
		30	9.99238-01			

POINT	POSITION	POWER DIST.	FLUX 1	FLUX 2	FLUX 3	FLUX 4
1	7.92500+00	1.0245+00	1.0606+00	1.8250+00	2.4620-01	1.0595+00
2	1.58500+01	9.9015-01	1.0345+00	1.7839+00	2.4027-01	1.0213+00
3	2.37750+01	9.2579-01	9.9262-01	1.7124+00	2.2913-01	9.4923-01
4	3.17000+01	8.2733-01	9.4763-01	1.6135+00	2.1064-01	8.3808-01
5	3.39750+01	8.0129-01	9.3946-01	1.5892+00	2.0523-01	8.0858-01
6	3.62500+01	7.9033-01	9.3470-01	1.5817+00	2.0364-01	7.9575-01
7	3.85250+01	7.9301-01	9.3342-01	1.5898+00	2.0550-01	7.9794-01
8	4.08000+01	8.0846-01	9.3524-01	1.6132+00	2.1077-01	8.1410-01
9	4.76000+01	8.5628-01	9.5075-01	1.6795+00	2.2385-01	8.6539-01
10	5.44000+01	8.7873-01	9.6477-01	1.7151+00	2.2963-01	8.8903-01
11	6.12000+01	8.7973-01	9.7387-01	1.7275+00	2.3060-01	8.8884-01
12	6.80000+01	8.6033-01	9.8153-01	1.7179+00	2.2626-01	8.6596-01
13	7.02750+01	8.5505-01	9.8657-01	1.7159+00	2.2457-01	8.5969-01
14	7.25500+01	8.5886-01	9.9357-01	1.7245+00	2.2532-01	8.6347-01
15	7.48250+01	8.7159-01	1.0027+00	1.7433+00	2.2831-01	8.7707-01
16	7.71000+01	8.9321-01	1.0136+00	1.7723+00	2.3362-01	9.0045-01
17	8.12000+01	9.3450-01	1.0354+00	1.8263+00	2.4322-01	9.4537-01
18	8.53000+01	9.6635-01	1.0561+00	1.8683+00	2.4997-01	9.8010-01
19	8.94000+01	9.9015-01	1.0738+00	1.8975+00	2.5461-01	1.0061+00
20	9.35000+01	1.0071+00	1.0876+00	1.9201+00	2.5751-01	1.0249+00
21	9.57750+01	1.0140+00	1.0933+00	1.9271+00	2.5842-01	1.0327+00
22	9.80500+01	1.0192+00	1.0977+00	1.9307+00	2.5884-01	1.0389+00
23	1.00325+02	1.0230+00	1.1006+00	1.9310+00	2.5877-01	1.0438+00
24	1.02600+02	1.0256+00	1.1021+00	1.9279+00	2.5821-01	1.0475+00
25	1.07275+02	1.0276+00	1.1005+00	1.9102+00	2.5544-01	1.0525+00
26	1.11950+02	1.0276+00	1.0923+00	1.8758+00	2.5036-01	1.0571+00
27	1.16625+02	1.0288+00	1.0763+00	1.8227+00	2.4273-01	1.0659+00
28	1.21300+02	1.0366+00	1.0497+00	1.7481+00	2.3233-01	1.0859+00
29	1.25975+02	1.0591+00	1.0067+00	1.6489+00	2.1904-01	1.1280+00
30	1.30650+02	1.1089+00	9.3593-01	1.5231+00	2.0305-01	1.2086+00
31	1.35325+02	1.2057+00	8.1591-01	1.3721+00	1.8522-01	1.3525+00
32	1.40000+02	1.3791+00	6.0806-01	1.2070+00	1.6753-01	1.5967+00
32	1.40000+02	0.	6.0806-01	1.2070+00	1.6753-01	1.5967+00
33	1.48750+02	0.	2.5350-01	8.0373-01	1.1916-01	1.9768+00
34	1.57500+02	0.	1.0586-01	4.8632-01	7.5315-02	1.9848+00
35	1.66250+02	0.	4.4270-02	2.7887-01	4.4466-02	1.7818+00
36	1.75000+02	0.	1.8531-02	1.5433-01	2.5105-02	1.4741+00
37	1.83750+02	0.	7.7507-03	8.2808-02	1.3659-02	1.1238+00
38	1.92500+02	0.	3.2101-03	4.2364-02	7.0543-03	7.6322-01
39	2.01250+02	0.	1.2503-03	1.8806-02	3.1479-03	4.0786-01
40	2.10000+02	0.	3.0150-04	3.1561-03	5.2523-04	6.3832-02

	AVERAGE CORE FLUXES			
REGION	FLUX 1	FLUX 2	FLUX 3	FLUX 4
ALL POWER PRODUCERS	4.6942-11	8.1092-11	1.0811-11	4.8922-11

	AVERAGE REGION FLUXES			
REGION	FLUX 1	FLUX 2	FLUX 3	FLUX 4
1	4.6958-11	8.0723-11	1.0770-11	4.4747-11
2	4.3983-11	7.4802-11	9.6829-12	3.7861-11
3	4.5257-11	7.9880-11	1.0625-11	4.0988-11
4	4.6729-11	8.1343-11	1.0662-11	4.0899-11
5	4.9538-11	8.7441-11	1.1677-11	4.5805-11
6	5.1482-11	9.0517-11	1.2133-11	4.8730-11
7	4.6042-11	7.8138-11	1.0453-11	5.4943-11
8	3.6841-12	1.2791-11	1.9332-12	5.7497-11

SAMPLE CASE

TIME STEP -0

K-EFFECTIVE= 9.99238-01

NEUTRON BALANCE PER SOURCE NEUTRON

NORMAL LEAKAGE

GROUP	ABSORPTION	TRANSVERSE LEAKAGE	SCATTERING OUT	SOURCE	NORMAL LEAKAGE	CROSS SECTION	BUCKLING
1	6.2981-03	3.5609-02	8.6196-01	1.0000+00	9.6133-02	1.3761-03	8.7740-04
2	2.6123-01	1.9295-02	5.4855-01	8.6196-01	3.2888-02	2.7252-04	2.7626-04
3	5.0748-02	1.1744-04	4.9437-01	5.4855-01	3.3183-03	2.0626-04	2.1080-04
4	5.5556-01	4.8700-04	0.	4.9437-01	-6.1672-02	-8.4709-04	-9.4471-04
TOTAL	8.7383-01	5.5499-02			7.0666-02		

FRACTIONAL ABSORPTIONS

FRACTIONAL PRODUCTIONS

MATERIAL	GROUP 1	GROUP 2	GROUP 3	GROUP 4	ALL GROUPS	GROUP 1	GROUP 2	GROUP 3	GROUP 4
1	2.7080-03	1.6472-01	1.7091-03	3.9837-02	2.0906-01	1.2702-03	0.	0.	0.
2	-0.	-0.	-0.	-0.	-0.	-0.	-0.	-0.	-0.
3	0.	0.	0.	0.	0.	0.	0.	0.	0.
4	0.	0.	0.	0.	0.	0.	0.	0.	0.
5	3.2498-03	9.7600-02	3.8833-02	4.5932-01	5.9900-01	7.1529-03	1.3214-01	4.3490-02	8.1587-01
6	0.	0.	0.	0.	0.	0.	0.	0.	0.
7	5.8946-05	4.6603-03	3.6882-03	2.0406-04	8.6115-03	7.1657-05	0.	0.	0.
8	-0.	-0.	-0.	-0.	-0.	-0.	-0.	-0.	-0.
9	0.	0.	0.	0.	0.	0.	0.	0.	0.
10	0.	0.	0.	0.	0.	0.	0.	0.	0.
11	0.	0.	0.	0.	0.	0.	0.	0.	0.
12	0.	0.	0.	0.	0.	0.	0.	0.	0.
13	0.	0.	0.	0.	0.	0.	0.	0.	0.
14	0.	6.8953-09	4.5132-07	1.7688-02	1.7689-02	0.	0.	0.	0.
15	1.2205-08	2.1196-05	1.3415-05	5.4870-03	5.5217-03	0.	0.	0.	0.
16	-0.	-0.	-0.	-0.	-0.	0.	0.	0.	0.
17	-0.	-0.	-0.	-0.	-0.	-0.	-0.	-0.	-0.
18	-0.	-0.	-0.	-0.	-0.	-0.	-0.	-0.	-0.
19	-0.	-0.	-0.	-0.	-0.	-0.	-0.	-0.	-0.
20	-0.	-0.	-0.	-0.	-0.	-0.	-0.	-0.	-0.
21	-0.	-0.	-0.	-0.	-0.	-0.	-0.	-0.	-0.
22	-0.	-0.	-0.	-0.	-0.	0.	0.	0.	0.
23	5.5725-04	1.6904-02	9.8038-03	9.3775-02	1.2104-01	-0.	-0.	-0.	0.
24	5.5344-04	1.5042-02	4.0276-03	1.8347-02	3.7970-02	0.	0.	0.	0.
25	0.	0.	0.	1.1143-03	1.1143-03	0.	0.	0.	0.

SAMPLE CASE

POWER DISTRIBUTION AT TIME STEP -0

1.3791+00I
1.3437+00I
1.3084+00I
1.2730+00I
1.2376+00I
1.2023+00I
1.1669+00I
1.1315+00I
1.0962+00I
1.0608+00I
1.0255+00I
9.9010-01I *
9.5474-01I
9.1938-01I
8.8402-01I
8.4866-01I
8.1330-01I
7.7794-01I
7.4258-01I
7.0722-01I
6.7186-01I
6.3649-01I
6.0113-01I
5.6577-01I
5.3041-01I
4.9505-01I
4.5969-01I
4.2433-01I
3.8897-01I
3.5361-01I
3.1825-01I
2.8289-01I
2.4753-01I
2.1216-01I
1.7680-01I
1.4144-01I
1.0608-01I
7.0722-02I
3.5361-02I
-1.6391-07I

TIME STEP -0

HOT REACTOR WITHOUT CONTROL POISON ,K-EFF = 1.08931+00

COLD REACTOR, NO XE AND ALL CONTROL RODS FULLY IN, K-EFF = 9.46677-01

TIME STEP 1

REGION	-----FRACTION OF FISSIONS FR3M-----			
	U-233	U-235	PU-239	PU-241
1	3.07586-02	9.64612-01	4.56503-03	6.46053-05
2	2.79879-02	9.67760-01	4.20794-03	4.41609-05
3	2.99884-02	9.65454-01	4.50260-03	5.48032-05
4	3.04114-02	9.64992-01	4.54104-03	5.51719-05
5	3.29620-02	9.62093-01	4.87202-03	7.26612-05
6	3.43079-02	9.60582-01	5.02646-03	8.36788-05
7	3.13419-02	9.64103-01	4.46566-03	8.91292-05
8	0.	0.	0.	0.

REGION	CONVERSION RATIO	REG VOLUME
1	3.62527-01	7.21679+05
2	3.79181-01	4.73811+05
3	3.76951-01	2.12532+06
4	3.81478-01	9.48275+05
5	3.74442-01	2.00932+06
6	3.69900-01	1.28158+06
7	3.20846-01	6.51611+06
8	0.	1.75951+07
AVERAGE	3.47620-01	POWER GENERATING VOL= 1.40761+07

TIME STEP 1

ATOMIC DENSITIES

REGION	1	2	3	4	5	6	7	8
MATERIAL								
1	1.93927-04	1.94021-04	1.93953-04	1.93937-04	1.93850-04	1.93804-04	1.93912-04	0.
2	3.88888-07	3.55320-07	3.79776-07	3.85379-07	4.16506-07	4.32896-07	3.94364-07	-0.
3	6.35596-07	5.85231-07	6.23635-07	6.32837-07	6.80871-07	7.05809-07	6.40364-07	0.
4	1.39383-08	1.13776-08	1.31480-08	1.34326-08	1.58777-08	1.72339-08	1.48324-08	0.
5	2.62074-05	2.65700-05	2.63833-05	2.63778-05	2.61058-05	2.59506-05	2.57772-05	0.
6	6.07298-07	5.36770-07	5.77525-07	5.80238-07	6.35947-07	6.66513-07	6.71468-07	0.
7	2.73542-06	2.73926-06	2.73601-06	2.73551-06	2.73178-06	2.72999-06	2.73653-06	0.
8	1.52350-09	1.39305-09	1.50340-09	1.52048-09	1.64665-09	1.70717-09	1.48568-09	-0.
9	3.32274-08	3.13985-08	3.33782-08	3.37695-08	3.57247-08	3.65287-08	3.09005-08	0.
10	2.67195-09	2.20097-09	2.50439-09	2.53177-09	2.94113-09	3.16100-09	2.90275-09	0.
11	6.64310-10	4.63244-10	5.70748-10	5.75894-10	7.49192-10	8.56512-10	8.84733-10	0.
12	1.95931-11	1.16430-11	1.55881-11	1.57412-11	2.29228-11	2.78339-11	3.10979-11	0.
13	2.21661-06	1.91806-06	2.06742-06	2.07063-06	2.29235-06	2.42028-06	2.58949-06	0.
14	3.27291-10	3.12520-10	3.21757-10	3.22683-10	3.33637-10	3.38853-10	3.35275-10	0.
15	3.09229-09	3.17913-09	3.15605-09	3.16729-09	3.11799-09	3.08720-09	2.92470-09	0.
16	5.10371-07	4.42347-07	4.76225-07	4.76886-07	5.27179-07	5.56186-07	5.96037-07	8.52500-02
17	6.28204-08	5.48055-08	5.83414-08	5.89301-08	6.48496-08	6.82274-08	7.25798-08	0.
18	6.29194-08	5.46088-08	5.87396-08	5.88070-08	6.49290-08	6.84540-08	7.34213-08	0.
19	1.28907-07	1.11964-07	1.20452-07	1.20629-07	1.33168-07	1.40370-07	1.49910-07	0.
20	4.85478-08	4.23695-08	4.53704-08	4.54184-08	4.98977-08	5.24860-08	5.66636-08	0.
21	7.21917-09	6.53727-09	6.89363-09	6.90501-09	7.39592-09	7.66004-09	7.93535-09	0.
22	8.33902-09	7.00509-09	7.64377-09	7.65147-09	8.63673-09	9.22238-09	1.01941-08	0.
23	7.50000-02	3.13500-04	1.61002-06	1.58386-06	1.54297-06	1.51143-06	1.47384-06	0.
24	0.	7.50000-02	7.50000-02	5.74442-04	7.50000-02	0.	7.50000-02	0.
25	0.	0.	0.	7.50000-02	0.	7.50000-02	0.	0.

TIME STEP 1

WEIGHTS OF MATERIALS (GRAMS)

REGION	TH-232	PA-233	U-233	U-234	U-235	U-236
1	5.39191+04	1.08593+02	1.77761+02	3.90883+00	7.38103+03	1.71768+02
2	3.54172+04	6.51415+01	1.07291+02	2.09483+00	4.91298+03	9.96761+01
3	1.58811+05	3.12308+02	5.12841+02	1.08587+01	2.18827+04	4.81051+02
4	7.08525+04	1.41402+02	2.32196+02	4.94980+00	9.76161+03	2.15644+02
5	1.50063+05	3.23819+02	5.29350+02	1.23973+01	2.04708+04	5.00803+02
6	9.56901+04	2.14665+02	3.49994+02	8.58261+00	1.29790+04	3.34773+02
7	4.86802+05	9.94303+02	1.61452+03	3.75571+01	6.55499+04	1.71479+03
8	0.	-0.	0.	0.	0.	0.
TOTAL	1.05155+06	2.16023+03	3.52396+03	8.03491+01	1.42938+05	3.51651+03

REGION	U-238	NP-239	PU-239	PU-240	PU-241	PU-242
1	7.80256+02	4.36389-01	9.51773+00	7.68567-01	1.91881-01	5.68286-03
2	5.12989+02	2.61974-01	5.90483+00	4.15651-01	8.78482-02	2.21713-03
3	2.29832+03	1.26819+00	2.81566+01	2.12146+00	4.85496-01	1.33149-02
4	1.02528+03	5.72271-01	1.27102+01	9.56905-01	2.18572-01	5.99920-03
5	2.16952+03	1.31321+00	2.84912+01	2.35544+00	6.02504-01	1.85113-02
6	1.38285+03	8.68375-01	1.25811+01	1.61465+00	4.39335-01	1.43389-02
7	7.04787+03	3.84236+00	7.99133+01	7.53888+00	2.30737+00	8.14403-02
8	0.	-0.	0.	0.	0.	0.
TOTAL	1.52171+04	8.56278+00	1.83280+02	1.57715+01	4.33301+00	1.41505-01

TIME STEP 1

LUMPED POISON DATA - DENSITY AND HOT,COLD SELF SHIELDING (SS)

REGION	MATERIAL	GRAMS/CC	HOT SS GRP1	HOT SS GRP2	HOT SS GRP3	HOT SS GRP4	COLD SS GRP3	COLD SS GRP4
3	23	5.47689-03	9.76072-01	9.80886-01	8.62763-01	4.92441-01	8.62583-01	4.43842-01
4	23	5.47728-03	9.76072-01	9.80884-01	8.62754-01	4.92424-01	8.62575-01	4.43827-01
5	23	5.31832-03	9.76105-01	9.81476-01	8.66363-01	4.99411-01	8.66191-01	4.50114-01
6	23	5.22705-03	9.76123-01	9.81818-01	8.68448-01	5.03514-01	8.68281-01	4.53814-01
7	23	5.08396-03	9.76152-01	9.82356-01	8.71738-01	5.10092-01	8.71580-01	4.59764-01

STATUS OF CONTROL POISONS -- TIME STEP 1

REGION	MATERIAL	ATOM DENSITY	INSERTION FRACT
2	23	8.13500-04	5.00000-01
4	24	5.74442-04	7.06223-01
6	24	0.	0.

SAMPLE CASE

DIFFUSION CALCULATION

TIME STEP 1

REGIONAL DATA

REGION	INTERVALS	POSITION
1	4	3.17000+01
2	4	4.08000+01
3	4	6.80000+01
4	4	7.71000+01
5	4	9.35000+01
6	4	1.02600+02
7	8	1.40000+02
8	8	2.10000+02

GROUP CONSTANTS

REGION	GROUP	BUCKLING	DIFFUSION	ABSORPTION	FISSION	SCATTER OUT
1	1	3.25000-04	1.56970+00	7.43402-05	1.16184-04	1.23263-02
1	2	1.62000-04	9.87806-01	1.90145-03	1.01802-03	4.54287-03
1	3	7.46000-06	9.80494-01	2.52681-03	2.60840-03	3.07219-02
1	4	7.46000-06	9.00525-01	6.07670-03	1.05455-02	0.
2	1	3.25000-04	1.55631+00	2.32622-04	1.17079-04	1.24270-02
2	2	1.62000-04	9.74688-01	4.45280-03	1.02936-03	4.57315-03
2	3	7.46000-06	9.63602-01	8.02849-03	2.62970-03	3.07665-02
2	4	7.46000-06	8.86986-01	1.08067-02	1.06528-02	0.
3	1	3.25000-04	1.56955+00	7.62519-05	1.16700-04	1.23276-02
3	2	1.62000-04	9.87598-01	1.94179-03	1.02408-03	4.54332-03
3	3	7.46000-06	9.79467-01	2.85445-03	2.62144-03	3.07245-02
3	4	7.46000-06	8.98066-01	7.07401-03	1.06064-02	0.
4	1	3.25000-04	1.56078+00	1.79469-04	1.16741-04	1.23931-02
4	2	1.62000-04	9.79275-01	3.55304-03	1.02430-03	4.56248-03
4	3	7.46000-06	9.69325-01	6.14387-03	2.62333-03	3.07512-02
4	4	7.46000-06	8.91737-01	9.66876-03	1.06103-02	0.
5	1	3.25000-04	1.56957+00	7.59744-05	1.16133-04	1.23272-02
5	2	1.62000-04	9.87622-01	1.93690-03	1.01623-03	4.54331-03
5	3	7.46000-06	9.79480-01	2.85333-03	2.61062-03	3.07244-02
5	4	7.46000-06	8.98194-01	7.02377-03	1.05364-02	0.
6	1	3.25000-04	1.56958+00	7.58077-05	1.15769-04	1.23270-02
6	2	1.62000-04	9.87635-01	1.93414-03	1.01151-03	4.54330-03
6	3	7.46000-06	9.79488-01	2.85218-03	2.60271-03	3.07244-02
6	4	7.46000-06	8.98265-01	6.99573-03	1.04922-02	0.

REGION	GROUP	BUCKLING	DIFFUSION	ABSORPTION	FISSION	SCATTER OUT
7	1	3.25000-04	1.56959+00	7.53818-05	1.14733-04	1.23268-02
7	2	1.62000-04	9.87657-01	1.92885-03	1.00189-03	4.54328-03
7	3	7.46000-06	9.79566-01	2.82765-03	2.56913-03	3.07243-02
7	4	7.46000-06	8.98437-01	6.92580-03	1.03768-02	0.
8	1	8.03000-05	1.39022+00	0.	0.	1.36513-02
8	2	8.03000-05	8.82307-01	0.	0.	5.16090-03
8	3	8.03000-05	8.76176-01	0.	0.	3.49058-02
8	4	8.03000-05	8.11740-01	1.03408-04	0.	0.

K-EFFECTIVE

58	9.84975-01
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POINT	POSITION	POWER DIST.	FLUX 1	FLUX 2	FLUX 3	FLUX 4
1	7.92500+00	9.8534-01	1.0237+00	1.7781+00	2.3902-01	1.0745+00
2	1.58500+01	9.5353-01	1.0005+00	1.7412+00	2.3369-01	1.0371+00
3	2.37750+01	8.9371-01	9.6359-01	1.6770+00	2.2360-01	9.6629-01
4	3.17000+01	8.0170-01	9.2567-01	1.5877+00	2.0657-01	8.5661-01
4	3.17000+01	8.0985-01	9.2567-01	1.5877+00	2.0657-01	8.5661-01
5	3.39750+01	7.8561-01	9.1969-01	1.5663+00	2.0162-01	8.2790-01
6	3.62500+01	7.7643-01	9.1691-01	1.5615+00	2.0044-01	8.1654-01
7	3.85250+01	7.8094-01	9.1743-01	1.5722+00	2.0266-01	8.2092-01
8	4.08000+01	7.9832-01	9.2086-01	1.5980+00	2.0827-01	8.3999-01
8	4.08000+01	7.9482-01	9.2086-01	1.5980+00	2.0827-01	8.3999-01
9	4.76000+01	8.4758-01	9.4079-01	1.6712+00	2.2229-01	8.9932-01
10	5.44000+01	8.7407-01	9.5285-01	1.7133+00	2.2634-01	9.2801-01
11	6.12000+01	8.7858-01	9.7151-01	1.7314+00	2.3067-01	9.3229-01
12	6.80000+01	8.6233-01	9.8230-01	1.7267+00	2.2698-01	9.1194-01
12	6.80000+01	8.6263-01	9.8230-01	1.7267+00	2.2698-01	9.1194-01
13	7.02750+01	8.5340-01	9.8818-01	1.7261+00	2.2550-01	9.0667-01
14	7.25000+01	8.6344-01	9.9598-01	1.7361+00	2.2642-01	9.1208-01
15	7.49250+01	8.7754-01	1.0057+00	1.7564+00	2.2960-01	9.2790-01
16	7.71000+01	9.0073-01	1.0172+00	1.7808+00	2.3510-01	9.5434-01
17	8.12000+01	9.3445-01	1.0172+00	1.7808+00	2.3510-01	9.5434-01
17	8.12000+01	9.3420-01	1.0399+00	1.8431+00	2.4500-01	1.0048+00
18	8.53000+01	9.7244-01	1.0616+00	1.8809+00	2.5701-01	1.0443+00
19	9.94000+01	9.7871-01	1.0601+00	1.9175+00	2.5605-01	1.0746+00
20	9.35000+01	1.0173+00	1.0743+00	1.9411+00	2.5790-01	1.0974+00
20	9.35000+01	1.0135+00	1.0943+00	1.7411+00	2.5930-01	1.0974+00
21	9.57750+01	1.0717+00	1.1000+00	1.9074+00	2.6077-01	1.1074+00
22	9.80000+01	1.0233+00	1.1043+00	1.9523+00	2.6134-01	1.1157+00
23	1.00325+02	1.0335+00	1.1070+00	1.9527+00	2.6131-01	1.1226+00
24	1.02000+02	1.0374+00	1.1081+00	1.9495+00	2.6079-01	1.1283+00
24	1.02000+02	1.0262+00	1.1081+00	1.9495+00	2.6079-01	1.1283+00
25	1.07275+02	1.0306+00	1.1059+00	1.9313+00	2.5803-01	1.1368+00
26	1.11750+02	1.0322+00	1.0973+00	1.8961+00	2.5287-01	1.1438+00
27	1.16625+02	1.0345+00	1.0810+00	1.8417+00	2.4508-01	1.1543+00
28	1.21300+02	1.0427+00	1.0538+00	1.7653+00	2.3446-01	1.1756+00
29	1.25975+02	1.0643+00	1.0098+00	1.6639+00	2.2090-01	1.2187+00
30	1.30650+02	1.1114+00	9.3745-01	1.5354+00	2.0461-01	1.2999+00
31	1.35325+02	1.2018+00	8.1570-01	1.3816+00	1.8648-01	1.4433+00
32	1.40000+02	1.3623+00	6.0687-01	1.2136+00	1.6853-01	1.6842+00
32	1.40000+02	0.	6.0687-01	1.2136+00	1.6853-01	1.6842+00
33	1.48750+02	0.	2.5301-01	8.0672-01	1.1970-01	2.0514+00
34	1.57500+02	0.	1.0565-01	4.8767-01	7.5584-02	2.0465+00
35	1.66250+02	0.	4.4183-02	2.7949-01	4.4596-02	1.8313+00
36	1.75000+02	0.	1.8495-02	1.5462-01	2.5167-02	1.5125+00
37	1.83750+02	0.	7.7355-03	8.2941-02	1.3683-02	1.1519+00
38	1.92500+02	0.	3.2038-03	4.2425-02	7.0682-03	7.5186-01
39	2.01250+02	0.	1.2479-03	1.8831-02	3.1535-03	4.1770-01
40	2.10000+02	0.	3.0091-04	3.1603-03	5.2620-04	6.5371-02

AVERAGE CORE FLUXES				
REGION	FLUX 1	FLUX 2	FLUX 3	FLUX 4
ALL POWER PRODUCERS	4.7697-11	8.2869-11	1.1033-11	5.2949-11

AVERAGE REGION FLUXES				
REGION	FLUX 1	FLUX 2	FLUX 3	FLUX 4
1	4.6306-11	3.0292-11	1.0674-11	4.6271-11
2	4.3844-11	7.5049-11	9.6862-12	3.9495-11
3	4.5720-11	8.1106-11	1.0766-11	4.3515-11
4	4.7593-11	8.3209-11	1.0886-11	4.3903-11
5	5.0593-11	8.9725-11	1.1962-11	4.9603-11
6	5.2523-11	9.2997-11	1.2448-11	5.3179-11
7	4.9427-11	8.0142-11	1.0714-11	6.0048-11
8	5.7057-12	1.3042-11	1.9723-12	6.0221-11

SAMPLE CASE

POWER DISTRIBUTION AT TIME STEP 1

1.3623+00I
1.3273+00I
1.2924+00I
1.2575+00I
1.2226+00I
1.1876+00I
1.1527+00I
1.1178+00I
1.0828+00I
1.0479+00I
1.0130+00I
9.7804-01I*
9.4311-01I*
9.0818-01I
8.7325-01I
8.3832-01I
8.0339-01I
7.6846-01I
7.3353-01I
6.9860-01I
6.6367-01I
6.2874-01I
5.9381-01I
5.5888-01I
5.2395-01I
4.8902-01I
4.5409-01I
4.1916-01I
3.8423-01I
3.4930-01I
3.1437-01I
2.7944-01I
2.4451-01I
2.0958-01I
1.7465-01I
1.3972-01I
1.0479-01I
6.9860-02I
3.4930-02I
-2.1979-07I

STATUS OF CONTROL POISONS -- TIME STEP 4

REGION	MATERIAL	ATOM DENSITY	INSERTION FRACT
2	23	8.13500-04	5.00000-01
4	24	4.28309-04	5.26566-01
6	24	0.	0.

A number of pages for time steps 1 through 4, from the original IBM printout, have not been reproduced for inclusion in this report. This information was omitted because of its repetitious nature.

SAMPLE CASE

DIFFUSION CALCULATION

TIME STEP 4

REGIONAL DATA

REGION	INTERVALS	POSITION
1	4	3.17000+01
2	4	4.08000+01
3	4	6.80000+01
4	4	7.71000+01
5	4	9.35000+01
6	4	1.02600+02
7	8	1.40000+02
8	8	2.10000+02

GROUP CONSTANTS

REGION	GROUP	BUCKLING	DIFFUSION	ABSORPTION	FISSION	SCATTER OUT
1	1	3.25000-04	1.57000+00	7.01710-05	1.05339-04	1.23153-02
1	2	1.62000-04	9.88260-01	1.81031-03	8.54275-04	4.54282-03
1	3	7.46000-06	9.79990-01	2.76528-03	2.55984-03	3.07215-02
1	4	7.46000-06	9.02209-01	5.44045-03	9.19572-03	0.
2	1	3.25000-04	1.55657+00	2.29057-04	1.07814-04	1.24169-02
2	2	1.62000-04	9.75084-01	4.37155-03	8.84526-04	4.57311-03
2	3	7.46000-06	9.63103-01	8.26517-03	2.61371-03	3.07662-02
2	4	7.46000-06	8.90380-01	1.02693-02	9.49228-03	0.
3	1	3.25000-04	1.56995+00	7.09380-05	1.05844-04	1.23156-02
3	2	1.62000-04	9.88188-01	1.82484-03	8.58213-04	4.54298-03
3	3	7.46000-06	9.79565-01	2.90231-03	2.57965-03	3.07225-02
3	4	7.46000-06	9.00907-01	5.96645-03	9.24816-03	0.
4	1	3.25000-04	1.56341+00	1.47696-04	1.05397-04	1.23640-02
4	2	1.62000-04	9.81982-01	3.02231-03	8.51603-04	4.55727-03
4	3	7.46000-06	9.71974-01	5.36054-03	2.57468-03	3.07423-02
4	4	7.46000-06	8.96259-01	7.85841-03	9.18945-03	0.
5	1	3.25000-04	1.57000+00	7.00730-05	1.03865-04	1.23141-02
5	2	1.62000-04	9.88267-01	1.80926-03	8.32137-04	4.54295-03
5	3	7.46000-06	9.79595-01	2.90281-03	2.54407-03	3.07222-02
5	4	7.46000-06	9.01388-01	5.77773-03	9.00226-03	0.
6	1	3.25000-04	1.57002+00	6.96863-05	1.02940-04	1.23136-02
6	2	1.62000-04	9.88296-01	1.80315-03	8.21185-04	4.54294-03
6	3	7.46000-06	9.79622-01	2.89715-03	2.52192-03	3.07222-02
6	4	7.46000-06	9.01592-01	5.69726-03	8.89144-03	0.

REGION	GROUP	BUCKLING	DIFFUSION	ABSORPTION	FISSION	SCATTER OUT
7	1	3.25000-04	1.57004+00	6.83585-05	9.94691-05	1.23135-02
7	2	1.62000-04	9.88342-01	1.79026-03	7.90822-04	4.54291-03
7	3	7.46000-06	9.79861-01	2.81959-03	2.38934-03	3.07220-02
7	4	7.46000-06	9.02171-01	5.46252-03	8.51323-03	0.
8	1	8.03000-05	1.39022+00	0.	0.	1.36513-02
8	2	8.03000-05	8.82307-01	0.	0.	5.16090-03
8	3	8.03000-05	8.76176-01	0.	0.	3.49058-02
8	4	8.03000-05	8.11740-01	1.03408-04	0.	0.

K-EFFECTIVE

14	1.00005+00
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POINT	POSITION	POWER DIST.	FLUX 1	FLUX 2	FLUX 3	FLUX 4
1	7.92500+00	8.9339-01	9.4273-01	1.6948+00	2.2737-01	1.1503+00
2	1.58500+01	8.6953-01	9.2797-01	1.6704+00	2.2370-01	1.1168+00
3	2.37750+01	8.2406-01	9.0618-01	1.6278+00	2.1647-01	1.0527+00
4	3.17000+01	7.5290-01	8.8932-01	1.5668+00	2.0327-01	9.5219-01
4	3.17000+01	7.7701-01	8.8932-01	1.5668+00	2.0327-01	9.5219-01
5	3.39750+01	7.5953-01	8.8995-01	1.5542+00	1.9953-01	9.2820-01
6	3.62500+01	7.5760-01	8.9344-01	1.5583+00	1.9956-01	9.2487-01
7	3.85250+01	7.7008-01	8.9985-01	1.5780+00	2.0305-01	9.4070-01
8	4.08000+01	7.9645-01	9.0873-01	1.6131+00	2.1004-01	9.7492-01
8	4.08000+01	7.7611-01	9.0873-01	1.6131+00	2.1004-01	9.7492-01
9	4.76000+01	8.5145-01	9.4491-01	1.7134+00	2.2786-01	1.0761+00
10	5.44000+01	8.9672-01	9.7828-01	1.7805+00	2.3790-01	1.1363+00
11	6.12000+01	9.1836-01	1.0038+00	1.8209+00	2.4278-01	1.1642+00
12	6.80000+01	9.1955-01	1.0234+00	1.8359+00	2.4229-01	1.1645+00
12	6.80000+01	9.1377-01	1.0234+00	1.8359+00	2.4229-01	1.1645+00
13	7.02750+01	9.1468-01	1.0306+00	1.8401+00	2.4171-01	1.1656+00
14	7.25500+01	9.2274-01	1.0390+00	1.8520+00	2.4293-01	1.1766+00
15	7.48250+01	9.3789-01	1.0484+00	1.8711+00	2.4586-01	1.1973+00
16	7.71000+01	9.6022-01	1.0585+00	1.8976+00	2.5053-01	1.2280+00
16	7.71000+01	9.4081-01	1.0585+00	1.8976+00	2.5053-01	1.2280+00
17	8.12000+01	9.8118-01	1.0777+00	1.9446+00	2.5868-01	1.2849+00
18	8.53000+01	1.0126+00	1.0953+00	1.9792+00	2.6417-01	1.3297+00
19	8.94000+01	1.0368+00	1.1092+00	2.0022+00	2.6760-01	1.3646+00
20	9.35000+01	1.0552+00	1.1178+00	2.0138+00	2.6927-01	1.3920+00
20	9.35000+01	1.0423+00	1.1178+00	2.0138+00	2.6927-01	1.3920+00
21	9.57750+01	1.0503+00	1.1200+00	2.0154+00	2.6949-01	1.4046+00
22	9.80500+01	1.0589+00	1.1206+00	2.0134+00	2.6921-01	1.4154+00
23	1.00325+02	1.0623+00	1.1192+00	2.0079+00	2.6844-01	1.4248+00
24	1.02600+02	1.0669+00	1.1157+00	1.9987+00	2.6720-01	1.4334+00
24	1.02600+02	1.0218+00	1.1157+00	1.9987+00	2.6720-01	1.4334+00
25	1.07275+02	1.0267+00	1.1050+00	1.9683+00	2.6296-01	1.4457+00
26	1.11950+02	1.0274+00	1.0900+00	1.9214+00	2.5629-01	1.4534+00
27	1.15625+02	1.0276+00	1.0680+00	1.8559+00	2.4707-01	1.4626+00
28	1.21300+02	1.0317+00	1.0353+00	1.7692+00	2.3511-01	1.4812+00
29	1.25975+02	1.0459+00	9.8575-01	1.6584+00	2.2035-01	1.5199+00
30	1.30650+02	1.0791+00	9.0845-01	1.5220+00	2.0304-01	1.5939+00
31	1.35325+02	1.1443+00	7.8419-01	1.3621+00	1.8412-01	1.7244+00
32	1.40000+02	1.2594+00	5.7983-01	1.1900+00	1.6561-01	1.9403+00
32	1.40000+02	0.	5.7983-01	1.1900+00	1.6561-01	1.9403+00
33	1.48750+02	0.	2.4173-01	7.8601-01	1.1684-01	2.2438+00
34	1.57500+02	0.	1.0095-01	4.7357-01	7.3489-02	2.1910+00
35	1.66250+02	0.	4.2214-02	2.7086-01	4.3252-02	1.9395+00
36	1.75000+02	0.	1.7671-02	1.4964-01	2.4368-02	1.5923+00
37	1.83750+02	0.	7.3909-03	8.0199-02	1.3239-02	1.2084+00
38	1.92500+02	0.	3.0611-03	4.0996-02	6.8309-03	8.1863-01
39	2.01250+02	0.	1.1923-03	1.8189-02	3.0463-03	4.3689-01
40	2.10000+02	0.	2.8751-04	3.0526-03	5.0829-04	6.8374-02

	AVERAGE CORE FLUXES			
REGION	FLUX 1	FLUX 2	FLUX 3	FLUX 4
ALL POWER PRODUCERS	4.7396-11	8.4065-11	1.1196-11	6.5086-11

	AVERAGE REGION FLUXES			
REGION	FLUX 1	FLUX 2	FLUX 3	FLUX 4
1	4.3224-11	7.7329-11	1.0254-11	5.0041-11
2	4.2468-11	7.4468-11	9.5910-12	4.4546-11
3	4.6386-11	8.3897-11	1.1145-11	5.3096-11
4	4.9299-11	8.8071-11	1.1580-11	5.6149-11
5	5.1835-11	9.3489-11	1.2461-11	6.2810-11
6	5.3041-11	9.5294-11	1.2741-11	6.7052-11
7	4.5789-11	7.9867-11	1.0683-11	7.3772-11
8	3.5470-12	1.2615-11	1.9099-12	6.4001-11

SAMPLE CASE

TIME STEP 4

K-EFFECTIVE= 1.00005+00

NEUTRON BALANCE PER SOURCE NEUTRON

GROUP	ABSORPTION	TRANSVERSE LEAKAGE	SCATTERING OUT	SOURCE	NORMAL LEAKAGE
1	5.5992-03	3.5857-02	8.6628-01	1.0000+00	9.2259-02
2	2.4502-01	1.9950-02	5.6679-01	8.6628-01	3.4522-02
3	5.2896-02	1.2127-04	5.1031-01	5.6679-01	3.4693-03
4	5.6380-01	6.4917-04	0.	5.1031-01	-5.4142-02
TOTAL	8.6731-01	5.6577-02			7.6108-02

NORMAL LEAKAGE

CROSS SECTION	BUCKLING
1.3121-03	8.3622-04
2.7682-04	2.8034-04
2.0888-04	2.1342-04
-5.6074-04	-6.2219-04

FRACTIONAL ABSORPTIONS

MATERIAL	GROUP 1	GROUP 2	GROUP 3	GROUP 4	ALL GROUPS
1	2.7621-03	1.6755-01	1.7357-03	5.2006-02	2.2406-01
2	2.6644-05	1.4102-03	1.5149-03	1.1353-03	4.0871-03
3	5.2822-04	8.6942-03	7.2078-03	8.1683-02	9.8114-02
4	1.0251-05	1.3295-04	8.5840-04	4.2999-04	1.4316-03
5	2.0570-03	6.3453-02	2.5215-02	3.8097-01	4.7170-01
6	7.7465-05	2.3335-03	4.2803-03	4.9449-04	7.1858-03
7	5.5937-05	4.5405-03	3.5897-03	2.5526-04	8.4413-03
8	6.8165-08	5.0685-06	3.7568-06	2.9795-06	1.1873-05
9	1.0182-05	1.9712-04	9.2296-05	8.3368-03	8.6364-03
10	1.0630-06	3.0820-05	7.6651-06	2.9937-03	3.0333-03
11	2.8463-06	9.0179-05	9.0326-05	1.4915-03	1.6749-03
12	2.4263-07	2.6952-06	3.3345-05	3.2347-06	3.9518-05
13	3.1756-05	2.6626-03	1.0896-04	1.8042-03	4.6076-03
14	0.	6.0868-09	3.9788-07	1.9864-02	1.9865-02
15	8.7234-09	1.5561-05	9.8356-06	5.1377-03	5.1631-03
16	2.1903-05	3.1824-03	3.8329-03	2.5032-03	9.5404-03
17	2.6203-06	8.0620-05	9.5327-06	5.7336-03	5.8264-03
18	1.9264-06	2.2582-03	3.8863-05	1.0963-03	3.3953-03
19	1.1417-06	4.0888-04	6.4997-05	5.5173-03	5.9923-03
20	7.4093-06	8.4597-04	3.2716-03	1.0123-03	5.1373-03
21	6.3657-07	8.2289-05	6.7333-05	1.9162-03	2.0665-03
22	2.2951-07	1.1907-04	9.8473-04	3.3341-04	1.4374-03
23	4.1892-04	1.2209-02	4.6949-03	5.3019-02	7.0342-02
24	4.3723-04	1.2196-02	3.2758-03	2.0771-02	3.6680-02
25	0.	0.	0.	1.5386-03	1.5386-03

FRACTIONAL PRODUCTIONS

GROUP 1	GROUP 2	GROUP 3	GROUP 4
1.2480-03	0.	0.	0.
3.5844-05	0.	0.	0.
1.1784-03	1.6765-02	1.2978-02	1.6235-01
1.9721-05	1.3457-08	0.	0.
4.4900-03	8.5200-02	2.8005-02	6.7112-01
1.2523-04	0.	0.	0.
6.7438-05	0.	0.	0.
8.4299-08	0.	0.	0.
2.4145-05	2.6930-04	1.2435-04	1.2945-02
2.6044-06	0.	0.	0.
7.0367-06	1.1760-04	1.4148-04	2.7803-03
5.9443-07	0.	0.	0.
0.	0.	0.	0.
0.	0.	0.	0.
0.	0.	0.	0.
-0.	-0.	-0.	-0.
0.	0.	0.	0.
0.	0.	0.	0.
0.	0.	0.	0.
0.	0.	0.	0.
0.	0.	0.	0.
-0.	-0.	-0.	-0.
-0.	-0.	-0.	0.
0.	0.	0.	0.
0.	0.	0.	0.

SAMPLE CASE

POWER DISTRIBUTION AT TIME STEP 4

1.2594+00I
1.2271+00I
1.1948+00I
1.1626+00I
1.1303+00I
1.0980+00I
1.0657+00I
1.0334+00I
1.0011+00I
9.6880-01I
9.3650-01I
9.0421-01I
8.7192-01I
8.3962-01I
8.0733-01I
7.7504-01I
7.4274-01I
7.1045-01I
6.7816-01I
6.4586-01I
6.1357-01I
5.8128-01I
5.4898-01I
5.1669-01I
4.8440-01I
4.5210-01I
4.1981-01I
3.8752-01I
3.5522-01I
3.2293-01I
2.9064-01I
2.5835-01I
2.2605-01I
1.9376-01I
1.6147-01I
1.2917-01I
9.6879-02I
6.4586-02I
3.2293-02I
-7.8231-08I

TIME STEP 4

HOT REACTOR WITHOUT CONTROL POISON ,K-EFF = 1.08467+00

COLD REACTOR, NO XE AND ALL CONTROL RODS FULLY IN, K-EFF = 9.10643-01

TIME STEP 5

REGION	-----FRACTION OF FISSIONS FROM-----			
	U-233	U-235	PU-239	PU-241
1	2.23017-01	7.61667-01	1.23704-02	2.94516-03
2	2.06935-01	7.78253-01	1.23024-02	2.50932-03
3	2.28634-01	7.55616-01	1.26673-02	3.08283-03
4	2.36264-01	7.47740-01	1.27406-02	3.25540-03
5	2.50285-01	7.33299-01	1.27928-02	3.62401-03
6	2.56094-01	7.27454-01	1.26607-02	3.79136-03
7	2.37446-01	7.48181-01	1.08741-02	3.49860-03
8	0.	0.	0.	0.

REGION	CONVERSION RATIO	REG VOLUME	
1	4.39887-01	7.21679+05	
2	4.43666-01	4.73811+05	
3	4.43564-01	2.12532+06	
4	4.45746-01	9.48275+05	
5	4.43803-01	2.00932+06	
6	4.39246-01	1.28158+06	
7	3.96315-01	6.51611+06	
8	0.	1.75951+07	
AVERAGE	4.20167-01	POWER GENERATING VOL=	1.40761+07

TIME STEP 5

ATOMIC DENSITIES

REGION	1	2	3	4	5	6	7	8
MATERIAL								
1	1.89699-04	1.90049-04	1.89501-04	1.89291-04	1.88947-04	1.88812-04	1.89468-04	0.
2	4.04773-07	3.84704-07	4.35691-07	4.57104-07	4.88433-07	5.01831-07	4.51217-07	-0.
3	3.58020-06	3.45114-06	3.67897-06	3.76747-06	3.88029-06	3.90252-06	3.43739-06	0.
4	1.78099-07	1.53829-07	1.89615-07	2.02777-07	2.27975-07	2.39283-07	2.09414-07	0.
5	1.70927-05	1.91414-05	1.69918-05	1.66507-05	1.58679-05	1.54626-05	1.50640-05	0.
6	2.47372-06	2.29349-06	2.51363-06	2.58027-06	2.71953-06	2.78491-06	2.75424-06	0.
7	2.56727-06	2.58072-06	2.55784-06	2.55049-06	2.53728-06	2.53312-06	2.56917-06	0.
8	1.36515-09	1.30384-09	1.47697-09	1.53955-09	1.63739-09	1.67055-09	1.43269-09	-0.
9	6.96095-08	7.26506-08	7.16487-08	7.12725-08	6.90793-08	6.67597-08	5.26630-08	0.
10	1.64623-08	1.65267-08	1.71169-08	1.72463-08	1.71389-08	1.67760-08	1.33170-08	0.
11	2.18217-08	1.94615-08	2.29406-08	2.39766-08	2.58212-08	2.64432-08	2.27284-08	0.
12	4.61073-09	3.48309-09	4.91273-09	5.41446-09	6.56517-09	7.17352-09	6.80612-09	0.
13	1.08030-05	9.72516-06	1.09320-05	1.13087-05	1.21613-05	1.26079-05	1.29225-05	0.
14	2.76238-10	2.77027-10	2.84277-10	2.87025-10	2.87897-10	2.87004-10	2.69846-10	0.
15	2.28395-09	2.42501-09	2.29614-09	2.26210-09	2.16622-09	2.10708-09	1.94026-09	0.
16	2.29280-06	2.07911-06	2.31218-06	2.38351-06	2.54598-06	2.63247-06	2.72737-06	8.525
17	2.31772-07	2.16852-07	2.33666-07	2.38491-07	2.48484-07	2.53082-07	2.53447-07	0.
18	2.70873-07	2.46786-07	2.72926-07	2.80710-07	2.98643-07	3.08262-07	3.20331-07	0.
19	5.49061-07	5.03006-07	5.54264-07	5.67698-07	6.03756-07	6.20975-07	6.32030-07	0.
20	1.68443-07	1.57004-07	1.68152-07	1.71652-07	1.79210-07	1.83842-07	1.97956-07	0.
21	1.15975-08	1.19671-08	1.16352-08	1.15332-08	1.12048-08	1.09910-08	1.03704-08	0.
22	4.47242-08	4.06663-08	4.47527-08	4.60147-08	4.87638-08	5.03789-08	5.45543-08	0.
23	7.50000-02	8.13500-04	3.30137-07	2.96413-07	2.34867-07	2.04327-07	1.63297-07	0.
24	0.	7.50000-02	7.50000-02	4.28309-04	7.50000-02	0.	7.50000-02	0.
25	0.	0.	0.	7.50000-02	0.	7.50000-02	0.	0.

TIME STEP 5

WEIGHTS OF MATERIALS (GRAMS)

REGION	TH-232	PA-233	U-233	U-234	U-235	U-236
1	5.27436+04	1.13029+02	9.99725+02	5.01140+01	4.81396+03	6.99669+02
2	3.46921+04	7.05234+01	6.32699+02	2.83227+01	3.35448+03	4.25891+02
3	1.55165+05	3.58290+02	3.02538+03	1.56599+02	1.40933+04	2.09374+03
4	6.91554+04	1.67719+02	1.38234+03	7.47214+01	6.16192+03	9.58951+02
5	1.46267+05	3.79744+02	3.01677+03	1.78003+02	1.24428+04	2.14161+03
6	9.32252+04	2.48648+02	1.93517+03	1.19165+02	7.73351+03	1.39879+03
7	4.75647+05	1.13764+03	8.66654+03	5.30255+02	3.83068+04	7.03377+03
8	0.	-0.	0.	0.	0.	0.
TOTAL	1.02690+06	2.47560+03	1.96586+04	1.13718+03	8.69067+04	1.47524+04

REGION	U-238	NP-239	PU-239	PU-240	PU-241	PU-242
1	7.32294+02	3.91316-01	1.99391+01	4.73528+00	6.30304+00	1.33733+00
2	4.83298+02	2.45197-01	1.36627+01	3.12104+00	3.69063+00	6.63270-01
3	2.14865+03	1.24590+00	6.04400+01	1.44997+01	1.95140+01	4.19630+00
4	9.55932+02	5.79446-01	2.68256+01	6.51839+00	9.09998+00	2.06353+00
5	2.01505+03	1.30583+00	5.50922+01	1.37259+01	2.07655+01	5.30170+00
6	1.28313+03	8.49745-01	3.39583+01	8.56923+00	1.35637+01	3.59485+00
7	6.61683+03	3.70532+00	1.35203+02	3.45863+01	5.92753+01	1.78241+01
8	0.	-0.	0.	0.	0.	0.
TOTAL	1.42352+04	8.32275+00	3.46122+02	8.57558+01	1.32212+02	3.50811+01

TIME STEP 5

LUMPED POISON DATA - DENSITY AND HOT,COLD SELF SHIELDING (SS)

REGION	MATERIAL	GRAMS/CC	HOT SS GRP1	HOT SS GRP2	HOT SS GRP3	HOT SS GRP4	COLD SS GRP3	COLD SS GRP4
3	23	1.12304-03	9.76740-01	9.96875-01	9.72076-01	8.33659-01	9.72144-01	8.01493-01
4	23	1.02505-03	9.76748-01	9.97172-01	9.74766-01	8.47243-01	9.74833-01	8.17444-01
5	23	8.09542-04	9.76765-01	9.97803-01	9.80712-01	8.78497-01	9.80773-01	8.54449-01
6	23	7.06636-04	9.76772-01	9.98093-01	9.83566-01	8.94114-01	9.83623-01	8.73088-01
7	23	5.63286-04	9.76781-01	9.98484-01	9.87556-01	9.16644-01	9.87606-01	9.00142-01

STATUS OF CONTROL POISONS -- TIME STEP 5

REGION	MATERIAL	ATOM DENSITY	INSERTION FRACT
2	23	8.13500-04	5.00000-01
4	24	4.28309-04	5.26566-01
6	24	0.	0.

SAMPLE CASE

DIFFUSION CALCULATION

TIME STEP 5

REGIONAL DATA

REGION	INTERVALS	POSITION
1	4	3.17000+01
2	4	4.08000+01
3	4	6.80000+01
4	4	7.71000+01
5	4	9.35000+01
6	4	1.02600+02
7	8	1.40000+02
8	8	2.10000+02

GROUP CONSTANTS

REGION	GROUP	BUCKLING	DIFFUSION	ABSORPTION	FISSION	SCATTER CUT
1	1	3.25000-04	1.57009+00	6.83479-05	1.01945-04	1.23120-02
1	2	1.62000-04	9.88401-01	1.73312-03	8.06279-04	4.54280-03
1	3	7.46000-06	9.79895-01	2.81827-03	2.52832-03	3.07214-02
1	4	7.46000-06	9.02756-01	5.23194-03	8.77240-03	0.
2	1	3.25000-04	1.55665+00	2.27366-04	1.04759-04	1.24138-02
2	2	1.62000-04	9.75211-01	4.34630-03	8.40137-04	4.57309-03
2	3	7.46000-06	9.62998-01	8.32146-03	2.59216-03	3.07661-02
2	4	7.46000-06	8.90860-01	1.00826-02	9.10849-03	0.
3	1	3.25000-04	1.57007+00	6.92976-05	1.02218-04	1.23120-02
3	2	1.62000-04	9.88365-01	1.79088-03	8.06958-04	4.54290-03
3	3	7.46000-06	9.79605-01	2.91353-03	2.54502-03	3.07220-02
3	4	7.46000-06	9.01881-01	5.58606-03	8.79448-03	0.
4	1	3.25000-04	1.56353+00	1.45987-04	1.01588-04	1.23602-02
4	2	1.62000-04	9.82163-01	2.98717-03	7.98034-04	4.55719-03
4	3	7.46000-06	9.72009-01	5.37390-03	2.53639-03	3.07418-02
4	4	7.46000-06	8.97258-01	7.46409-03	8.71276-03	0.
5	1	3.25000-04	1.57013+00	6.82006-05	9.96060-05	1.23100-02
5	2	1.62000-04	9.88463-01	1.77177-03	7.73498-04	4.54288-03
5	3	7.46000-06	9.79634-01	2.91684-03	2.49302-03	3.07217-02
5	4	7.46000-06	9.02482-01	5.35082-03	8.47137-03	0.
6	1	3.25000-04	1.57016+00	6.77005-05	9.83648-05	1.23094-02
6	2	1.62000-04	9.88500-01	1.76422-03	7.59140-04	4.54287-03
6	3	7.46000-06	9.79664-01	2.91106-03	2.46099-03	3.07217-02
6	4	7.46000-06	9.02736-01	5.25068-03	8.32321-03	0.

REGION	GROUP	BUCKLING	DIFFUSION	ABSORPTION	FISSION	SCATTER OUT
7	1	3.25000-04	1.57017+00	6.61493-05	9.42269-05	1.23094-02
7	2	1.62000-04	9.88549-01	1.74975-03	7.22912-04	4.54284-03
7	3	7.46000-06	9.79932-01	2.82390-03	2.30120-03	3.07216-02
7	4	7.46000-06	9.03394-01	4.98454-03	7.87469-03	0.
8	1	8.03000-05	1.39022+00	0.	0.	1.36513-02
8	2	8.03000-05	8.82307-01	0.	0.	5.16090-03
8	3	8.03000-05	8.76176-01	0.	0.	3.49058-02
8	4	8.03000-05	8.11740-01	1.03408-04	0.	0.
			K-EFFECTIVE			
		58	1.00193+00			

POINT	POSITION	POWER DIST.	FLUX 1	FLUX 2	FLUX 3	FLUX 4
1	7.92500+00	8.6673-01	9.1844-01	1.6669+00	2.2342-01	1.1776+00
2	1.58500+01	8.4508-01	9.0602-01	1.6460+00	2.2021-01	1.1455+00
3	2.37750+01	8.0368-01	8.8838-01	1.6093+00	2.1376-01	1.0838+00
4	3.17000+01	7.3859-01	8.7721-01	1.5560+00	2.0160-01	9.8675-01
4	3.17000+01	7.6668-01	8.7721-01	1.5560+00	2.0160-01	9.8675-01
5	3.39750+01	7.5128-01	8.7959-01	1.5457+00	1.9818-01	9.6459-01
6	3.62500+01	7.5157-01	8.8471-01	1.5521+00	1.9853-01	9.6431-01
7	3.85250+01	7.6651-01	8.9260-01	1.5740+00	2.0232-01	9.8444-01
8	4.08000+01	7.9566-01	9.0280-01	1.6113+00	2.0962-01	1.0244+00
8	4.08000+01	7.6844-01	9.0280-01	1.6113+00	2.0962-01	1.0244+00
9	4.76000+01	8.5019-01	9.4297-01	1.7179+00	2.2829-01	1.1410+00
10	5.44000+01	9.0030-01	9.8010-01	1.7906+00	2.3905-01	1.2118+00
11	6.12000+01	9.2580-01	1.0087+00	1.8355+00	2.4451-01	1.2471+00
12	6.80000+01	9.3033-01	1.0303+00	1.8536+00	2.4440-01	1.2525+00
12	6.80000+01	9.2178-01	1.0303+00	1.8536+00	2.4440-01	1.2525+00
13	7.02750+01	9.2385-01	1.0380+00	1.8586+00	2.4391-01	1.2555+00
14	7.25500+01	9.3315-01	1.0467+00	1.8711+00	2.4522-01	1.2690+00
15	7.46250+01	9.4967-01	1.0563+00	1.8909+00	2.4824-01	1.2932+00
16	7.71000+01	9.7354-01	1.0665+00	1.9180+00	2.5299-01	1.3282+00
16	7.71000+01	9.4678-01	1.0665+00	1.9180+00	2.5299-01	1.3282+00
17	8.12000+01	9.8945-01	1.0858+00	1.9657+00	2.6126-01	1.3929+00
18	8.53000+01	1.0229+00	1.1035+00	2.0004+00	2.6678-01	1.4441+00
19	8.94000+01	1.0490+00	1.1172+00	2.0231+00	2.7018-01	1.4846+00
20	9.35000+01	1.0691+00	1.1251+00	2.0338+00	2.7174-01	1.5170+00
20	9.35000+01	1.0506+00	1.1251+00	2.0338+00	2.7174-01	1.5170+00
21	9.57750+01	1.0595+00	1.1267+00	2.0346+00	2.7188-01	1.5321+00
22	9.80500+01	1.0670+00	1.1265+00	2.0313+00	2.7150-01	1.5453+00
23	1.00325+02	1.0733+00	1.1242+00	2.0252+00	2.7063-01	1.5569+00
24	1.02600+02	1.0787+00	1.1196+00	2.0149+00	2.6927-01	1.5675+00
24	1.02600+02	1.0208+00	1.1196+00	2.0149+00	2.6927-01	1.5675+00
25	1.07275+02	1.0268+00	1.1069+00	1.9820+00	2.6474-01	1.5829+00
26	1.11950+02	1.0282+00	1.0904+00	1.9325+00	2.5775-01	1.5922+00
27	1.16625+02	1.0283+00	1.0670+00	1.8643+00	2.4818-01	1.6018+00
28	1.21300+02	1.0315+00	1.0329+00	1.7748+00	2.3588-01	1.6197+00
29	1.25975+02	1.0435+00	9.3168-01	1.6613+00	2.2078-01	1.6569+00
30	1.30650+02	1.0724+00	9.0268-01	1.5224+00	2.0316-01	1.7280+00
31	1.35325+02	1.1296+00	7.7721-01	1.3603+00	1.8397-01	1.8532+00
32	1.40000+02	1.2307+00	5.7351-01	1.1866+00	1.6527-01	2.0598+00
32	1.40000+02	0.	5.7351-01	1.1866+00	1.6527-01	2.0598+00
33	1.46750+02	0.	2.3910-01	7.8224-01	1.1639-01	2.3390+00
34	1.57500+02	0.	9.9846-02	4.7083-01	7.3117-02	2.2661+00
35	1.66250+02	0.	4.1754-02	2.6913-01	4.3002-02	1.9980+00
36	1.75000+02	0.	1.7478-02	1.4863-01	2.4216-02	1.6366+00
37	1.83750+02	0.	7.3103-03	7.9633-02	1.3152-02	1.2404+00
38	1.92500+02	0.	3.0277-03	4.0700-02	6.7843-03	8.3968-01
39	2.01250+02	0.	1.1793-03	1.8056-02	3.0251-03	4.4794-01
40	2.10000+02	0.	2.8437-04	3.0302-03	5.0475-04	7.0105-02

	AVERAGE CORE FLUXES			
REGION	FLUX 1	FLUX 2	FLUX 3	FLUX 4
ALL POWER PRODUCERS	4.7368-11	8.4430-11	1.1240-11	7.0307-11

	AVERAGE REGION FLUXES			
REGION	FLUX 1	FLUX 2	FLUX 3	FLUX 4
1	4.2336-11	7.6375-11	1.0115-11	5.1475-11
2	4.2031-11	7.4140-11	9.5377-12	4.6450-11
3	4.6451-11	8.4333-11	1.1193-11	5.6606-11
4	4.9632-11	8.2927-11	1.1682-11	6.0533-11
5	5.2184-11	9.4422-11	1.2575-11	6.8182-11
6	5.3284-11	9.6102-11	1.2842-11	7.3163-11
7	4.5635-11	8.0071-11	1.0712-11	8.0112-11
8	3.5063-12	1.2544-11	1.9004-12	6.6135-11

1.2307+00I
1.1991+00I
1.1676+00I
1.1360+00I
1.1045+00I
1.0729+00I
1.0414+00I
1.0098+00I
9.7825-01I
9.4670-01I
9.1514-01I
8.8358-01I
8.5203-01I*
8.2047-01I
7.8891-01I
7.5736-01I
7.2580-01I
6.9424-01I
6.6269-01I
6.3113-01I
5.9957-01I
5.6802-01I
5.3646-01I
5.0470-01I
4.7335-01I
4.4179-01I
4.1023-01I
3.7868-01I
3.4712-01I
3.1557-01I
2.8401-01I
2.5245-01I
2.2070-01I
1.8934-01I
1.5778-01I
1.2623-01I
9.4670-02I
6.3113-02I
3.1557-02I
1.3970-08I

Figure 1 is a scatter plot showing the distribution of the number of iterations required for the algorithm to converge. The x-axis represents the number of iterations, ranging from 2.8132e+01 to 2.1000e+02. The y-axis represents the frequency of iterations, ranging from 0 to 10. The data points are marked with asterisks. A dashed horizontal line is drawn at y=0. The distribution shows a peak at 1.0896e+02 iterations with a frequency of 10.

Iterations (x)	Frequency (y)
2.8132e+01	1
3.2145e+01	1
3.6158e+01	1
4.0171e+01	1
4.4184e+01	1
4.8197e+01	1
5.2210e+01	1
5.6223e+01	1
6.0236e+01	1
6.4249e+01	1
6.8262e+01	1
7.2275e+01	1
7.6288e+01	1
8.0301e+01	1
8.4314e+01	1
8.8327e+01	1
9.2340e+01	1
9.6353e+01	1
1.00366e+02	1
1.04379e+02	1
1.08392e+02	1
1.12405e+02	1
1.16418e+02	1
1.20431e+02	1
1.24444e+02	1
1.28457e+02	1
1.32470e+02	1
1.36483e+02	1
1.40496e+02	1
1.44509e+02	1
1.48522e+02	1
1.52535e+02	1
1.56548e+02	1
1.60561e+02	1
1.64574e+02	1
1.68587e+02	1
1.72600e+02	1
1.76613e+02	1
1.80626e+02	1
1.84639e+02	1
1.88652e+02	1
1.92665e+02	1
1.96678e+02	1
2.00691e+02	1
2.04704e+02	1
2.08717e+02	1
2.12730e+02	1
2.16743e+02	1
2.20756e+02	1
2.24769e+02	1
2.28782e+02	1
2.32795e+02	1
2.36808e+02	1
2.40821e+02	1
2.44834e+02	1
2.48847e+02	1
2.52860e+02	1
2.56873e+02	1
2.60886e+02	1
2.64899e+02	1
2.68912e+02	1
2.72925e+02	1
2.76938e+02	1
2.80951e+02	1
2.84964e+02	1
2.88977e+02	1
2.92990e+02	1
2.97003e+02	1
3.01016e+02	1
3.05029e+02	1
3.09042e+02	1
3.13055e+02	1
3.17068e+02	1
3.21081e+02	1
3.25094e+02	1
3.29107e+02	1
3.33120e+02	1
3.37133e+02	1
3.41146e+02	1
3.45159e+02	1
3.49172e+02	1
3.53185e+02	1
3.57198e+02	1
3.61211e+02	1
3.65224e+02	1
3.69237e+02	1
3.73250e+02	1
3.77263e+02	1
3.81276e+02	1
3.85289e+02	1
3.89302e+02	1
3.93315e+02	1
3.97328e+02	1
4.01341e+02	1
4.05354e+02	1
4.09367e+02	1
4.13380e+02	1
4.17393e+02	1
4.21406e+02	1
4.25419e+02	1
4.29432e+02	1
4.33445e+02	1
4.37458e+02	1
4.41471e+02	1
4.45484e+02	1
4.49497e+02	1
4.53510e+02	1
4.57523e+02	1
4.61536e+02	1
4.65549e+02	1
4.69562e+02	1
4.73575e+02	1
4.77588e+02	1
4.81601e+02	1
4.85614e+02	1
4.89627e+02	1
4.93640e+02	1
4.97653e+02	1
5.01666e+02	1
5.05679e+02	1
5.09692e+02	1
5.13705e+02	1
5.17718e+02	1
5.21731e+02	1
5.25744e+02	1
5.29757e+02	1
5.33770e+02	1
5.37783e+02	1
5.41796e+02	1
5.45809e+02	1
5.49822e+02	1
5.53835e+02	1
5.57848e+02	1
5.61861e+02	1
5.65874e+02	1
5.69887e+02	1
5.73900e+02	1
5.77913e+02	1
5.81926e+02	1
5.85939e+02	1
5.89952e+02	1
5.93965e+0	

TIME STEP 5

HOT REACTOR WITHOUT CONTROL POISON ,K-EFF = 1.08928+00

COLD REACTOR, NO XE AND ALL CONTROL RODS FULLY IN, K-EFF = 9.03818-01

SAMPLE CASE

K-EFFECTIVE VS TIME (MAX HOT AND COLD SHUTDOWN)

1.1237+00I*
 1.1180+00I
 1.1124+00I
 1.1067+00I
 1.1011+00I
 1.0955+00I
 1.0898+00I
 1.0842+00I*
 1.0786+00I
 1.0729+00I
 1.0673+00I
 1.0617+00I
 1.0560+00I
 1.0504+00I
 1.0447+00I
 1.0391+00I
 1.0335+00I
 1.0278+00I
 1.0222+00I
 1.0166+00I
 1.0109+00I
 1.0053+00I
 9.9965-01I
 9.9401-01I
 9.8837-01I
 9.8273-01I
 9.7710-01I
 9.7146-01I
 9.6582-01I
 9.6019-01I
 9.5455-01I*
 9.4891-01I
 9.4328-01I*
 9.3764-01I
 9.3200-01I
 9.2637-01I
 9.2073-01I
 9.1509-01I
 9.0945-01I
 9.0382-01I

 * * * * *
 5.0000+01 1.0000+02 1.5000+02 2.0000+02 2.5000+02 3.0000+02 3.5000+02 4.0000+02 4.5000+02 5.0000+02

SAMPLE CASE

U233 CONCENTRATION VS POSITION AT TIME STEP 5

3.9025-06I
 3.8025-06I
 3.7024-06I
 3.6023-06I
 3.5023-06I*
 3.4022-06I
 3.3021-06I
 3.2021-06I
 3.1020-06I
 3.0019-06I
 2.9019-06I
 2.8018-06I
 2.7017-06I
 2.6017-06I
 2.5016-06I
 2.4016-06I
 2.3015-06I
 2.2014-06I
 2.1014-06I
 2.0013-06I
 1.9012-06I
 1.8012-06I
 1.7011-06I
 1.6010-06I
 1.5010-06I
 1.4009-06I
 1.3008-06I
 1.2008-06I
 1.1007-06I
 1.0006-06I
 9.0058-07I
 8.0052-07I
 7.0045-07I
 6.0039-07I
 5.0032-07I
 4.0026-07I
 3.0019-07I
 2.0013-07I
 1.0006-07I
 -1.5099-13I

SAMPLE CASE

U235 CONCENTRATION VS POSITION AT TIME STEP 5

1.8141-05I
1.7676-05I
1.7211-05I
1.6746-05I*
1.6281-05I
1.5816-05I
1.5350-05I
1.4885-05I
1.4420-05I
1.3955-05I
1.3490-05I
1.3025-05I
1.2559-05I
1.2094-05I
1.1629-05I
1.1164-05I
1.0699-05I
1.0234-05I
9.7685-06I
9.3033-06I
8.8381-06I
8.3730-06I
7.9078-06I
7.4426-06I
6.9775-06I
6.5123-06I
6.0471-06I
5.5820-06I
5.1168-06I
4.6517-06I
4.1865-06I
3.7213-06I
3.2562-06I
2.7910-06I
2.3258-06I
1.8607-06I
1.3955-06I
9.3033-07I
4.6516-07I
-1.4495-12I

SAMPLE CASE

TIME STEP	HOT MAX K-EFFECTIVE	SHUTDOWN COLD K-EFF	MAX/AVRG POWER	MAX PT.	CONVERSION RATIO	TH 232 (GRAMS)	U 233 (GRAMS)	U 235 (GRAMS)	PU 239 (GRAMS)	PU 241 (GRAMS)
-1	1.1237+00	9.5476-01	1.4562+00	32	0.	1.0575+06	0.	1.5930+05	0.	0.
0	1.0893+00	9.4668-01	1.3791+00	32	0.	1.0575+06	0.	1.5930+05	0.	0.
1	1.0755+00	9.2753-01	1.2943+00	32	3.4762-01	1.0516+06	3.5240+03	1.4294+05	1.8323+02	4.3330+00
2	1.0752+00	9.2044-01	1.2790+00	32	3.8220-01	1.0455+06	8.4201+03	1.2746+05	2.8935+02	2.5804+01
3	1.0788+00	9.1505-01	1.2704+00	32	3.7562-01	1.0394+06	1.2804+04	1.1297+05	3.3329+02	6.0953+01
4	1.0847+00	9.1064-01	1.2594+00	32	4.0766-01	1.0332+06	1.6548+04	9.9459+04	3.5240+02	9.9309+01
5	1.0893+00	9.0382-01	0.	C	4.2017-01	1.0269+06	1.9659+04	8.6907+04	3.4612+02	1.3221+02

TIME STEP	REGION	INSERTION FRACTION
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-1	2	5.0000-01
-1	4	1.0000+00
-1	6	1.2335-01

0	2	5.0000-01
0	4	7.0622-01
0	6	0.

1	2	5.0000-01
1	4	4.0020-01
1	6	0.

2	2	5.0000-01
2	4	4.0031-01
2	6	0.

3	2	5.0000-01
3	4	4.5130-01
3	6	0.

4	2	5.0000-01
4	4	5.2657-01
4	6	0.